Section on European Quaternary Stratigraphy
INTERNATIONAL UNION FOR QUATERNARY RESEARCH (INQUA)

SEQS 2012 Meeting

AT THE EDGE OF THE SEA: SEDIMENTS, GEOMORPHOLOGY, TECTONICS AND STRATIGRAPHY IN QUATERNARY STUDIES.

SASSARI, Sardinia, Italy
September 26-27 2012

PROGRAMME AND ABSTRACT BOOK

SEPTEMBER, 26th

9.00-9,30 Welcome of the University of Sassari – Prof. Vincenzo Pascucci
Welcome of the Organizing Commette – Prof. Mauro Coltorti
Welcome of the SEQS President – Prof.Wim Westerhof

SESSION 1. EUROPEAN QUATERNARY GEOCHRONOLOGY AND PROBLEMS IN QUATERNARY METHODS

Chairman: Hillarie-Marcel G. and Huot S.

9.30 -9.50

F.S.Busschers, R.H.Kars, J.Wallinga, F.Wesseling, J.A.A. Bos, J.Timmner, M.Versluijs-Helder, G.T.Klaver, T.Meijer, F.Bunnik, H.De Wolf,

RADIOCARBON GHOSTDATES FROM SOUTHERN NORTH SEA MARINE SHELLS: IMPLICATIONS FOR DATING OF PLEISTOCENE LANDSCAPES, SEDIMENTS AND ARCHAEOLOGY?

9,50 -10.10

C. Hillaire-Marcel, B. Ghaleb

U-Th-Ra SYSTEMATICS AND THE DATING OF LAST INTERGACIAL HIGH SEA-LEVELS

10.10-10.30

M. Fiebig, P. Herbst, L. Bickel, R. Drescher-Schneider, J. Lomax & G. Doppler

GLACIAL SEQUENCE AND STRATIGRAPHY OF THE SALZACH FORELAND GLACIER BASIN (SOUTHERN GERMANY) – REVEALED BY NEW MAPPING, DRILLING AND DATING

10,30-10,50

Lamothe, M., Balescu, S., Huot S. Mejri H., Melis R., Stark, P.C.

LUMINESCENCE DATING OF PLEISTOCENE SEA LEVEL HIGH STANDS ALONG MEDITERRANEAN COASTLINES: ASSESSMENT OF RECENT DATING TECHNOLOGIES

10.50-11.30 COFFEE BREAK

SESSION 2. RELATIONSHIP BETWEEN COASTAL, FLUVIAL, AEOLIAN AND SLOPE DEPOSITS AND LANDFORMS IN THE INTERIOR AND AT THE TRANSITION FROM CONTINENTAL TO MARINE ENVIRONMENTS.

Chairmen: Fiebig M. - Pieruccini P.

11.30-11.50

J. Schokker, J. Peeters, F.S. Busschers, F.P.M. Bunnik and J. Wallinga

NEW RESULTS FROM A CLASSIC LOCALITY: SEDIMENTOLOGY, BIOSTRATIGRAPHY AND DATING OF EEMIAN TO EARLY WEICHSELIAN DEPOSITS AT AMERSFOORT, THE NETHERLANDS

11.50-12.10

Barbanova E.

EVOLUTION OF STRATIFIED CURRENTS SYSTEM DURING UPWELLING.

12.10-12.30

D.G. Borisov, I.O. Murdmaa, E.V. Ivanova, O.V. Levchenko

CONTOURITES FROM THE CONTINENTAL RISE OFF URUGUAY AND SOUTHERN BRAZIL (SOUTH ATLANTIC)

12.30 – 12.50

M.Coltorti, P. Calzia, A. Funedda, G.Oggiano, D. Patta, E. Sarria, V. Sale

A STAIRCASE OF MARINE TERRACES AND THE PLEISTOCENE EVOLUTION OF THE OROSEI GULF (SARDINIA, ITALY)

12.50-13,10

G.A. Danukalova

GEOMORPHOLOGICAL LOCATION AND STRATIGRAPHICAL INTERPRETATION OF THE FLUVIAL DEPOSITS OF THE BELAYA RIVER BASIN (SOUTHERN FORE-URALS)

13.10-14.10 LUNCH

SESSION 2

Chairman: Mozzi P. - Schokker J.

14.10-14.30

E. Draganits, L. Bickel, M. Zuschin & S. Gier

LATE PLEISTOCENE EOLIANITES IN THE AEGEAN: PALAEOENVIRONMENTAL INFORMATION AND SEA-LEVEL RELATIONSHIP

14.30-14.50

M. H. Field

THE AGE OF AN ARCHEOLOGICAL ARTEFACT BEARING PLEISTOCENE FLUVIAL DEPOSIT AT HAPPISBURGH SITE 1, NORFOLK, UK

14.50-15.10

K. Gobo, M. Ghinassi, W. Nemec

THE ARCHITECTURE OF INCISED VALLEY-FILL AS A RECORD OF THE RELATIVE RATES OF SEA-LEVEL RISE AND SEDIMENT SUPPLY

15.10 – 15.30

G. Jouet, M. Dupouy, J. Moreau, V. Abreu, M. Blum, S. Jorry, G. Lericolais, J-L. Rubino, S. Toucanne, G. Unterseh, C. Vella and the Golo Program Team.

MORPHOLOGICAL AND STRATIGRAPHIC IMPRINTS OF LATE QUATERNARY SHOREFACE MIGRATIONS AND SEA-LEVEL FLUCTUATIONS ON THE EAST-CORSICA MARGIN (NW MEDITERRANEAN)

15.30-15.50

E. Kalińska[1], M. Nartišs[2]

SEDIMENTARY RECORD AND VARIABILITY OF AEOLIAN SEDIMENTS IN THE DIFFERENT CLIMATIC ZONES – PRELIMINARY RESULTS

15.50-16.10

J.P. Lefort, J.L. Monnier and G.A. Danukalova

DEFLATION AND TRANSPORTATION OF THE UPPER PLEISTOCENE LOESS PARTICLES BY KATABATIC WINDS DURING THE LOW STANDS OF THE ENGLISH CHANNEL: THEIR CONTROL ON THE NEANDERTALIANS AND HOMO SAPIENS DWELLING

16.10-16.30

J. Moreau, G. Jouet, C. Vella, J-C. Parisot, D. Hermitte, L. Blanchet, N. Freslon, G. Maillet, C. Marin, G. Lericolais.

NEW INSIGHTS ON THE QUATERNARY STRATIGRAPHY OF THE COARSE-GRAINED GOLO DELTA (EAST-CORSICA MARGIN).

16.30-17.00 COFFEE BREAK

SESSION 2

Chairmen: Marks L. – Gerasimenko N.

17.00-17.20

I.O. Murdmaa, K.M. Shimkus, L.V. Voronov, Yu.D. Evsyukov

BOTTOM ENVIRONMENT ON THE GIBRALTAR SILL: ARGUS SUBMERSIBLE OBSERVATIONS

17.20-17.40

J. Peeters, F.S. Busschers, J.H.A. Bosch, M.W. van den Berg, J. Schokker and E. Stouthamer

LOWER DELTA OF THE RIVER RHINE DURING THE LAST INTERGLACIAL: ARCHITECTURE, FACIES DISTRIBUTION AND PRESERVATION IN A NEAR-COASTAL DELTAIC SETTING IN THE SOUTHERN NORTH SEA BASIN, THE NETHERLANDS.

17,40 - 18,00

L. Sanna, J. De Waele

PLIO-PLEISTOCENE FLUVIOKARST CANYON DEEPENING IN CENTRAL EAST SARDINIA.

18,00-18,20

C. Ravazzi, Badino, G. Patera, R. Pini, P. Reimer

THE LATEGLACIAL WÜRMIAN DEGLACIATION IN THE ITALIAN ALPS. A NEW ACCURATE GEOCHRONOLOGICAL FRAMEWORK AND EVIDENCE OF TREE COLONIZATION OF THE DEGLACIATED TERRAIN

18,20-19.00 POSTER SESSION

Chairman: Pascucci V

The authors will be invited to give a 5 minutes explanation of their posters

S. Balescu[1], M. Barri[2], M. Lamothe[2], H. Mejri[3], A. Weisrock[4]

COMPARATIVE IRSL DATING OF MIS 7 MARINE SHORELINE DEPOSITS FROM TUNISIA AND ATLANTIC MORROCO

A. Damušytė[1], V. Baltrūnas[2], A. Bitinas[3], P. L. Gibbard[4], V. Katinas[2], S. Saarmann[5], J. Satkūnas[1]

THE LOWER-MIDDLE PLEISTOCENE (BRUNHES-MATUYAMA) BOUNDARY IN EASTERN LITHUANIA

B. Ghaleb[1], C. Hillaire-Marcel[1], S. Carboni[2], L. Lecca[2]

FURTHER U-SERIES DATA FROM THE LATE PLEISTOCENE DEPOSITS OF CAPO SAN MARCO (SARDINIA): AN OPEN CHEMICAL SYSTEM OR EVIDENCE FOR A ~70 KA HIGH RELATIVE SEA-LEVEL ?

A. Irace[1], G. Monegato[1], E. Tema[2], E.Martinetto[2], R. Pini[3], D. Gianolla[4], L. Bellino[5]

THE PLIOCENE-PLEISTOCENE TRANSITION IN SOUTHERN PIEDMONT: NEW DATA FROM THE ALESSANDRIA BASIN

M. T. Karasiewicz, P. Hulisz*, A. M. Noryśkiewicz**, I. Krześlak**

SEDIMENTOLOGICAL RECORD OF THE LATE VISTULIAN AND EARLY HOLOCENE IN A KETTLE-HOLE (NORTH-CENTRAL POLAND)

J. Rychel[1], M. T. Karasiewicz[2], I. Krześlak[2], L. Marks[1], B. Noryśkiewicz[2], B. Woronko[3]
JAŁÓWKA – A NEW EEMIAN INTERGLACIAL SITE IN NE POLAND

L. Wachecka-Kotkowska
THE GLACIMARGINAL ZONE IN THE NORTHERN PART OF POLISH HIGHLANDS BETWEEN RADOMSKO AND PRZEDBÓRZ: SEDIMENTS, GEOMORPHOLOGY, TECTONICS AND STRATIGRAPHY IN QUATERNARY STUDIES

Wim Westerhoff and Armin Menkovic
IS THE MEINWEG SECTION (NETHERLANDS) STILL VALID FOR THE ONSET OF THE QUATERNARY?

U. Wielandt-Schuster, [1]D. Ellwanger[1], M. Frechen[2], C. Hoselmann[3], M. Weidenfeller[4]
QUATERNARY CORRELATION ALONG THE RHINE

19,00 MEETING OF THE SEQS COUNCIL

20.30 SOCIAL DINNER

SEPTEMBER, 27th

SESSION 3. CORRELATING LAND-SEA EVIDENCE OF LATE QUATERNARY CLIMATIC CHANGE: PALEONTOLOGICAL RECORDS AS EVIDENCE FOR ENVIRONMENTAL CHANGE AND BIOSTRATIGRAPHIC CORRELATION.

Chairman: Danukalova G., Simakova A.

8.30-8.50

Akif Alizad[1], Elmira Aliyeva, Salomon Kroonenberg, Marc de Batis, Robert Hoogendoor, Dadash Huseynov, Speranta Popescu, Nikolay Kasimov, Michail Lychagin, Jean-Pierre Suc

LATE PLEISTOCENE-HOLOCENE CASPIAN SEA LEVEL AND CLIMATE CHANGES

8.50-9.10

A.V. Borodin, E.A. Markova, T.V. Strukova

BIOSTRATIGRAPHIC CORRELATIONS AND ENVIRONMENTAL GRADIENTS: CORRELATING THE ARVICOLINE FAUNAS OF NORTH EURASIA

9.10-9.30

Danukalova G.

BIOSTRATIGRAPHICAL CHARACTERISTIC OF THE HOLOCENE DEPOSITS OF THE SOUTHERN URALS REGION

9.30-9.50

N.Gerasimenko, D.Subetto, V.Bakhmutov. L.Dubis

PALAEOENVIRONMENTAL CHANGES RECORDED IN THE SEDIMENTARY ARCHIVE OF THE COASTAL LAKE SAKI (WESTERN CRIMEA) AND THE BLACK SEA LEVEL FLUCTUATIONS DURING THE HOLOCENE

9.50-10.10

E. Ivanova, I. Murdmaa, E. Schornikov, R. Aliev, F. Marret, A. Chepalyga, L. Bradley, M. Zenina, V. Kravtsov, G. Alekhina

DECADAL-TO-MILLENNIAL SCALE ENVIRONMENTAL CHANGES ON THE NORTHEASTERN BLACK SEA SHELF DURING THE LATE HOLOCENE AND 20TH CENTURY

10.10-10.50 COFFEE BREAK

10.50-11.10

M.R. Palombo, R. Rozzi

QUATERNARY MAMMALS OF SARDINIA: BIOCHRONOLOGY, PALEOBIOGEOGRAPHY AND FAUNAL TURNOVER

11.10-11.40

M. J. Sier, J. Peeters, M. J. Dekkers, F. S. Busschers, J. M. Parés, F. Bunnik, W. Roebroeks

A PALAEOMAGNETIC SIGNAL FROM THE LAST INTERGLACIAL

11.40-12.00

A.Simakova, G. Aleksandrova, L. Golovina

NEW PALEOFLORISTIC DATA FROM MARINE LATE PLIOCENE–PLEISTOCENE DEPOSITS OF WESTERN SYRIA

SESSION 4. EEMIAN TO HOLOCENE SEA LEVEL CHANGE AND TECTONICS

Chairman: Andreucci S. and Westerhof W.

12.00-12.20

W. Westerhoff and A. Menkovic

IS THE MEINWEG SECTION (NETHERLANDS) STILL VALID FOR THE ONSET OF THE QUATERNARY?

12.20-12.40

M. Coltorti , P. Pieruccini, P.Montagna

TOPOGRAPHICALLY LOWER BUT STRATIGRAPHICALLY HIGHER HOLOCENE (?) –TYRRHENIAN (?) BEACH DEPOSITS AT CAPO S.MARCO (SINIS PENINSULA, WEST SARDINIA, ITALY)

12.40 – 14.00 LUNCH

14.00-14.20.

S. Faivre, T. B. Petricioli, N. Horvatinčić

RELATIVE SEA-LEVEL CHANGE IN THE CENTRAL ADRIATIC DURING THE LAST 1.5 KA YEARS

14.20-14.40

A. Fontana, A. Correggiari, P. Slavec, A. Remia, V. Maselli, A. Žerjal, S. Poglajen, B. Celarc, M. Bavec

STRATIGRAPHIC AND MORPHOLOGIC EVIDENCE OF THE HOLOCENE EVOLUTION OF THE ITALIAN AND SLOVENIAN WATERS (NORTHERN ADRIATIC)

14.40-15.00

P. A.T.Kondrashov,

A RICH MOLLUSKAN AND MAMMALIAN FAUNA FROM THE MIKULINO (EEMIAN) INTERGLACIAL OF THE CENTRAL PART OF THE RUSSIAN PLAIN AT MIKHAILOVKA-5 LOCALITY (KURSK REGION)

15.00-15.20

L. Marks, D. Gałązka, J. Krzymińska, N.Małgorzata, R. Stachowicz-Rybka, A. Witkowski, B. Woronko

CHRONOLOGY OF SEA TRANSGRESSIONS DURING EEMIAN IN NORTHERN POLAND

15.20-15.40

P. Mozzi, A. Fontana, A. Correggiari, L. Vigliotti, G. Fontolan, R. Pini, C. Ravazzi, F. Antonioli

THE MIS 5 HIGHSTANDS ALONG THE NORTHERN ADRIATIC SEA: STRATIGRAPHIC DATA AND PALEOGEOGRAPHIC RECONSTRUCTION

15.40-16.00

Pascucci V., Andreucci S., Sechi D.

UPPER PLEISTOCENE TO HOLOCENE COASTAL EVOLUTION OF NW SARDINIA MEDITERRANEAN SEA, ITALY)

16,00-16,20

M.Vacchi, A. Rovere, N. Zouros, M. Firpo

LATE QUATERNARY EVOLUTION AND PALEOSEISMICITY IN THE NE AEGEAN SEA: NEW INSIGHTS FROM THE COASTAL AREA OF LESVOS ISLAND

16,20-16.50 COFFEE BREAK

16.50-17,50 POSTER SESSION

Chairman: Ravazzi C.

The authors will be invited to give a 5 minutes explanation of their posters

L. Di Bell[1], V. Frezz[1], L. Bergami[2], F.L. ChioccI , F. Falesi, E. Martorelli , C. Tarragoni ,M.G. Carboni

FORAMINIFERAL RECORD AND HIGH RESOLUTION SEISMIC STRATIGRAPHY OF THE LATE HOLOCENE DELTAIC SUCCESSION OF THE OMBRONE RIVER (NORTHERN TYRRHENIAN SEA, ITALY).

D. Huseynov, I. Guliyev

PRESENT TECTONICS, FLUID DYNAMICS AND CASPIAN SEA LEVEL CHANGE

K. Khaksar and S. Haghighi

CORRELATION BETWEEN QUATERNARY GEOLOGICAL FORMATIONS OF IRAN

E. Konikov,N. Gerasimenko, S. Ivanova,D. Kiosak,G. Pedan,E Vinogradova.

THE LATE PLEISTOCENE AND HOLOCENE OF THE NORTH-WESTERN BLACK SEA AREA: PALAEOGEOGRAPHY, PALAEOCLIMATE AND ARCHAEOLOGY

R. T. Melis, A. M. Porcu, F. Di Rita, G. Aiello, D. Barra

LATE-QUATERNARY PALEOENVIRONMENTAL EVIDENCES ALONG THE CENTRAL WESTERN COAST OF SARDINIA (ITALY): PRELIMINARY RESULTS

R. T. Melis, M.R. Palombo, B. Ghaleb , S. Meloni

THE SU FOSSU DE CANNAS CAVE (SADALI, CENTRAL-EASTERN SARDINIA, ITALY): A KEY SITE FOR INFERRING THE TIMING OF DISPERSAL OF GIANT DEER IN SARDINIA

S.Ogorodov, O.Kokin

GEOMORPHOLOGICAL STRUCTURE AND DYNAMICS OF BARRIER ISLANDS IN THE BARENTS SEA

M. Surić

SUBMERGED SPELEOTHEMS AS ARCHIVES OF SEA LEVEL CHANGES ON CROATIAN ADRIATIC COAST

Yu.A. Tymchenko

DIATOM ECOLOGICAL GROUPS AS A TOOL FOR RECONSTRUCTING HOLOCENE COASTAL SEDIMENTARY ENVIRONMENTS IN THE NOTH-WESTERN SHELF OF THE BLACK SEA

S. Tonkov, E. Bozilova, E. Marinova, I. Vajsov

PALAEOECOLOGY OF THE COASTAL BLACK SEA LAKE DURANKULAK, NORTHEASTERN BULGARIA

L. Wachecka-Kotkowska, D. Krzyszkowski, J. Krzymińska

CLIMATIC CONTROL ON SAALIAN GLACILACUSTRINE SEDIMENTATION IN THE KLESZCZÓW GRABEN, CENTRAL POLAND, CAUSE OF THE ŁAWKI FORMATION

C. Zucca, S. Andreucci, S. M. Shaddad, S. Madrau, V. Pascucci, S. Kapur

PALAEOENVIRONMENTAL IMPLICATIONS THROUGH THE STUDY OF AN EEMIAN PALAEOSOL IN NORTHWESTERN SARDINIA (ITALY)

17,50 - 18.45

GENERAL DISCUSSION. FUTURE ACTIVITIES OF THE SEQS

CLOSURE OF THE MEETING

LATE PLEISTOCENE-HOLOCENE CASPIAN SEA LEVEL AND CLIMATE CHANGES

A. Alizada[1], E. Aliyeva[1], S. Kroonenberg[2], M. de Batist[3], R. Hoogendoor[2], D. Huseynov[1], S. Popescu[4], N. Kasimov[5], M. Lychagin[5], J. Suc[4]

[1]Geology Institute of AzNAS, Baku, Azerbaijan; [2]TUDelft, Delft, The Netherlands; [3]Ghent University, Belgium; [4]Claude Bernard University, Lyon, France;[5]Moscow State University, Russia
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High resolution studies on the new core and seismic data from the Kura river delta in the South-West Caspian Sea provided a deep insight into its late Pleistocene – Holocene history enabling characterizations of short-term climatic variations and improving of the Caspian Sea level curve. The data display several phases of delta retrogradation during the Caspian Sea highstands, interrupted by erosional phases during lowstands, recognisable in the seismic profiles as prominent reflectors. The first phase is represented by coarse sands with numerous shell fragments encountered at the base of deepest well A at the subCaspian depth 34 m. The data obtained allow us to assume that sand deposition took place during late Pleistocene Caspian lowstand (24-25 Ky BP) (14C) (sequence 1). Overlying dark reddish-brown sandy shales (interval 30-34m) were deposited in the time interval 18-23,7 Ky BP, which corresponds to the last glacial phase. These sediments are characterised by lack or very rare fresh –brackish water molluscs (Dreissena) in the lowermost portion, and enriched in Fe_2O_3, MnO suggesting sedimentation in the continental environment. We assume a deep Caspian Sea regression in the late Pleistocene (18- 25 Ky BP) with the Sea level fall to -102m.

The subsequent warming recorded in the peaks of warm temperature and subtropical palynomorphes was accompanied by the sea level rise and accumulation of grey shales with abundant mollusc and ostracode shells (core interval 25-30m). A deep Mangyshlak regression at the beginning of Holocene is recognized in the core samples as peat deposits or shallow water grey sandy shales with sand laminas and shallow water ostracodes (interval 21-25m) (sequence 2). Recovered palynomorphes display cool temperature and peak in halophytes. The sea level was gradually falling from -92m (12 Ky BP) to -96,5m (9,24 Ky BP).

The overlying Kura delta's Holocene sediments consist of 20 m thick thinly bedded silty clays and laminated dark grey clays. Locally sand and shell-rich horizons occur.

The data have given a concise insight in the development of the delta during the last ~10000 years. They show several phases of delta retrogradation during the Caspian Sea highstands, interrupted by erosional phases during lowstands, recognisable in the sesimic profiles as prominent reflectors. The first phase is represented by reddened fluvial clays (Sequence 1) possibly affected by soil formation during a lowstand at –90 m absolute depth dated at 12000 BP. These are overlain by several metres of laminated clays and silts, 14C dated at 9240-5920 BP (Sequence 2). This succession is truncated by a prominent reflector bounding Sequence 3 (modern delta dated at 1400 BP consisting of thin laminated clays. Sequence 3 consists of four progradational and retrogradational phases of a higher order corresponding to: 1. a lowstand at about –48m absolute depth and correlated with the 11th century Derbent Regression, 2. laminated deltaic clays and silts, passing locally to organic clays with fluvial diatom assemblages; 3. an erosional event, related to a lowstand in the 16th century; 4. last 200 years deposited succession. Onshore delta consists of progradational sequences of channel-levee sands and floodplain silts and clays deposited during gradual sea-level fall and overlain by clays and silts reflecting the last phase of rapid sea- level rise since 1977. Overall sedimentation rates in the delta determined by 210Pb methods range between 1.5-3.0 cm/year.

Data on O, C isotope composition of ostracods shell carbonate as well as Ca/Mg, Sr/Ba ratios therein testify to significant climate and basin salinity changes through out the Pleistocene-Holocene, and provided us by unique opportunity for characterizations of short-term climatic cyclicity, which was the major lake-level control.

The applied multi-component demonstrates a strong influence of climatically driven rapid fluctuations of the Caspian Sea level on stratigraphic architecture and faunal assemblages in the Pleistocene-Holocene succession.

COMPARATIVE IRSL DATING OF MIS 7 MARINE SHORELINE DEPOSITS FROM TUNISIA AND ATLANTIC MORROCO

S. Balescu[1], M. Barri[2], M. Lamothe[2], H. Mejri[3], A. Weisrock[4]

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[2]*Laboratoire de Luminescence LUX, Département des Sciences de la Terre et de l'Atmosphère, Université du Québec à Montréal, CP 8888 Succ. Centre-Ville, H3C 3P8 Montréal, Canada* magali.barre@uqam.ca; luxlamothe@yahoo.ca

[3]*Laboratoire Halma Ipel, UMR 8164 (CNRS), Université Lille 1, 59655 Villeneuve d'Ascq Cedex, France et Laboratoire Eau-Energie-Environnement, ENIS, Université de Sfax BP W 3038 Tunisie* hajerm79@gmail.com

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Evidence for Pleistocene sea-level changes and coastal neotectonics occur extensively along the Tunisian coast and the Atlantic coast of Morroco. Both areas being affected by tectonic uplift during the Quaternary, the Pleistocene shoreline deposits show a wide variability in elevation that is related to both glacio-eustatic change and regional neotectonic deformation. In these areas, the chronology of the Middle Pleistocene interglacial high sea level stands remains problematic. In absence of corals, the only datable material are mollusc shells. These yielded either unreliable ages beacause of post-mortem U-uptake or widely dispersed U/Th ages because of the presence of reworked shells (mixed populations of shells). Marine sediments belonging to the "Douira Formation" in Tunisia and the «Agadirian marine stage» in Atlantic Morocco, are both assigned to MIS 7 on the basis of chronostratigraphic and geomorphic evidence, but their age has not yet been unambiguously demonstrated and is still a matter of debate (MIS 7 or MIS 9?).

The «Douira Formation» culminating at 10-11m a.s.l., is overlain by Tyrrhenian (MIS 5.5) *Strombus bubonius* bearing marine sediments and is separated from the latter by pedogenised continental deposits. The «Agadirian» shallow-marine sediments rest on a marine erosion plateform culminating at 20 m a.s.l nd lying just above the Last interglacial (Ouljian) marine plateform (8 m a.s.l.).

The present study is designated to make an independent age assessment of both the "Douira Formation" and the "Agadirain" using the IRSL dating method. The latter is applied to alkali feldspar coarse grains (200-250 mm) from shallow-marine sand deposits, using both the multiple aliquot additive g dose technique and the SAR (*Single aliquot regenerative*) dating technique.

This paper focuses on littoral deposits from three key reference sites: (1) El Hajeb and (2) Oued Dar Oufa, from respectively central and northern Tunisia and (3) Agadir Founti in the Agadir region (Morocco).

The feldspar IRSL signal being unstable over geological time (« fading »), all measured IRSL ages need to be corrected for fading. Three protocols of age correction for the observed fading have been applied.

The corrected IRSL ages obtained in Tunisia and Atlantic Morocco will be compared with the IRSL ages obtained in Sardinia for the MIS 7 shallow-marine deposits at San Giovanni de Sinis.

This study demonstrates the potential of the IRSL dating method to provide chronological information on MIS 7 paleoshorelines of Tunisia and Atlantic Morocco when U/Th and/or Amino Acid Racemisation methods failed to provide unequivocal or reliable ages.

Evolution of stratified currents system during upwelling.

Barbanova E.S. (Elena Sergeyevna)

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The paper presents experimental results and results of theoretical studies of evolution of stratified currents system, which includes upwelling-induced currents, seiche-induced wave currents and density currents in Volkhov bay, Lake Ladoga. It was discovered that in the near bottom layer coastal upwelling prevails. It was found that upwelling provides bay's water purification in a moderate wind. Blocking of submerged jet of river water by upwelling was discovered. It was shown that during this process jet rise and jet thickening took place, given that the speed increased and the height of bottom current also increased. The version of mathematical model of discovered currents system was suggested, being represented as a determined system, using semi-empirical expression for upwelling height, trajectory and thickness of a jet.

This work was support by RFBR, Grants 1105-05-01146-a, 12-05-09331- mob_z

CONTOURITES FROM THE CONTINENTAL RISE OFF URUGUAY AND SOUTHERN BRAZIL (SOUTH ATLANTIC)

D.G. Borisov, I.O. Murdmaa, E.V. Ivanova, O.V. Levchenko

P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences, dborisov@ocean.ru

The continental margin off Uruguay and Southern Brazil is characterized by a very abundant fluvial sediment discharge by the de la Plata River (about $80 \cdot 10^6$ t/year) and dynamic oceanographic regime (Krastel et al. 2011). Hence, this region represents a perfect site for investigation of submarine sedimentation processes.

One of the main tasks of the 33rd, 35th and 37th cruises abroad the RV “Akademik Ioffe” was the investigation of depositional patterns on the Uruguay-Brazil continental rise, by means of the very high resolution (VHR) seismoacoustic profiling provided by the parametric echo-sounder “SES-2000 deep” and sediment sampling using the gravity corer. The study area extends from the Mar del Plata submarine canyon in the south up to the Sao Paulo Plateau in the north.

The surface circulation in this region includes interaction of the northward-flowing cold Malvinas Current with the southward warm Brazil Current. The area where the currents converge is called the Brazil/Malvinas confluence zone (BMC). It migrates seasonally between 32º and 40º S (Olson et al., 1988). The stratification of the water masses in the study area at 300-4000 water depths is characterized by the northward-flowing Antarctic Intermediate Water (AAIW) at 300-1000 m, the Upper Circumpolar Deep Water (UCDW) at 1000-1500 m, the North Atlantic Deep Water (NADW) moving southward at 1500-2800 m, the northward-flowing Lower Circumpolar Deep Water (LCDW) at 2800-4000 m, and the Antarctic Bottom Water (AABW) bellow 4000 m. (Hernández-Molina et al., 2010).

Four gravity cores were retrieved directly at the “SES-2000 deep” seismic lines crossing the continental rise roughly in the SW-NE direction. All the gravity cores were retrieved from the base of the continental slope, but from different depositional environments: from the northern flank of the Ewing drift - AI-2442 (32°41.3'S, 46°05,6'W, 3890 m), the Lower Santos Plateau (the plateau westward of the Vema Channel) - AI-2443 and AI-2613 (30°36.2'S, 44°16.97'W, 3410 m; 30º35.36'S, 45º44.10'W, 3345 m, respectively), and from the summit of the deepwater channel-related levee - AI-2563 (28°32.4'S, 43°17.0'W, 3620) (fig.1). The sublatitudinally oriented channel, about 150 m deep, is bounded by the steep escarp of the Sao Paulo Plateau in the north and is considered as a continuation of the Rio Grande transform fault. The seismic profile running through the core AI-2443 reveals a field of sedimentary waves which seem to be similar to those partly covering the giant Ewing contourite drifts located southward (Hernández-Molina et al., 2010). The core AI-2443 was retrieved from the top of one of the waves, about 40 m high. The core AI-2613 is located on the smooth surface without any evidence of sediment waves in the seismic profile. All cores recovered the Upper Pleistocene sediments composed of homogenous hemipelagic silty clay with evidence of bioturbation, thin (up to 1cm) hardgrounds, and a considerable content of foraminiferal tests.

Presence of the BMC zone and strong contour currents imply increased bottom currents velocity which are considered to be mainly responsible for the non-deposition of the high fluvial sediment input by the de la Plata River on the shelf and upper continental slope off Uruguay (Krastel et al. 2011). Entrained in the nepheloid flows, the fluvial material moves down-slope and then is transported and deposited by contour currents.

The core AI-2442 is located at the base of the Ewing drift flank, somewhat above the present upper boundary of the AABW (~4000 m). The drift is generated by the long-term cyclonic gyre of the AABW centered in the Argentine Basin. Sediments recovered by the core are possibly deposited from the down-slope nepheloid flows. A thin oxidized layer (4 cm) at the core top suggests high sedimentation rates and a slow bottom current velocity. This area represents a calm bottom water zone defended from the influence of strong contour currents by the Ewing drift and the Lower Santos Plateau that resulted in intensive accumulation of the fine-grained terrigenous material.

Sediment waves covering the Lower Santos Plateau are probably created by the LCDW contour current. A good foraminiferal preservation and high species diversity in the core AI-

2443 indicates insignificant dissolution, but their rare occurrence points to a strong dilution of the biogenic carbonate by terrigenous material. Hardgrounds in the core suggest short-term hiatuses, probably related to episodic increase in contour current velocity. They well correlate with reflectors in the SES-2000 deep seismic profiles. The thinner oxidized layer in the core AI-2613, as well as absence of sediment waves in the seismic profile, are evidence of higher sedimentation rates and lower contour current velocity at the foot of the steep slope.

The levee where the gravity core AI-2563 was retrieved from is likely formed by the influence of the LCDW contour current constrained by the Coriolis force against the steep flank of the Sao Paulo Plateau. There are no available lithological data to determine the relative role of turbidity currents in formation of the levee, but some strong reflectors in the seismic profile running across the levee may correspond to turbidites.

Variations in foraminiferal preservation throughout the cores seem to be associated with the glacial-interglacial variability of the foraminiferal lysocline corresponding to the upper AABW boundary.

This study was partly supported by the Program “Basic problems in Oceanology” by the Russian Academy of Sciences, and the Russian Foundation for Basic Research grant 11-05-01000.

References

F.J. Hernández-Molina, M.Paterlini, L. Somoza, R. Violante, M.A. Arecco, M. de Isasi, M.Rebesco, G. Uenzelmann-Neben, S. Neben, P. Marshall, 2010. Giant mounded drifts in the Argentine Continental Margin: Origins, and global implications for the history of thermohaline circulation. Marine and Petroleum Geology, 27, p.1508-1530.

S. Krastel, G. Wefer, T. Hanebuth, A. Antobreh, T. Freudenthal, B. Preu, T. Schwenk, M. Strasser, R. Violante, D. Winkelmann, 2011. Sediment dynamics and geohazards off Uruguay and the de la Plata River region (northern Argentina and Uruguay). Geo-Mar Letters.

D.B. Olson, G.P. Podesta, R.H. Evans, O.B. Brown, 1988. Temporal variations in the separation of Brazil and Malvinas Currents. Deep-Sea Research, 35, p. 1971–1990.

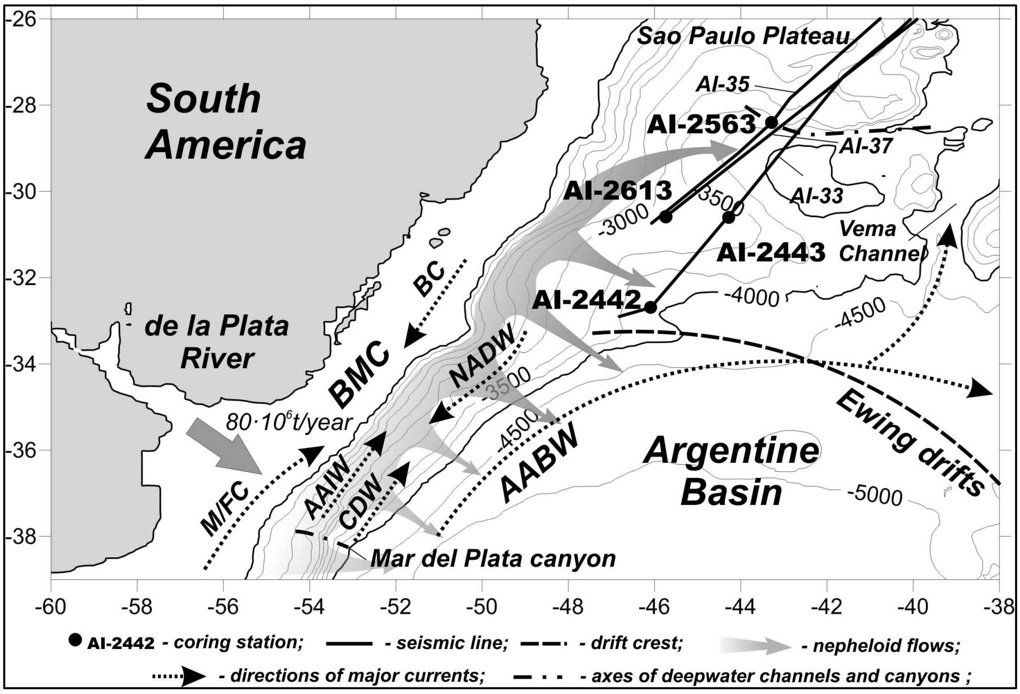

Figure 1. Bathymetric map showing location of cores, seismic lines, directions of major currents and nepheloid flows.

BC – Brazil current; M/FC – Malvinas/Falkland current; BMC – Brazil-Malvinas Confluence zone; AAIW – Antarctic Intermediate Water; CDP – Circumpolar Deep Water (including Lower and Upper Circumpolar Deep Water); NADW – North Atlantic Deep Water; AABW – Antarctic Bottom Water.

BIOSTRATIGRAPHIC CORRELATIONS AND ENVIRONMENTAL GRADIENTS: CORRELATING THE ARVICOLINE FAUNAS OF NORTH EURASIA

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In the Northern Hemisphere, the arvicolines represent the group of mammals which is the most widely used for the biostratigraphic and biochronological purposes due to their rapid evolution, abundant fossil record, wide geographical ranges and high rates of dispersal in Eurasia and North America. At the same time, the well pronounced zoogeographical differences at regional level exist within the continents determined by their latitudinal or (and) longitudinal extent, and the relief. The boundaries of biochronological units in different regions are often diachronous and based on different taxa that causes considerable difficulties in interregional correlations (e.g., Vangengeim, Tesakov, 2008). For example, the need for independent biochronologies in low and high latitudes of the North America has been considered by Bell et al. (2004) and the problems of interregional correlations within Eurasia (based on micromammals) are discussed by many authors (e.g., Fejfar et al., 1998; Maul, Markova, 2007). Vangengeim and Tesakov (2008) emphasize the need to develop the criteria and approaches to correlate the data from different zoogeographic provinces and landscape-geographic zones.

Our previous studies show that one of the possible ways to solve the problem of interregional biochronological correlations in the Northern Eurasia is to develop the approach based on the analogy between the modern biogeographic gradient and the gradual change in faunal composition along the latitudinal gradient of environment in the central part of Northern Eurasia, namely in the Trans-Urals and Western Siberia, detected at different stages of the Quaternary (Borodin, 1996; Borodin et al., 2011). Based on the key taxa and their latitudinal range overlaps, several zones were proposed according to the north-south gradient (Fig. 1). To designate the zones, we use index A (“area”, because these zones characterize the distribution areas of the key taxa). The key lineages and taxa are as follows: †*Mimomys intermedius* or †*M. savini* (*M.i.*) → †*A. mosbachensis* (*A.m.*) → †*A. chosaricus-kalmankensis* (*A.ch.*) → *A. terrestris* (*A.t.*); †*Allophaiomys deucalion* (*A.d.*) → †*A. pliocaenicus* (*A.p.*) → *Microtus* (*Stenocranius*): † *Stenocranius hintoni* (*S.h.*), → †*S. gregaloides* (*S.gd.*), → *S. gregalis* (*S.g.*); †*Borsodia newtoni* (*B.n.*) → †*Prolagurus ternopolitanus* (*Pl.t.*) → †*P. pannonicus* (*Pl.p.*) → †*Lagurus transiens* (*L.t.*) → *L. lagurus* (*L.l.*); †*Praedicrostonyx hopkinsi* (*Pd.h.*) → †*Pd. compitalis* or †*Pd. meridionalis* (*Pd.m.*) → †*D. renidens* (*D.r.*) → †*D. simplicior* (*D.s.*) → †*D. henseli* (*D.h.*) → *D. torquatus* (*D.t.*).

The latitudinal biochronological zones are established based on the geographic occurrence of the key lineages of Arvicolinae in the Quaternary localities in the Trans-Urals and Western Siberia and entitled using the Latin names of the terminal taxa (at generic or subgeneric level) of those lineages: **AI** latitudinal zone includes the distribution area of collared lemming (*Dicrostonyx* lineage); **AII** zone includes the area of the shared occurrence of *Dicrostonyx* & *Stenocranius*; **AIII** zone includes the area where *Dicrostonyx* & *Stenocranius* & *Arvicola* & *Lagurus* may be found together; **AIV** zone includes the area of the shared occurrence of *Stenocranius* & *Arvicola* & *Lagurus*.

The zones are numbered sequentially from I to IV according to the north-south gradient in the Trans-Urals and Western Siberia. However, we suggest that the principle of shared geographical occurrence of the key taxa shown in the fig. 1 may be also used in other regions with pronounced latitudinal or altitudinal zonation. Gradual change in species composition over space allows one to link the synchronous faunas of different zones along the environmental gradient based on the evolutionary level of the key taxa.

When correlating the arvicoline faunas, any fauna may be placed to a particular spatio-temporal position in the table shown at the fig. 1 according to the evolutionary level of the key taxa and to the range of its distribution in geographical space. For example, a hypothetical fauna comprising *Dicrostonyx simplicior*, *M.* (*Stenocranius*) *gregaloides* and *Lagurus transiens* should be placed to the biochronological zone MQR5, and to the geographical zone AIII. A hypothetical fauna comprising the only one species (of the key taxa mentioned above) belonging to *Arvicola* lineage and corresponding to the evolutionary level of *A. mosbachensis* should be placed to the biochronological zone MQR3, and to the geographical zones AIII-IV (Fig. 1).

The key taxa used here represent the most common arvicolines distributed in the Northern Hemisphere during the Quaternary. By adding the data on the composition of regional faunas for a given period of geological time one may reconstruct the gradients in the composition of micromammal communities along the regional environmental gradients.

The study was supported by the RAS Presidium program no. 12-C-4-1034, the Russian Foundation for Basic Research (research grant 10-04-96102), and the Government of Sverdlovsk region.

References

C.J. Bell, C.A. Repenning, A.D. Barnosky, 2004. Arvicoline rodents from Porcupine Cave – identification, spatial distribution, taxonomic assemblages, and biochronologic significance. In: Barnosky A.D. (ed.) Biodiversity Response to Climate Change in the Middle Pleistocene – the Porcupine Cave Fauna from Colorado. - California, Berkeley: Univ. of California Press. P. 207-263.

A.V. Borodin, 1996. Quaternary faunas of small mammals from the West-Sibirian Plain. Acta zoologica cracoviensia. Vol. 39. №1. P. 75-81.

A. Borodin, E. Markova, E. Zinovyev, T. Strukova, M. Fominykh, S. Zykov, 2011. Quaternary rodent and insect faunas of the Urals and Western Siberia: Connection between Europe and Asia. Quaternary International. doi:10.1016/j.quaint.2011.07.050.

O. Fejfar, W.D. Heinrich, E.H. Lindsay, 1998. Updatind the Neogene Rodent biochronology in Europe. MNITG-TNO. Vol. 60. P. 533-554.

L.C. Maul, A.K Markova, 2007. Similarity and regional differences in Quaternary arvicolid evolution in Central and Eastern Europe. Quaternary International. 160, 81–99.

E.A. Vangengeim, M.A. Pevzner, A.S. Tesakov, 2001. Zonal subdivisions of the Quaternary in Eastern Europe based on small mammals. Stratigraphy and geological correlation. 9 (3). P. 280-292.

E.A. Vangengeim, A.S. Tesakov, 2008. Principles of construction for the biochronological scales based on the Pliocene and Pleistocene mammals. State of art. Bulletin of Commission for Quaternary Research. N68. P. 59-69 (in Russian).

Time vs. Space		Areas of the key taxa geographic co-occurrence			
		AI	**AII**	**AIII**	**AIV**
Modern*		*D.t.*	*D.t., S.g.., A.t.*	*A.t.*	*S.g., L.l., A.t.*
Biochronological units **MQR** (Vangengeim et al., 2001)	**1**	*D.t.*	*D.t., S.g.*	*D.t., L.l., S.g., A.t.*	*S.g., L.l., A.t.*
	2	*D.h.*	*D.h., S.g.*	*D.h., S.g., A.ch., L.l.*	*S.g., A.ch., L.l.*
	3	*D.h.*	*D.h., S.g.*	*D.h., S.g., A.m., L.t.*	*S.g., A.m., L.t.*
	4	*D.s.*	*D.s., S.g.*	*D.s., S.g., L.t.* (*M.i.*last appearance)	*S.g., L.t.* (*M.i.*last appearance)
	5	*D.s.*	*D.s., S.gd.*	*D.s., S.gd.., L.t.*	*S.gd., L.t.*
	6	*D.r.*	*D.r., S.h.*	*D.r., S.h., L.t.*	*S.h., L.t.*
	7	*D.r.*	*D.r., S.h.*	*D.r., S.h., Pl.p.*	*S.h., Pl.p.*
	8	*Pd.m.*	*Pd.m., A.p.*	*Pd.m., A.p., Pl.p.*	*A.p., Pl.p.*
	9	*Pd.m.*	*Pd.m., A.p.*	*Pd.m., A.p., Pl.p.*	*A.p., Pl.t*
	10	*Pd.h.*	*Pd.h., A.d.*	*Pd. h., A.d., Pl.p.*	*A.d., Pl.t*
	11	*Pd.h.*	*Pd.h., A.d.*	*Pd. h., A.d., B.n.*	*A.d., B.n.*

* The Urals and Western Siberia

Fig.1. Combinations of the key arvicoline taxa showing the principle of shared geographic occurrence applied to biochronological correlation of the Quaternary faunas of the regions with pronounced environmental gradients in Northern Eurasia. The combinations known in the Trans-Urals and Western Siberia are marked with grey.

RADIOCARBON GHOSTDATES FROM SOUTHERN NORTH SEA MARINE SHELLS: IMPLICATIONS FOR DATING OF PLEISTOCENE LANDSCAPES, SEDIMENTS AND ARCHAEOLOGY?

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Deltares
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We compared a new set of marine shell AMS radiocarbon age estimates from boreholes in the Netherlands (southern North Sea area) with other sources of age control. Most of the marine shells give ages between 32-46 ^{14}C ka (36-50 ka BP; MIS3). A much older MIS5e age (>117 ka) is however suggested by 1) both quartz and feldspar Optically Stimulated Luminescence dating, 2) pollen based biostratigraphical linkage to the Eemian type localities of Amsterdam and 3) a for MIS3 unknown combination of a fully interglacial vegetation assemblage, high sea-level position and warm sea-water temperatures.

The presence of intracrystalline cement on SEM photographs, absent in modern (analogue) mollusc samples, shows that the molluscs were subject to significant post-mortem crystal growth. Although some percentage of secondary carbonates (calcite) is also suggested by XRD analysis, the major part of the secondary crystals is likely of aragonitic origin and hence undetectable because of their structural similarity to the original mollusc aragonite.

The clear evidence for recrystallisation and therefore for a potential mechanism for uptake of younger contaminant carbon from CO_2 rich groundwater into the mollusc carbonate structures leads us to conclude that in case of our samples, the ^{14}C outcomes are erroneously young and severely underestimate the true geological age. This finding confirms the other age-constraints that all point to an age beyond 117 ka.

Despite the recent extension of the calibration dataset back to 50.000 calendar years BP our datasets illustrates that at least for marine mollusc carbonate, major challenges remain to determine reliable geological ages for ^{14}C outcomes from the Pleistocene period. Multidisciplinary approaches like we present should also be applied to other materials and settings since it could evaluate the value of ^{14}C dating at higher half-life and therefore the dating of Pleistocene landscapes, sediments and archeological sites.

A STAIRCASE OF MARINE TERRACES AND THE PLEISTOCENE EVOLUTION OF THE OROSEI GULF (SARDINIA, ITALY)

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During the new geological mapping of the Orosei and Nuoro Sheets, located in the central eastern part of Sardinia, for the first time a staircase of marine terraces has been recognized at progressive elevation above the sea level. Their association with coastal deposits allows creating a series of Unconformity Bounded Stratigraphic Units (UBSU, Salvador, 1994), as requested by the Geological Survey of Italy. Their relationship with lava flows allow us to distinguish units usually covered by basalts from units lying unconformably over the basalts. From the older to the younger units we recognized three major pre-basaltic units and three post-basaltic units. In the former we included: 1. Su Cascheri Synthem made of deeply weathered quartz gravels and sands lying on a marine abrasion terrace preserved up to ca. 125 m asl; 2. Zi Martine Synthem, made of deeply weathered quartz gravels and sands preserved inside sinkholes and lapiaz departing from a marine abrasion terrace at ca. 40 m asl; 3. Nuraghi Casteddu Synthem, composed of coarse and very coarse mostly fluvial and deltaic gravels, blocks and sands with intercalations of silty and clayey layers at the top forming a terrace with an inner edge located around 20 m. Among the post-basaltic units we included: 4. Matta su Turcu Synthem, made of quartz gravels and sands lying unconformably over lava flow and generating a marine terrace with an inner edge at ca. 25 m asl.; 5. The Cala Mosca Synthem, usually referred to the Last Interglacial, crops out between 1 m ad 11 m asl and probably represents various MIS 5 stages including the MIS 5e. The tidal notch preserved between 8 and 11.5 m along the gulf is referred to one of these deposits (Carobene & Pasini, 1982). It is overlaid by the Porto Scuso Synthem, made of alluvial fan, slope and locally aeolian deposits radiometrically dated to the coldest stages of the Last Glaciation (Coltorti et al., 2010); 6. The last synthem is made of coastal, fluvial and slope deposits attributed to the Holocene. However, contrasting results have been obtained using OSL dating (Thiel et al., 2010). The lava flows was K/Ar dated between 2 and 3 Ma although it is possible that the new ongoing dating will result in younger ages as occurred in most of the Apennines in the last decades. This new geomorphologic setting reveals ongoing uplift of Sardinia during Late Pliocene and Quaternary and open many doubts on its presumed long-term stability. The occurrence of pre-basaltic marine terraces, together with stratigraphic observations. also allow to reject the hypothesis that the uplift is associated to the emplacement of a batolite after the Last Interglacial (Mariani et al.,

Reference

Carobene, L. & Pasini, G.C., 1982: Contributo alla conoscenza del Pleistocene superiore e dell'Olocene del Golfo di Orosei (Sardegna orientale).- Bollettino della Società Adriatica di Scienze, 64, 5-35, Trieste.

Coltorti M., Melis E., Patta D., 2009. Geomorphology, stratigraphy and facies analysis of some Late Pleistocene and Holocene key deposits along the coast of Sardinia (Italy). Quaternary International, 1-17

Thiel C., Coltorti M., Tsukamoto S., Frechen M., 2010. Geochronology for some key sites along the coast of Sardinia (Italy). Quaternary International., in press

Salvador, A., 1994. International Stratigraphic Guide. A guide to stratigraphic classification, terminology and procedures. The International Union of Geological Science and the Geological Society of America (Eds), 214 pp.

GEOMORPHOLOGY, STRATIGRAPHY, FACIES ANALYSIS AND GEOCHRONOLOGY OF QUATERNARY DEPOSITS AT CAPO S.MARCO (SINIS PENINSULA, WEST SARDINIA, ITALY)

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Capo S.Marco is the southernmost termination of the Sinis Peninsula, in the north western border of the Oristano Gulf (western Sardinia, Italy). In the area there are some of the most controversial and debated Quaternary deposits of Sardinia. They are beach, aeolian and slope sediments whose chronological attribution changed according to different Authors and, in different times, by the same Authors. These problems have not been solved by new radiometric dates because radiocarbon and OSL methods provided completely different ages (Andreucci et al., 2009; Coltorti et al., 2010; Thiel et al., 2010). During recent investigations at Capo S.Marco the Authors discovered beach notches filled with bioclastic sands, gravels and boulders up to an elevation of ca 4.0 m asl, that is the elevation of the already known higher beach notch. These sediments rest over aeolian deposits and in two sites generate a marine terrace. In some places these sediments also include *Cladocora caespitosa* corals in living position that have been recently dated by means of U/Th at 70 krs (D'Orefice et al., 2012), attributed to the end of MIS 5. A new U/Th dating has been performed on a small piece (~ 30mg) of another *C. caespitosa sample* found on top of all the existing deposits. The Uranium content (2.6ppm) is similar to living specimens of the same coral species but the initial ratio $^{234}U/^{238}U$ is higher (177) compared to the seawater value (147), suggesting an open system behaviour. The age of 152 kyrs corrected using the method of Thomson et al. (2003) is ca. 140 kyrs. Nevertheless, these deposits and the beach notches are not buried under aeolian or colluvial sediments like most of the Tyrrhenian marine deposits of the Island. They also rest on the aeolian sediments attributed to the MIS 4 based on OSL dating but on the Late MIS 2 and the beginning of the Holocene based on radiocarbon dates. Therefore the stratigraphical evidence could also suggest their attribution to the Holocene although this actually contrasts with the Holocene sea level models available. If this attribution will be confirmed some doubts could be cast on the models unless the area is affected by neotectonic movements. New U/Th datings on micro-portions of the thecal wall are in progress in order to better constrain the system and try to solve this controversial topic of the Quaternary deposits of Sardinia.

References

Andreucci, S., Pascucci, V., Murray, A.S., Clemmersen, L.B., 2009. Late Pleistocene coastal evolution of S.Giovanni in Sinis, west Sardinia (Western Mediterranean). Sedimentary Geology, 216,104-116.

Coltorti M., Melis E., Patta D., 2010. Geomorphology, stratigraphy and facies analysis of some Late Pleistocene and Holocene key deposits along the coast of Sardinia (Italy). Quaternary International, 1-17

D'Orefice M., Graciotti R., Lo Mastro S., Muraro C., Pantaloni M., Soligo M., & Tuccimei P., 2012. U/Th dating of a *cladocora caespitosa* from Capo San Marco marine quaternary deposits (Sardinia, Italy). Alpine and Mediterranean Quaternary, 25 (1), 35-40.

Thiel C., Coltorti M., Tsukamoto S., Frechen M., 2010. Geochronology for some key sites along the coast of Sardinia (Italy). Quaternary International., in press

Thomson W.G., Spiegelman M.W., Goldstein S.L., Speed R.C., 2003. An open-system model for U-series age determinations of fossil corals. Earth and Planetary Science Letters, 210, 365-381.

THE LOWER-MIDDLE PLEISTOCENE (BRUNHES-MATUYAMA) BOUNDARY IN EASTERN LITHUANIA

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The layers of lacustrine and alluvial sediments represented by stratifieded sand, silt and, rarely clay (total thickness more than 20 m) are widely distributed in Eastern Lithuania overlying on the Devonian rocks and covered by the Pleistocene glacial deposits (Fig. 1). According to interpretation of geological data these sediments could be formed in a few sedimentary basins of different age. According to recent stratigraphic schemes of Lithuanian the mentioned sediments are attributed to the Anykščiai Formation of the Upper Pliocene and Daumantai Formation of the Early Pleistocene (Satkūnas 1998, Guobytė, Satkūnas 2011), i.e. they contain a boundary between Neogene and Quaternary. Presented stratigraphic subdivision of mentioned sediments is based on the results of palaeobotanic investigations, but is not yet confirmed by geochronological data. The precise determination of Neogene/Quaternary boundary is problematic due to low content of pollen in the sediments (Kondratienė 1971). The sediments of Daumantai Formation is widely distributed in the SE Lithuania (Vilnius environs) where the stratigraphic subdivision and Neogene/Quaternary boundary determination is based, except palaeobotanic data, on the results of lithological (mineralogical) investigations, i.e. according to the changes of content of Scandinavian minerals (like pyroxene, garnet, epidote, hornblende) in the sediment's section (Satkūnas 1998).

The recent palaeomagnetic investigations of mentioned sediments in the Eastern Lithuania show that in a few sections – Daumantai (Baltrūnas *et al*., in press) and Šlavė-2 – an obvious boundary between normal and reversal polarity has been established. This boundary preliminary was interpreted as boundary of Brunhes-Matuyama (Fig. 2). For the lowermost part of Šlavė-2 section, separated by a few sedimentation breakes, variations of polarity are characteristic as well. This part of section, according to palaeobotanic data, belongs to the second half of Miocene (Kondratienė 1971) that indirectly is confirming by relatively bigger amount of chemically weathered sand grains in sediments. But identification of established palaeomagnetic zones is still problematic. According to measurements of anisotropy of magnetic susceptibility (AMS) in the investigated sections (outcrops) of Eastern Lithuania the general water flow direction in the all existed sedimentary basins, despite their different age, are generally oriented from the West to East (Fig. 1). The anomalies of magnetic anisotropy in the uppermost part of the Vetygala section can be explained by glaciotectonic deformation (rotation of frozen megablock) the investigated section of sediments during the one of Pleistocene glaciations.

The interpretation of Brunhes-Matuyama boundary in the Daumantai and Šlavė-2 outcrops could be confirmed by results of palaeomagnetic investigations in the other sections of Eastern Lithuania, and also substantiated by palaeobotanic and lithological data – the mentioned investigations are performed. On 2011-2012 received a new data – the results of palaeomagnetic investigations first of all – could be an essential background for revision of stratigraphic scheme of Lithuania and surrounding regions, and also for correction of Pre-Quaternary geological map of Lithuania. Investigations were made by kappabridge MFK-1B, magnetometer JR-6, AF molspin demagnetizer and ESM QUANTA 250 at Nature Research Centre of Lithuania.

References

Baltrūnas, V., Zinkutė, R., Katinas, V., Karmaza, B., Taraškevičius, R., Kisielienė, D., Šeirienė, V. and Lagunavičienė, L. Sedimentation environment changes during the Early-Middle Pleistocene transition as recorded from Daumantai sections investigations, Lithuania. (In press).

Guobytė, R., Satkūnas, J. 2011. Pleistocene Glaciations in Lithuania. In: J. Ehlers, P. L. Gibbard and P. D. Hughes (Eds), Developments in Quaternary Science, Vol. 15, Amsterdam, The Netherlands, 231-246.

Kondratienė, O. 1971. Paleobotanicheskaja charakteristika opornych razrezov Litvy. In: Strojenie, litologija i stratigrfija otlozhenij nizhnego pleistocena, Vilnius, 57-116 (In Russian).

Satkūnas, J. 1998. The oldest Quaternary in Lithuania. Mededelingen NederlandsInstituut voor Toegepaste Geowetenschappen, 60, 293-304.

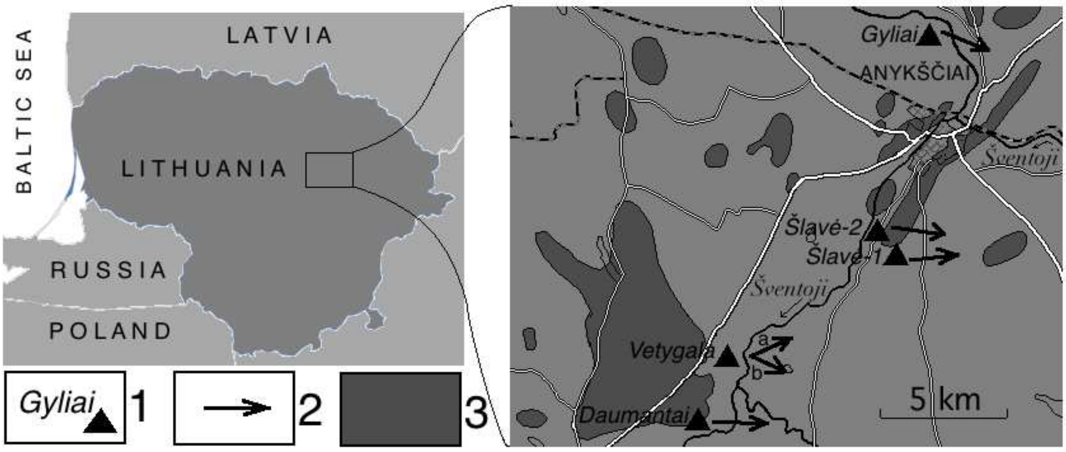

Fig. 1. Location of investigated sections: 1 – section (outcrop) and its name; 2 – AMS direction: a and b – for upper and lower part of section respectively; 3 – area of Neogene sediments surrounded by Devonian, according to Pre-Quaternary geological map of Lithuania (Lithuanian Geological Survey, 1:200 000, 1999). Note, that majority of investigated sections are located outside of the mapped Neogene areas.

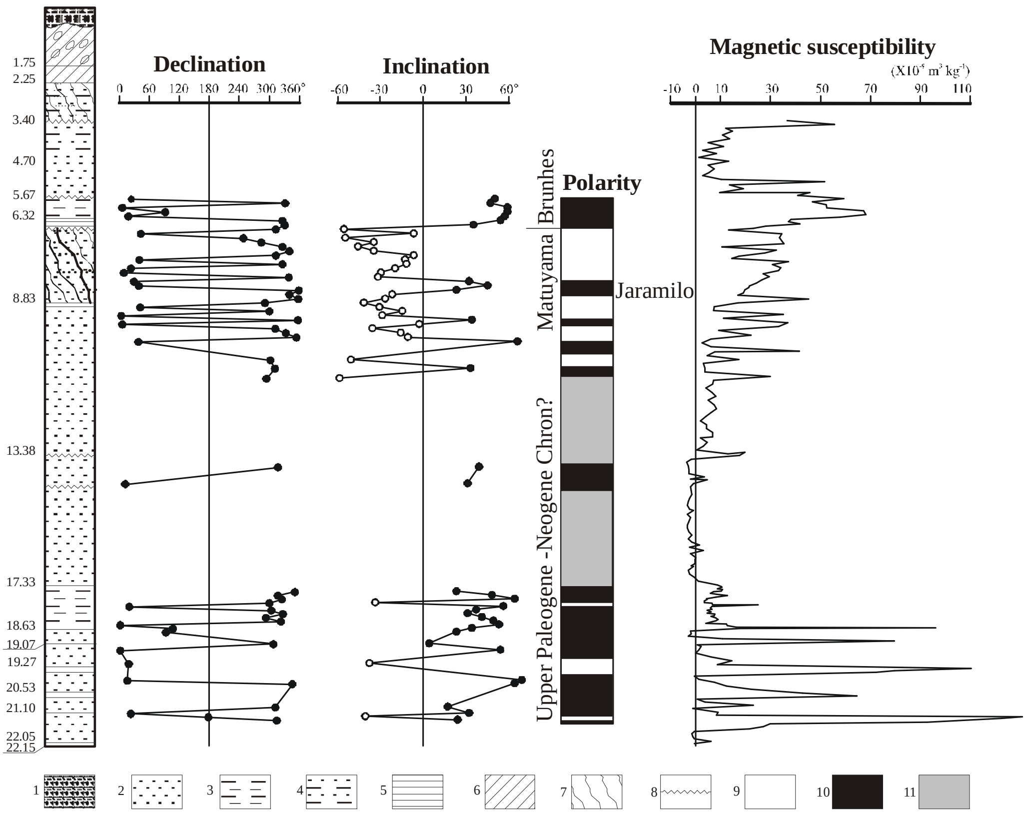

Fig. 2. Lithology and data of palaeomagnetic investigations of the Šlavė-2 section: 1 – soil; 2 – sand;3 – silt; 4 – silty sand; 5 – clay; 6 – till; 7 – sediments with disturbed structure; 8 – unconformity. Polarity: 9 – normal, 10 – reversed; 11 – area of palaeomagnetic data gap.

GEOMORPHOLOGICAL LOCATION AND STRATIGRAPHICAL INTERPRETATION OF THE FLUVIAL DEPOSITS OF THE BELAYA RIVER BASIN (SOUTHERN FORE-URALS)

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In the Southern Fore-Urals region, erosional processes weither they are fluvial or deluvial were playing a leading role in the sedimentation during the Neogene (Pliocene) and the Quaternary periods.

In the studied territory, the river network started to develop in the late Miocene and early Pliocene, when the regression of the Caspian Sea and the tectonic movements related with the active drainage of the Paleo-Volga, Paleo-Urals and their tributaries (Yakhemovich et al., 1970; Rozhdestvensky, 1971). Nowadays, the orientation and the location of the major river valleys of the Caspian basin follow broadly the same ancient deepened river system. During the middle Aktschagylian (2.6 Ma) the ingression of the sea invided the Volga – Kama – Belaya, Sakmara and Ural river systems up to the Southern Urals. Resulting in a large flooding of the valleys. The Quaternary period is characterized by the development of the hydrographic network which reoccupied the past river valleys. The Pliocene to Quaternary development of the hydrographic network is reflected by the building of the river terraces.

The Fluvial deposits are widely developed, and can be found in landscapes showing a different origin; they were generated during the glacial or interglacial epochs as well. As a result the structure of the alluvial complex reflects the rhythm of the warm-cold climate alternations. Alluvium represents a link between the glacial and marine sediments and forms together a continuous paragenetic series of the same age.

The alluvial deposits represent the basic element in the development of the local stratigraphic scheme and for the comparison with other genetic types of Quaternary sediments. They are important in the study of the palaeogeography and tectonic movements (Danukalova, 2010).

Nowadays the best preserved terraces are located in the lower stream of the Belaya River, this area is the key site for the understanding of the development of the stratigraphic scheme of the whole region. The complete set of terraces is represented by three above flood plain terraces, high and low flood plain. Very often the II above flood plain terrace is absent. The lack of continuity can explained by the weathering and by the the sedimentation of slope deposits above the high terraces (Rozhdestvensky, 1971). High terraces have lost their importance as geomorphological levels. All terraces were formed during the Neopleistocene and the Holocene. The formation of the flood plain landforms continues nowadays.

The analysis of numerous published and unpublished materials and of some field data permitted to establish the conditions of occurrence and the stratigraphic relationships existing in the Quaternary alluvial deposits (Danukalova et al., 2010) (tab.).

The high and low flood plains are forming in the Holocene. The high flood plain is characterized by two levels (low and high). The basal fluvial facies and the overlapping of its flood plain reflect respectively the warm-humid and the cold periods. These facies form the I-III above flood plain terraces. Terraces of the beginning of the Middle and of the Lower Neopleistocene are absent probably because of erosion. Alluvium of this age rest in the valley depressions or form the base of the terraces in the areas of local tectonic deformation or of diapir uplifts. The high banks of the valleys and slopes of the interfluves are covered by Eopleistocene and Pliocene sediments which are resting directly on the Palaeozoic bedrock forming the post-Aktschagylian surface of leveling.

References

G.A. Danukalova, 2010. The Refined Quaternary Stratigraphic Scale of the Cisuralian Region and Main Events in the South Urals. Stratigraphy. Geological Correlation 18 (3), 107–124.

A.P. Rozhdestvensky, 1971. Neotectonics and relief development of the Southern Fore-Urals. Nauka Press, Moscow (in Russian).

V.L. Yakhemovich, 1958. Quaternary deposits of the low river terraces of the Bashkirian Fore-Urals. In: Cenozoic of the Bashkirian Fore-Urals. V. 2. Part 1. BFAN USSR press, Ufa (in Russian).

V.L. Yakhemovich, V.K. Nemkova, N.P. Verbitskaya, V.P. Sukhov, G.I. Popov, 1970. Stages of the geological development of the Bashkirian Fore-Urals during Cenozoic. In: Yakhemovich, V.L. (Ed.), Cenozoic of the Bashkirian Fore-Urals. V. 2. Part 3. Nauka Press, Moscow (in Russian).

A.I. Zhamoida, L.Ch. Girshgorn, O.P. Kovalevsky, A.N. Oleynikov, E.L. Prozorovskaya, L.S. Margulis, A.N. Khramov and V.K. Shkatova, 2006. Stratigraphic Code of Russia. Third edition. VSEGEI-Press, Sankt Petersburg 96 pp. (Interdepartamental Stratigraphic Committee) (in Russian).

General Stratigraphic scheme (Zhamoida et al., 2006)				Regional stratigraphy: Southern Fore-Urals (Danukalova, 2010)			According to Yakhemovich, 1958	According to Rozhdestvensky, 1971	According to the author's interpretation	
System	Superdivision	Division	Link	Superhorizon	Horizon		Geomorphological location	Geomorphological location	Geomorphological location	
Quaternary	Holocene	Holocene			Agidel	Upper	Flood plain	Flood plain terrace	Low flood plain terrace	
						Middle	I terrace		High flood plain terrace (well preserved)	
						Lower		I above flood plain terrace		
	Pleistocene	Neopleistocene	Upper	Valdai	Kudashevo		II terrace and upper part of the III terrace		I above flood plain terrace (well preserved)	Upper part
					Tabulda					Lower part
					Saigatka		Main part of the III terrace	II above flood plain terrace	II above flood plain terrace (almost eroded)	Upper part
					Kushnarenkovo					Lower part
			Middle	Middle Russia	Elovka		IV terrace (in Fore-Urals), It is eroded at the plain and can be seen in the base of the low terraces		III above flood plain terrace (sometimes surface of this terrace is located at the level of the I above flood plain terrace	Upper part
					Klimovka		Lower part of the IV terrace located below the level of the modern rivers or in the base of the low terraces (in the case of uplifted area)	III above flood plain terrace		Lower part
					Larevka		Alluvium in the overdeep valleys and sometimes in the base of the terraces (in mountains)		IV above flood plain terrace (eroded). sometimes its deposits could be seen in the base of the terraces	Upper part
					Belaya			IV above flood plain terrace		Lower part
			Lower		Chusovskoi				Alluvium of the overdeep valleys and could be seen in the base of the terraces	
				Chui-Atasevo	Atasevo					
					Tanyp					
					Baza					
					Minzitarovo		These deposits cover alluvial deposits of the V terraces and interfluves		Alluvium of the overdeep valleys	
		Eopleistocene	Upper		Oktyabrsky					
				Karmasan	Blagovar				These deposits cover Pliocene and interfluves	
					Dombarovka					
			Lower	Davleka-novo	Khlebodarovka		Vth terraces and interfluves			
					Udryak					
				Dema	Raevka					
					Tyulyan					

Scheme of the stratigraphical and geomorphological position of the Quaternary alluvial deposits of the Southern Fore-Urals

BIOSTRATIGRAPHICAL CHARACTERISTIC OF THE HOLOCENE DEPOSITS OF THE SOUTHERN URALS REGION

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In the Southern Urals region, the Agidel Horizon is the only deposit of Holocene age. This horizon is subdivided into lower, middle and upper subhorizons.

The Lower Holocene deposits form the lower parts of the high flooded plain terraces and consist of pebble (which can be seen for example the Karlaman site) or of peat which are located in the lower stream of the Belaya river, in the upper stream of the Ik and Dema Rivers (in Tallykulevo, Mullino, Syun'I, Ishkarovo, Abdullino or Ishbulatovo sites). Those Lower Holocene deposits also represent the basic horizons of the unconsolidated deposits of the caves (see for example the Bajslan-Tash and the Nukatskaya caves et al.). The Mullino site corresponds with the stratotype site and the Bajslan-Tash site represents the parastratotype site of the Lower Holocene subhorizon.

The Molluscs fauna of the Early Holocene is represented by 17 terrestrial species and 31 freshwater species. The variety and quantity of the terrestrial species increase when compared with the Late Neopleistocene interval.

Small mammal remains in the Lower Holocene deposits of the Southern Fore-Urals are not numerous. Steppe species such as *Ochotona pusilla*, (Pallas), *Allactaga major* (Kerr), *Cricetulus migratorius* (Pallas), *Allocricetulus eversmanni* (Brandt), *Eolagurus luteus* (Eversmann), *Lagurus lagurus* (Pallas), *Microtus gregalis* (Pallas) and near-water species characterize these faunas. Rare *Dicrostonyx torquatus* (Pallas) continued to live at that time. The small mammal faunas of the Trans-Urals area are mainly characterized by steppe species and *Dicrostonyx* was absent.

Large mammal fauna of the Early Holocene were transitional fauna between the Mammoth complex and the Holocene complex. *Bison priscus* continued to live in the Southern Urals region.

The Early Holocene time is characterized by pine forests with *Picea*, *Betula* and some broadleaved trees admixture; *Artemisia*-Chenopodiaceae-herbage and meadow-steppe associations covered the open areas. The climate was warm.

The Middle Holocene deposits are located in the middle parts of the high flood plain terraces (Uteimullino I, Old Kieshki I, Yukalykul, Ishkarovo sites etc.) and in the middle part of the unconsolidated cave deposits (Bajslan-Tash cave). The Ishkarovo site represents the stratotype site and the Uteimullino I and Old Kieshki I sites correspond with the parastratotype of the Middle Holocene subhorizon.

The Middle Holocene malacofauna is presented by 21 terrestrial and 24 freshwater species which are wide spread in the moderate climate conditions.

Small mammals from the Middle Holocene deposits of the region are known in the mountains and in the Trans-Urals. There, small mammal taxa of the next genera were determined: *Talpa*, *Crocidura*, *Sorex*, Chiroptera, *Ochotona*, *Spermophilus*, *Sicista*, *Allactaga*, *Alactagulus*, *Cricetulus*, *Apodemus*, *Ellobius*, *Eolagurus*, *Lagurus*, *Clethrionomys*, *Arvicola*, *Microtus* and *Mustela*.

The variations in the species composition of the Middle Holocene faunas of the Southern Urals evidence the replacement of the Early Holocene steppe biotopes by the forest biotopes. Part of the mammals of the forest, meadow and near-water species increased. Tundra species were not discovered. The composition of the species and the relationship between the different species of the Trans-Ural faunas didn't change and was similar to the small mammal faunas of the Early Holocene.

The large mammal faunas of the Middle Holocene are known from the cave located in the mountainous part of the Southern Urals. The existence of *Equus ferus ferus* is a characteristic feature for these faunas.

The Floral composition of the complex is characterized by coniferous-leaved forests with the dominance of *Pinus*, *Picea* and *Betula* and by meadow-steppe associations. A large part of the warm-loving broadleaved trees (*Tilia, Quercus, Carpinus* and *Alnus*) is marked in the pollen composition. Herbage spectrum displays a larger variety when compared with the Early Holocene interval. The climate was warm.

The Upper Holocene deposits are located in the upper part of the high flood plain terraces and are represented by the modern soil, form the lower flood plain terrace and the modern flood plain. These deposits are represented by proluvial, lacustrine facies, different kinds of cave and slope deposits (sometimes soliflucted), by cryogenic eluvium, aeolic deposits and technogenic sediments. The Zoren'ka site corresponds with the stratotype site and the Uteimullino I site is the parastratotype of this Upper Holocene subhorizon.

The Late Holocene malacofauna is represented by 22 terrestrial and 22 freshwater species which are wide spread in the conditions of the moderate climate.

At the beginning of the Late Holocene, steppe species were usual in the small mammal faunas in the mountainous part of the Southern Urals. Their contribution started to decrease in the second half of this interval when the small forestal mammal species became wide spread. Steppe species dissapeared at the end of the Late Holocene from the small mammal faunas of the Southern Urals. Forest, meadow and nearwater biotope species constitued these fauna. The sinantrope species *Rattus* sp. appeared in time. Steppe small mammal species characterize the Southern Trans-Urals faunas. The number of *Lagurus lagurus* (Pallas) slightly decreased whisle *Microtus* ex gr. *arvalis* and *Arvicola terrestris* (L.) increased when compare with the Middle Holocene faunas. *Rattus* sp. also appeared in that fauna composition. The totality the Trans-Uralian faunas saved their steppe types.

In the mountainous part of the Southern Urals the large Late Holocene mammal fauna already developed indentical to nowadays species including wide spread *Equus ferus ferus*, *Cervus elaphus* as well as *Rangifer tarandus*.

Pollens of *Pinus*, *Picea* and *Betula* dominated in the Late Holocene spectrums. Part of the broadleaved trees pollen (*Tilia*, *Quercus* and *Alnus*) decreased when compared with the Middle Holocene interval. *Artemisia*-Chenopodiaceae-herbage associations covered the open woodlands. The Climate was warm.

References

G.A. Danukalova, 2009. Holocene deposits of the Southern Urals region. In: Kontorovich, A.E. (Ed.), Fundamental Problems of Quaternary: Results and Trends of Further Researches. Proceedings of the VI All-Russian Quaternary Conference, October 19-23, 2009, Novosibirsk. Siberian Branch of Ras Press, Novosibirsk, p. 170-174 (in Russian).

P.L. Gibbard, K.M. Cohen, 2008. Global Chronostratigraphical correlation table for the last 2.7 million years. Episodes 31 (2), 243-247.

C. Ravazzi, 2004. An overview of the Quaternary continental stratigraphic units based on biological and climatic events in Italy. II Quaternario 16 (1 Bis), 11-13.

S.M. Shik, 2004. About project of the regional stratigraphic scheme of the Quaternary of the European Russia. In: Leonov, J.G., et al. (Eds.), Ecology of the Antropogene and the present: nature and a man. Collection of the scientific reports to the international conference (Volgograd – Astrakhan – Volgograd, September 24-27, 2004). Gumanistica-Press, Sankt-Peterburg, pp. 21-26 (in Russian).

V.V. Stefanovsky, 1997. Stratigraphical scheme of the Quaternary deposits of the Urals. In: Explanatory Notes to the Unified Stratgraphic Schemes of the Urals (Mezozoic, Cenozoic). Stratigraphic Committee of Russia Press, Ekaterinburg, p. 97-139 (in Russian).

W.H. Zagwijn, 1996. Borders and boundaries: a century of stratigraphical research in the Tegelen-Reuver area of Limburg (The Netherlands). In: Volume of Abstracts of the INQUA-SEQS Conference "The dawn of the Quaternary", 16-21 June 1996, p. 2-9.

A.I. Zhamoida, L.Ch. Girshgorn, O.P. Kovalevsky, A.N. Oleynikov, E.L. Prozorovskaya, L.S. Margulis, A.N. Khramov and V.K. Shkatova, 2006. Stratigraphic Code of Russia. Third edition. VSEGEI-Press, Sankt Petersburg 96 pp. (Interdepartamental Stratigraphic Committee) (in Russian).

FORAMINIFERAL RECORD AND HIGH RESOLUTION SEISMIC STRATIGRAPHY OF THE LATE HOLOCENE DELTAIC SUCCESSION OF THE OMBRONE RIVER (NORTHERN TYRRHENIAN SEA, ITALY).

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The marine sector between Piombino-Elba Island to the north and Argentario-Giglio Island to the south is dominated by the Ombrone River delta. Such river has a considerable load discharge in comparison to the limited drainage basin area and is responsible for the natural processes of transport and coastal evolution of the entire basin. Its fine sediments are dispersed along a wide area between the Elba Island and the Argentario Promontory. During the last low-stand, the continental shelf was largely exposed and the Ombrone River flowed into the Tyrrhenian Sea several kilometres to the west of the present mouth (Carboni et al., 2005).

The Holocene evolution of the Ombrone delta was characterised by flooding of the coastal plain during the rapid sea-level rise, thus giving rise to brackish marshes or lagoons. Sea-level rise was punctuated by minor still stands, during which the river was able to build fluvio-deltaic bodies into the paleovalley (Bellotti et al., 2004). At the end of postglacial sea-level rise (about 6000 yr BP), the Ombrone River flowed in a large lagoon, partly closed by prograding barrier-beaches (Bellotti et al., 2004). Sediment deposits referable to Etruscan-early Middle Ages (2800 to 700 yr BP), are considerable, as fluvial supplies were very high during cool-humid periods. At 700 yr BP, sedimentation values were low because of anthropic impact on this area (Bellotti et al., 2004). From 500 to 200 years BP, a new phase of high sedimentation rate started, related to a cool-humid climatic oscillation kwon as the Little Ice Age (LIA) coinciding with the maximum progradation of the delta. Successively an erosive phase affected the delta area caused by a decrease in solid supply, related to human actions (dams, wetland reclamations) or to a rainfall decrease.

The submarine portion of the Ombrone River delta can be subdivided into delta front and prodelta slope. The prodelta slope develops between 20 m and about 90-100 mwd.

Single-channel, very high resolution seismic profiles show three distinct seismic units (A, B and C), overlying the LGM unconformity, and formed during the last sea-level rise and highstand. The most recent unit (unit A) has a distinct seismic facies characterised by high-amplitude and high-continuity reflectors generally affected by soft-sediment deformation (creep). This unit formed during the highstand phase and covers almost all the shelf area, exceeding 46 m in thickness off the Ombrone River mouth. It can be subdivided into several sub-units (at least six) possibly related to distinct phases of delta construction. Unit B lies above unit C and is characterised by a transparent seismic facies. It is distributed over the shelf with thickness of about 10-14 m and possibly formed during the late transgression-early highstand, before the construction of the wave-dominated delta.

In this study we discuss temporal and spatial distribution patterns of the benthic foraminifera collected in cores comprising sediments of Holocene age. The specific aim of this paper is to document the paleoenvironmental changes in the Ombrone River delta area, by comparison with appropriate modern analogues. In this area, recent benthic foraminiferal assemblages have been extensively studied and a bathymetrical zonation parallel to the coast was defined (Frezza and Carboni, 2009). The quantitative and qualitative changes in foraminiferal assemblages reflect the impact of factors as organic matter and oxygen content, sediment type, and presence of seagrass.

Seven cores collected in 1996 on the delta front (11-25.1 mwd) and on the outer continental shelf (76.4-105 mwd), were considered in this study. The cores mainly sampled sediment of unit A. The upper part of unit B was found only in one case.

Two radiocarbon dates from core NK2 and one from NK3 were performed at the CEDAD (University of Salento, Italy). The analyses were carried out on benthic foraminifera at the bottom (sample NB1) and at -32.5 cm (sample NB16) of the core NK2, and at -136.5 cm (sample NC14) of the core NK3. All the results showed Late Holocene ages: NB1: 2815±100 cal yr BP; NB16: 302±45 yr BP; NC14: 656±93 cal yr BP.

The micropaleontological analysis was carried out on a total of 96 samples. The Q-mode Hierarchical Cluster Analysis (HCA) was applied to the results of quantitative analysis. The samples of the 4 cores from the delta front were considered into a single statistical analysis, whereas the 3 cores from the prodelta slope-continental shelf were analysed separately. On the whole, seven clusters were recognised by the HCA. Each cluster is characterised by rather homogeneous foraminiferal content, which may be considered as corresponding to a distinct environment, ranging from infralittoral to lower circalittoral zones.

Ammonia parkinsoniana assemblage (20.3-55.4%) was found in 6 samples from the NK7 core and indicates an infralittoral environment characterised by fresh-water input. *Ammonia tepida*, *Elphidium decipiens* and *Elphidium granosum* assemblage was found in 23 samples from the cores NK7, NK8, BOK5, and BOK10. This is a typical infralittoral assemblage characterised by taxa normally found in shallow-marine deposits near fluvial deltas, and it is comparable to the modern *Ammonia* spp. and *Elphidium* spp. assemblage (Frezza and Carboni, 2009). *Bolivina catanensis* assemblage (9.3-16.7%) was found in six samples from core NK8 and it is characterised by a dominance of *Bolivina* spp. (17.3-29.7%), that could be representative of relatively prolonged periods of dysoxia at the sea bottom. In the recent sediments of this area *Bolivina* spp. assemblages are not present. However, core NK8 was collected very close to the Ombrone mouth, whereas no recent samples studied by Frezza and Carboni (2009) were located in the same area. *Valvulineria bradyana* “high dominance” assemblage, comprising 10 samples from core NK4, is dominated by *V. bradyana* with very high percentages (56.2-72.4%), denoting stressed environmental conditions, related to very elevated input of organic matter by the Ombrone River. This foraminifer shows an opportunistic behaviour in organic matter enriched sediments, and it dominates assemblages corresponding to a transition between infralittoral and upper circalittoral environment, in the Mediterranean areas characterised by the presence of river mouths. *Valvulineria bradyana* “low dominance” assemblage consists of 10 samples from core NK2, 9 from core NK4, and 4 from core BOK10. *Valvulineria bradyana* is the dominant species, but with percentages lower than 50% (11-49%). The structure of this assemblage (as regards the percentages of dominance) allows comparison with the modern association found in the recent sediments (Frezza et al., 2005; Frezza and Carboni, 2009). *Bulimina marginata* and *Melonis* spp. assemblage includes 7 samples from core NK2 and 9 from NK3. These species are characteristic of circalittoral muds with high organic matter, but *Melonis* spp. does not seem to tolerate strong ecological stress. This assemblage is comparable to *B. marginata* assemblage present in recent sediments of the lower circalittoral zone (Frezza and Carboni, 2009). The circalittoral assemblage *Uvigerina* spp. and *Bigenerina nodosaria* is characteristic of 12 samples from the core NK3. *Uvigerina* spp. comprise two species (*U. peregrina* and *U. mediterranea*) recorded from the circalittoral zone and very abundant in bathyal muds, as well as *B. nodosaria*. On the whole, this association shows a high similarity with the circalittoral *U. mediterranea* assemblage, today present in front of the Ombrone River delta, at water depths exceeding 100 m (Frezza and Carboni, 2009).

References

P. Bellotti, C. Caputo, L. Davoli, S. Evangelista, E. Garzanti, F. Pugliese and P. Valeri, 2004. Morpho-sedimentary characteristics and Holocene evolution of the emergent part of the Ombrone River delta (southern Tuscany). Geomorphology, 61, 71-90.

M.G. Carboni, L. Bergamin, L. Di Bella, B. Landini, L. Manfra and L. Vesica, 2005. Late Quaternary paleoclimatic and paleoenvironmental changes in the Tyrrhenian Sea. Quaternary Science Reviews, 24, 2069-2082.

V. Frezza and M.G. Carboni, 2009. Distribution of recent foraminiferal assemblages near the Ombrone River mouth (Northern Tyrrhenian Sea, Italy). Revue de micropaléontologie, 52, 43-66.

V. Frezza, L. Bergamin and L. Di Bella, 2005. Opportunistic benthic foraminifera as indicators of eutrophicated environments. Actualistic study and comparison with the Santernian middle Tiber Valley (Central Italy). Bollettino della Società Paleontologica Italiana, 44, 193-201.

LATE PLEISTOCENE EOLIANITES IN THE AEGEAN: PALAEOENVIRONMENTAL INFORMATION AND SEA-LEVEL RELATIONSHIP

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Thin layers of yellowish calcareous sandstone are a common feature in many areas of the Aegean (e.g. Fytrolakis & Papanikolaou, 1979). They are rich in marine bioclasts and have been interpreted either as shallow marine sediments or aeolian sandstone, with obvious contrasting implication for sea-level reconstructions. We have investigated this type of sandstone on the Cycladic islands of Antiparos and Despotiko in the central Aegean. On these islands, yellowish calcareous sandstone occurs in many coastal outcrops and it is also found as up to a few meters thick sheets covering metamorphic rocks of the Attic-Cycladic Crystalline of the Central Hellenides. In some localities more than 1 m thick terra rossa type paleosol is preserved below the sandstone. The calcareous sandstone preferably fills pre-existing relief of the underlying crystalline, therefore the thickest occurrences are found in intermittent creeks. The sandstone can be mapped from below sea-level up to more than 110 m altitude. There are abundant occurrences in almost every part of the investigated islands, but they are most common in the north and northwest parts. Generally, the sandstone layers and the internal lamination are parallel or at shallow angles to the slopes of the underlying crystalline without forming any morphological terraces. In some cases continuous layers of the sandstone can be traced for more than 20 m altitude. Cross-bedding has been observed in very rare cases and usually dips steeply towards the SE.

The calcareous sandstone (in Greece commonly called "lithos poros") is strongly dominated by marine bioclasts (Corallinaceae, foraminifera, gastropod and bivalve fragments, etc.) with siliciclastic components hardly exceeding 20%. The grains are well-rounded and well-sorted in the medium sand to coarse grain sizes. Terrestrial gastropods have been found in some places, of which two samples gave calibrated radiocarbon ages between 31500 and 43000 B.P.

Several vertebrate tracks and trackways have been found in two outcrops on Antiparos (Bickel, 2011), comparable to those on the islands of Mallorca and Sardinia, both in age and size. Tracks have been found on bedding surfaces and in cross-section, where tracks are concentrated along certain horizons; the tracks are up to 11 cm wide and 4 cm deep. Track morphologies suggest that the traces may have been produced in moist sand. On bedding surfaces at least two distinguishable trackways are recorded. Due to overlapping tracks and weathering, the differentiation between *manus* and *pes* impressions is challenging. This situation and the relatively short length of individual trackways (<1.50 m) make stride and pace measurements difficult. The track morphologies (e.g. preservation of a cloven hoof track) and trackway sizes indicate an artiodactylous mammal in the size range of a goat, deer or antelope as producer. There is no evidence for the presence of goats in the Cyclades during the Pleistocene (Masseti, 2009), but fallow deer is proven at least for the Neolithic period by bone remains found during rescue excavation in the Antiparos Cave, (Ψάθη, 2006).

Based on the sandstone altitude distribution, sedimentary structures (e.g. pin-stripe lamination, high-angle cross bedding, rhizoliths, vertebrate trackways and occurrence of terrestrial gastropod shells) we conclude an aeolian origin of this sandstone. Horizons containing dm-sized, angular metamorphic clasts within well-rounded and well-sorted aeolian layers point to interaction of wind-blown and hill slope processes. Therefore these sediments are interpreted as sand ramps (e.g. Bateman et al., 2012) that formed during periods of increased aeolian activity during the late Pleistocene. Common rhizoliths and some traces of small tree trunks indicate the influence of vegetation during dune formation, which is also a common feature in sand ramp deposits.

The global sea-level at the time of the deposition, indicated by radiocarbon data, was about 60 to 100 m below the present one (Caputo, 2007). According to modern day bathymetry this resulted in a shift of the coastline at least 4 km away from the present position and the exposure of a large flat area of the Cycladic shelf – the probable source of the bioclasts of the investigated eolianites. Submerged archaeological remains around the investigated islands indicate >0.5 mm/year of local subsidence additional to the global sea-level rise (Draganits, 2009). Thus the combination of the present altitude range of the eolianites with the lowered sea-level during the time of their formation indicates that the marine bioclasts have been blown more than 150 m uphill.

The comparison of the late Pleistocene eolianites with modern dunes shows considerable differences. Modern aeolian dunes on the investigated islands are very rare, always related to sandy beaches and they hardly can be found above 10 m altitude. Modern dunes show quite considerable vegetation cover, they have much smaller grain sizes and low bioclast content compared to the calcareous sandstone. Compared to modern day conditions these differences probably imply an increased windiness during the formation of the late Pleistocene eolianites.

References

M.D. Bateman, R.G. Bryant, I.D.L. Foster, I. Livingstone & A.J. Parosns, 2012. On the formation of sand ramps: A case study from the Mojave Desert. Geomorphology, 161-162, 93-109.

L. Bickel, 2011. The Quaternary sediments of NW-Antiparos (Aegean): Lithostratigraphy and depositional environment. Master´s thesis, University of Vienna, Vienna, 98 p.

R. Caputo, 2007. Sea-level curves: Perplexities of an end-user in morphotectonic applications. Global and Planetary Change, 57, 417-423.

E. Draganits, 2009. Archaic sanctuary on Despotiko Island (Cyclades): Geological situation, lithological characterization of the building stones and their possible provenance. Austrian Journal of Earth Sciences, 102, 91-102.

N. Fytrolakis & D. Papanikolaou 1979. Some new occurrences of quaternary sandstones in the Cyclades and their paleogeographic importance. Proceedings of the VI Colloquium on the Geology of the Aegean Region 1977, Vol. 1, Institute of Geological and Mining Research, Athens, 459-467.

M. Masseti, 2009. The wild goats Capra aegagrus Erxleben, 1777 of the Mediterranean

Sea and the Eastern Atlantic Ocean islands, Mammal Review, 39(2), 141-157.

E. Ψάθη, 2007-2008. Τα αρχαιοζωολογικά κατάλοιπα από τη σωστική ανασκαφή του σπηλαίου Αντιπάρου: Τα δεδομένα από το υλικό των προϊστορικών στρωμάτων. Αρχαιολογικά ανάλεκτα εξ Αθηνών, 40-41, 25-40.

RELATIVE SEA-LEVEL CHANGE IN THE CENTRAL ADRIATIC DURING THE LAST 1.5 KA YEARS

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On the particularly exposed sites on rocky coasts of the Central Adriatic islands (Vis, Ravnik and Biševo) in Croatia, biogenic littoral rims built by the coralline rhodophyte *Lithophyllum byssoides* (formerly known as *L. lichenoides*) were found. They were mapped, measured and sampled for ^{14}C dating. The presence of thick and well-developed *Lithophyllum* rims, considered to be precise (±10 cm) sea-level indicator (Laborel, 1986; Laborel et al., 1994), points directly to the rising sea-level environment. Here we present new sea-level reconstruction for the past 1.5 ka years based on this biological indicator.

The obtained results revealed four phases of sea-level changes. The sea-level was near stable from around 1400 till 1170 cal BP, in the Dark Ages Cold Period (DACP), then during the Medieval Climate Anomaly (MCA) 1170 till 620 cal BP the sea-level increased at a rate of 0.71 mm/yr. During the Little Ice Age (LIA) 620 till 310 cal BP it was near stable again. Later, the sea-level started to rise at a much speedier rate particularly during the Current Warm Period (CWP). These data were compared with predictions derived from a glacio-hydro-isostatic model associated with the Last Glacial cycle (Lambeck et al., 2004; Lambeck and Purcel, 2005). If the isostatic-eustatic component is separated, this area reveals almost stable tectonic conditions during the past 1500 years.

Our results show that large algal rims grew during near-stable sea-level conditions that occurred during two relatively colder periods in the past 1500 years. They also reveal that well-developed (up to 1.8 m wide) upper levels of algal rims were formed during the ~300 years of stabilisation during the LIA, which also corresponds to the time needed for the formation of the tidal notch that is widespread and slightly submerged today. The obtained results have been also compared with archaeological markers, e. g. submerged port remains of the ancient Issa harbour on the island of Vis (Faivre et al., 2010) and other available data along the Croatian coast.

References

Faivre, S., Bakran-Petricioli, T., Horvatinčić, N., 2010: Relative Sea-Level Change during the Late Holocene on the Island of Vis (Croatia) – Issa harbour archaeological site, Geodinamica Acta, 23/5-6, 209-223.

Laborel J., 1986: Vermetid gastropods as sea-level indicators, in: van de Plassche O. (Ed.), Sea-Level Research: A Manual for the Collection and Evaluation of Data, Geo Books, Norwich, Amsterdam,. 281-310.

Laborel J., Morhange C., Lafont R., Le Campion J., Laborel-Deguen F., Sartoretto S., 1994: Biological evidence of sea-level rise during the last 4500 years on the rocky coasts of continental southwestern France and Corsica, Marine Geology 120, 203-223.

Lambeck K., Antonioli F., Purcell A., Silenzi S., 2004: Sea-level change along the Italian coast for the past 10,000 yr. Quaternary Science Reviews 23, 1567–1598.

Lambeck K., Purcell, A., 2005: Sea-level change in the Mediterranean Sea since the LGM: model predictions for tectonically stable areas, Quaternary Science Reviews 24, 1969–1988.

GLACIAL SEQUENCE AND STRATIGRAPHY OF THE SALZACH FORELAND GALCIER BASIN (SOUTHERN GERMANY) – REVEALED BY NEW MAPPING, DRILLING AND DATING

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In the context of a geological mapping programme of the Bavarian Environment Agency (LfU) sediments of the Salzach glacier area in southern Germany have been investigated. Complementary to surface mapping a deep research drilling was undertaken. Continuous coring reached the base of the Quaternary in more than 110 m below surface. Geological and geophysical logging, sampling and dating attempts of the core material have been conducted and revealed some details from the local sedimentation history of glacial advances and retreats in the Salzach glacier basin. A first glacial till is documented directly on top of the hardrock surface in the very bottom of the basin. Because of its dominantly fine material the till is considered to be a water lain till. The age is hitherto unknown. Thick piles of lake sediments above the water lain till are tentatively attributed to the time before 200 000 years (MIS 7 and older). A strong discontinuity separates the older lake sediments in the lower part of the basin from younger lake sediments and a coarse gravelly but partly diamictic infill in the upper part of the basin. Dating and pollen analysis assigned the coarsening upwards sequence (from fine lake sediments to coarse fluvial gravels) to a deposition during the last glacial cycle. Whether the diamicts from early last glacial time are of glacial origin or not is still a matter of discussion. The last glacier maximum lodgement till finally covers the drilled sequence on the very top. This upper most till is connected with drumlin formation on the surface of the Salzach glacier basin area. Further investigations are in progress (e.g. paleomagnetic analysis). A discussion and comparison with glacier sequences from other glacial basins of the circum Alpine area is intended.

THE AGE OF AN ARCHEOLOGICAL ARTEFACT BEARING PLEISTOCENE FLUVIAL DEPOSIT AT HAPPISBURGH SITE 1, NORFOLK, UK.

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A fluvial deposit (part of the Cromer Forest-bed Formation) occurs below the modern beach between Happisburgh and Cart Gap in Norfolk, UK. In places the channel is overlain by the Middle Pleistocene Happisburgh Till (the lowest member of the Happisburgh Formation). This locality has been called Happisburgh Site 1.

The discovery of a handaxe in the channel deposits in 2000 prompted an AHOB (Ancient Human Occupation of Britain) team to undertake an excavation in 2004. The result was the recovery of a small worked flint assemblage. Coleoptera remains suggested cooler conditions at the time of deposition than prevail in south-eastern England today. Cut marks on bone indicated butchery had taken place and the presence of *Arvicola* molars pointed to an age of between 500 to 600,000 years old.

In 2009 a team from Leiden University, The Netherlands began to dig at the Happisburgh Site 1 in collaboration with AHOB project members. The aims were to expand what was known about the geography of the channel deposits and their stratigraphy, examine the sedimentological setting, undertake a palaeomagnetic study, recover more artefacts, and undertake a palaeoenvironmental investigation (with a palaeobotanical bias). Preliminary results from the excavations have contributed to the debate about the age of the fluvial deposits which, of course, has implications for the understanding of hominin ecological tolerance, biogeography, and the timing of hominin presence in northwestern Europe. These initial results will be presented.

Work on the Happisburgh Site 1 site is on going and another field season has just been completed in July 2012.

Field, M.H. In press. The first British record of *Actinidia faveolata* C.Reid & E.M.Reid. *Quaternary International.*

STRATIGRAPHIC AND MORPHOLOGIC EVIDENCE OF THE HOLOCENE EVOLUTION OF THE ITALIAN AND SLOVENIAN WATERS (NORTHERN ADRIATIC)

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The seabed of the northernmost part of Adriatic Sea is a key area to understand the processes related to Holocene sea-level and climatic variations. This zone, which lies between Istria Peninsula, Karst and the Friulian Plain, is divided between Italian, Slovenian and Croatian territorial waters and this administrative fragmentation has strongly limited international cooperation in the past. In May 2012 a team of Italian and Slovenian researchers, on-board of the research vessel “Urania”, surveyed the shelf between Italian and Slovenian coasts. During cruise, named NAD2012, about 400 NM of CHIRP-sonar seismo-acoustic profiles were acquired in the whole area and 10 gravity cores were collected in the Italian waters. The new data gathered during NAD2012 cruise allowed for the first time to observe in continuity the stratigraphic transition from the alluvial plain of Friuli to the rocky coast of Istria. A robust chrono-stratigraphical framework of the general setting of the Northern Adriatic shelf is supported by the geophysical, bathymetric and stratigraphic data collected during cruises VE2004 and VE2005, that led to the production of the geological map of the Italian seabed, northern of Po river mouth (Trincardi et al., 2011).

In the last years Harpha Sea carried out a multibeam bathymetric survey of the Slovenian Waters, leading to the production of a very high-definition DEM. This is revealed as a fundamental tool for understanding the sea-floor morphologies and to plan the acquisition of the new seismo-acoustic profiles during NAD2012.

The area between Monfalcone and Piran Bay is characterized by a mud-dominated body consisting of Holocene marine deposits, with a maximum thickness of about 25 m in Piran Bay and that thins toward the Friulian coast, where the delta system of Isonzo (Soča) River is present. The marine sedimentary body seals the alluvial plain that occupied the area until ca. 7.5 ka BC, when sea-level rise led the Adriatic to re-occupy the Gulf of Trieste (Ogorelec, 1981; Covelli et al., 2006; Trincardi et al., 2011). The evolution of the investigated area is constrained by a main threshold corresponding to the deep morpho-structural depression existing in front of Savudrija Promontory. Connected to the first depression, some very large submarine dunes characterize the NW corner of Slovenian boundary, and their origin seem to be related to main stream entering in the northernmost Adriatic sector with a counterclockwise direction. Another shallower but important erosional scour is present in front of Piran Promontory.

The ancient alluvial plain is characterized by a complex network of fluvial ridges, with a general ENE-WSW direction, fed by the valleys draining Karst and Istria; moreover the DEM highlight an incised meandering paleochannel, recognizable from the Italian shelf to Koper Bay, partly sealed by the deltaic progradation of the Isonzo River.

References

S. Covelli, G. Fontolan, J. Faganeli, N. Ogrinc, 2006. Anthropogenic markers in the Holocene stratigraphic sequence of the Gulf of Trieste (northern Adriatic Sea). Marine Geology, 230, 29-51.

B. Ogorelec, M. Mišič, M., A. Šercelj, F. Cimerman, J. Faganeli, P. Stegnar, 1981. The sediment of the saltmarsh of Sečovlje. Geologija 24, 179–216.

F. Trincardi, A. Argnani, A. Correggiari, 2011. Note illustrative della Carta Geologica dei Mari Italiani alla scala 1:250.000 – Foglio NL 33-7 Venezia.S.EL.CA., Firenze, 151 pp.

PALAEOENVIRONMENTAL CHANGES RECORDED IN THE SEDIMENTARY ARCHIVE OF THE COASTAL LAKE SAKI (WESTERN CRIMEA) AND THE BLACK SEA LEVEL FLUCTUATIONS DURING THE HOLOCENE

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The lake Saki is a former lagoon of the Black Sea. It is located in the steppe area adjacent to the Crimean Mountains. Marine sediments recovered at the bottoms of the Saki cores, are overlain by mineralized lake deposits with fine lamination of dark clay bands (the result of runoff during wet seasons) and white salt layers (summer evaporites). The seasonal origin of the lamination has been suggested, and, on the basis of varve counts, it has been shown that the lake separation from the sea had happened 5444 ka BP (Shostakovich, 1934). In the new borehole (45°07'N, 33°33'E), varve deposition had started following 5380-5530 cal yr BP, ^{14}C AMS (Subetto et al., 2009). Within the Russian-Ukrainian research project ("Palaeogeography and climate of the North Black Sea during the Holocene", 2009-2010), the study of this borehole included lithology, pollen, quartz micromorphoscopy, magnetomineralogy and palaeomagnetic analysis. The magnetostratigraphy of the Saki Lake deposits corresponds well to the Holocene magnetochronological framework of West Europe (Turner and Thompson, 1981) and NE Europe (Bakhmutov, 2006). Paleosecular geomagnetic variations, together with ^{14}C AMS dates, have been used in order to establish the chronology of the Saki sequence. Multiple environmental oscillations which happened during formation of the studied sediments have been reconstructed. They are compared with the Black Sea level fluctuations revealed by the marine geologists (Balabanov, 2007; Konikov et al., 2007).

During the ***Late Atlantic climatic optimum***, the Early Novochernomorean transgression of the Black Sea occurred, and the sea gulf existed in the place of the lake Saki. Marine mollusks are abundant in the corresponding deposits, all quartz grains originate from water environment, and magnetomineralogical parameters of the sediments are exceptionally high, as well as the pollen counts of arboreal and broad-leaved taxa. The gulf was surrounded by the forest-steppe. This indicates that the climate was wetter and warmer than nowadays. At the end of this phase, the gulf was separated from the sea and became shallow (intense carbonate accumulation and strong chemical weathering of the quartz grains surfaces). The forest-steppe was replaced by mesophytic steppe. The warm climate became less wet. ***At the end of Atlantic*** (4643±41 – 4684±37 uncal yr BP), the climate was cool as it is evidenced by a significant decrease in pollen counts of broad-leaved trees. Magnetic mineralogy shows a decrease in precipitation of the finest clay fraction, and quartz grain morphoscopy indicates the very low aeolian activity and an increase in runoff. The regression of the Black Sea occurred 4800-4600 yr BP (Balabanov, 2007).

The following warm phase is marked by pollen appearance of thermophyllous *Tilia platyphyllous, Hedera helix, Cornus mas*, and an increase in magnetic susceptibility of the lake deposits. Quartz grains with fluvially reworked surface dominate. This phase coincides with high stands of the Black Sea 4500-4300 yr BP. At the end of the ***Early Subboreal*** (prior to the palaeomagnetic event of 4000 yr BP), *Pinus* and *Alnus* strongly dominated (or pollen productivity of broad-leaved species was low), and the steppe became mesophytic. This can be an evidence of a cool and wet climatic phase. Quartz morphoscopy indicates the stable sedimentation regime in the lake. The regressive phase is shown at this time (4200-4000 yr BP) both in NW and NE parts of the Black Sea. The ***Middle Subboreal*** started with a phase of warm and dry climate: grassland with halophytic associations in the plain, predominance of oak in the mountain forest, and intense salt accumulation in the lake. A short cool and wet phase has occurred prior 3630±90 uncal yr BP as it is evidenced by a prominent decrease in pollen percentages of herbal xerophytes and broad-leaved trees, as well as in pollen appearance of wet-loving *Fagus, Hedera, Humulus*, and *Viscum*. The strongest aridification started following 3630±90 uncal yr BP (predominance of *Artemisia* pollen, huge amount of quartz grains which surface was reworked by aeolian processes, and abundant microcrystals of gypsum). The magnetic parameters of these deposits show that the lake became very shallow. The dry steppe occupied the plain, reduction of forest occurred in the mountain foothills, the lake dried up frequently, and aeolian processes were the most intense during the whole period studied. This phase corresponds to high stands of the Black Sea during the Dzhemetinian (Novochernomorean) transgression. The beginning of the ***Late Subboreal*** is established above the level of the palaeomagnetic event at 3300 yr BP, on the basis of a new increase in pollen percentages of mesophytic herbs and trees (particularly wet-loving *Carpinus betulus* and *Fagus*). It was the last climatic phase when the high humidity provided such an extensive spread of mesophytic herbs in the area. The quartz grains of aeolian origin are absent in the corresponding deposits. On the contrary, the second half of the Late Subboreal (the palaeomagnetic event at 2700 yr BP) was warm and dry. The lake was surrounded by xeric associations from Poaceae and *Artemisia*. In the mountain forest, *Quercus* dominated over the wet-loving trees. This phase coincides with the last peak of the Dzhemetinian transgression (2700-2600 yr BP). In the core, this depth interval is the last one with such high pollen counts of broad-leaved trees. This can be connected with a cooler climate of the Subatlantic, or with human impact. Pollen appearance of Cerealia and *Juglans* at these levels is evidently connected with the Greek settlements on the Black Sea shore.

At the beginning of the ***Early Subatlantic***, the grassland with a low participation of xerophytes existed around the lake. Pollen percentages of Cerealia reach their maximum at the corresponding depth interval. At the level prior to 2360±50 uncal BP, the role of Chenopodiaceae pollen sharply increases, and pollen of *Quercus* disappear. Farming and cutting down the most valuable timber probably were at their peak then. On the contrary, the phase, following 2360±50 BP, was marked by a spread of *Artemisia* steppe in the plain and almost complete disappearance of wet-loving *Fagus* and *Carpinus* in the mountains (the palaeomagnetic event at 2100 yr BP). This arid phase is also traced in the magnetic parameters. The Nymphaean transgression of the Black Sea started at that time (Balabanov, 2007). Pollen of Cerealia have not been found in the corresponding deposits. The first phase of the ***Middle Subatlantic,*** following the palaeomagnetic event at 1700 yr BP, was rather wet and cool. The lake was surrounded by mesophytic steppe, and the role of broad-leaved trees decreased (or their pollen productivity got lower than before). Far-distance transport of *Betula* and *Picea* pollen became noticeable. In the deposits, corresponding to the “Medieval climatic optimum” (the palaeomagnetic event at 1100-1000 yr BP, the last phase of the Nymphaean transgression), pollen of broad-leaved trees occur more frequently than before, and Cerealia appear again (the effect of farming in the Late Byzantine settlements of Western Crimea). Magnetic mineralogy shows the last peak in an input of terrigenous material into the lake, the feature which is typical for the transgressive regime. In the deposits of the beginning of the ***Late Subatlantic*** (the palaeomagnetic date of 700 BP), the pollen percentages of *Artemisia* and *Betula* became higher at the expense of a decrease in pollen of broad-leaved taxa. Quartz grains, which surfaces were reworked by aeolian processes, appear again. Thus, in the area studied, the climate of the “Little Ice Age” was arid, particularly around 400 yr BP (based on varve counts). A significant increase in pollen counts of broad-leaved trees marks the beginning of the modern warm phase at the level around 250 yr BP (based on varve counts). At its start, the phase had a drier climate than nowadays: *Artemisia*-Poaceae steppe surrounded the lake Saki then, whereas the mesophytic steppe exists here at present.

Thus, cyclic alternation of warm and cool phases, as well as wet and dry phases during the last 5,500 years is recorded in sedimentary sequence of the lake Saki. The regional ecotones at transition between the steppe and forest-steppe of the mountain foothills appeared to be very sensitive to climatic changes. The direct correlation between temperature and moisture regime is absent, but after 5,000 years, the majority of warm phases were drier than the cool phases. The duration of a phase alters between 200 and 500 years. The climatic oscillations occur through the progressive trend to an increase in climatic continentality from the Atlantic to the “Little Ice Age”. The driest phase occurred though 3600-3300 BP (following 2140-1880 cal yr BC). The Late Atlantic optimum (prior 3380-3530 cal yr BC) was the warmest and wettest phase. Human impact (pollen of Cerealia and *Juglans* from the Greek settlements) appeared ca 750 cal yr BC, and, later on, it regularly increased during the wet phases. In general, warm and cool phases coincide with high and low stands of the Black Sea, respectively. Still in the area studied, the chronology of both marine and lacustrine sedimentary archives needs the further elaboration.

References

V. Bakhmutov, 2006. The connection between geomagnetic secular variation and long-range development of climate for the last 13,000 years: data from NNE Europe. Quaternary International, 149, 4-11.

I.P. Balabanov, 2007. Holocene sea-level changes of the Black Sea. In: The Black Sea Flood Question: Changes in Coastline, Climate and Human Settlement (Eds. V. Yanko-Hombach, A. Gilbert, N. Panin, and P. Dolukhanov), Springer, Dordrecht, p. 711–730.

E.G. Konikov, O.G. Likhodedova, G.S. Pedan, 2007. Paleogeographic reconstuctions of sea-level change and coastline migration on the northwest Black Sea shelf over the past 18 kyr. Quaternary International, 167-168, 49-60.

V.B. Shostakovich, 1934. IIovye otlozhenia ozer i periodicheskie kolebiania v yavleniyah pripody. Zapiski Gosudarstvennogo Gydrogeologicheskogo Instituta, 13, 95-140.

D.O. Subetto, N.P. Gerasimenko, V.G. Bakhmutov, I.Yu. Neustrueva, T.V. Sapelko, D.D. Kuznetsov, N.N. Davydova, A.V. Ludikova, V.F. Stolba, 2009. Rekonstruktsia paleogeografichyh umov Zahidnogo Krymu u piznyomu golotseni za litologichnymy i paleontologichnymy materialamy vyvchennya ozer. Fizychna geografia I geomorfologia, 56, 299-311.

G.M. Turner, R. Thompson, 1981. Lake sediment record of the geomagnetic secular variation in Britain during Holocene times. Geophysics Journal of Research Astronomic Society, 65 (3), 703-725.

FURTHER U-SERIES DATA FROM THE LATE PLEISTOCENE DEPOSITS OF CAPO SAN MARCO (SARDINIA): AN OPEN CHEMICAL SYSTEM OR EVIDENCE FOR A ~70 KA HIGH RELATIVE SEA-LEVEL ?

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In a recent paper, D'Orefice et al. (Alpine & Mediterranean Quaternary 25, 2012) report an apparent ^{230}Th-age of 70±4 ka for a colony of the coral *Cladocora caespitosa* at the well-known site Capo San Marco (e.g., Carboni et al., XXXX). Further measurements in a sample from this site yielded partly convergent information. Three biogenic carbonate remains were sub-sampled. One fragment of the *C. caespitosa* colony seen in the lower-left part of the picture, one fragment of the *Cardium* shell and a small unidentified carbonate tubule from the upper-right filling. It was unclear if the overall sample represented the same depositional unit or if two distinct events might have been recorded here, by each of the sub-units sampled. Following usual procedures (mechanical cleaning, grinding, XRay analysis, spiking & chemical extraction of U and Th), all samples were analyzed on a Triton™ TIMS instrument.

Despite evidence for a relatively open system, data from the *C. caespitosa* colony suggest it assignment to the Marine Isotopic Stage (MIS) 5e. This is in contradiction with the age cited above. The U-content of the two specimens differs: 3.099±0.088 (±1 s) vs. 2.557±0.010.

	[U±2s] ppm	[Th±2s] ppb	(^{234}U/^{238}U) * ±2s	(^{230}Th/^{234}U) * ±2s	^{230}Th-age ±2s (ka)	(d^{234}U)$_0$ ‰
Coral	2.557±0.010	90.6±7.9	1.124±0.006	0.730±0.011	137±4	183±9
Cardium	0.781±0.003	5.968±0.003	1.225±0.007	0.463±0.005	66±1	271±8
Tubule	0.976±0.004	12.37±0.68	1.201±0.008	0.517±0.007	77.4±1.5	250±9

The hypothesis of a diagenetic uptake of U in the apparently "younger" specimen does not stand strong. On one hand, the isotopic signature of this uranium (^{234}U/^{238}U initial activity ratio: 1.15±0.03) points to an authigenic "marine" origin. On another hand, any attempt at correcting the sample age assuming an "authigenic" fraction of about 2.5 ppm vs. 0.5 ppm of recently-uptaken diagenetic U, does not carry the age sufficiently back in time to fit with a MIS 5e assignment. Thus, the most likely explanation for the difference in the authigenic U-content would relate to a significant difference in ambient water paleotemperatures (with much colder waters being present during the precipitation of the 70±4 ka specimen). The two ^{230}Th-ages obtained on biogenic minerals from the upper-right section of the sample, correspond to a diagenetic phase of U-uptake. In the hypothesis of an "early" diagenetic U-uptake phase, the ages obtained would give some support to the presence of marine deposits dating from ~ 70 ka at Capo San Marco, although field/sedimentological evidence for a ~ 50 ka hiatus within the marine sequence of Capo San Marco is lacking. Nonetheless, if the existence of a high Mediterranean sea-level at ~ 70 ka, cannot be considered ascertained based on the above data, convergent information exists about a high sea-level of this age elsewhere (Barbados, Turkey).

THE ARCHITECTURE OF INCISED VALLEY-FILL AS A RECORD OF THE RELATIVE RATES OF SEA-LEVEL RISE AND SEDIMENT SUPPLY

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The deposits of transgressive and highstand systems tracts have the highest preservation potential in incised valleys, which suffer little erosion from storms and are virtually free of sediment removal by alongshore drift. Incised valley-fill successions, therefore, provide a valuable record of the relative rates of base-level rise (accommodation-space creation) and terrestrial sediment supply (accommodation-space infilling). In terms of these two parameters, four scenarios for an incised valley-fill are suggested by previous studies (Fig. 1): (A) a rapid sea-level rise combined with relatively low coarse-sediment supply, resulting in a Gilbert-type bayhead delta prograding slowly in a rapidly aggrading and shallowing prodelta environment (e.g., many postglacial fjord-head deltas); (B) a rapid sea-level rise combined with relatively high coarse-sediment supply, resulting in a quickly prograding Gilbert-type delta; (C) a gradual sea-level rise combined with relatively low coarse-sediment supply, resulting in the classical estuary with a bayhead delta, muddy central basin and an outer barrier/tidal-inlet complex; and (D) a gradual sea-level rise combined with relatively high coarse-sediment supply, resulting in a fluvial-dominated valley-fill. Considering the additional controlling role of climate, syndepositional tectonics, and marine regime, it is rather obvious that this range of basic scenarios may be far from exhausting the natural spectrum of incised valley-fill cases.

It is suggested that, in particular case studies, instead of pigeonholing the case into one of the four categories (Fig. 1A – D) – an attempt should rather be made to distinguish it from these end-members and recognize its own specific formative conditions. A case study from the southern margin of the Corinth Rift, Greece, is presented to show an 'intermediate' type of valley-fill, additionally influenced by syndepositional tectonics (Fig. 1E).

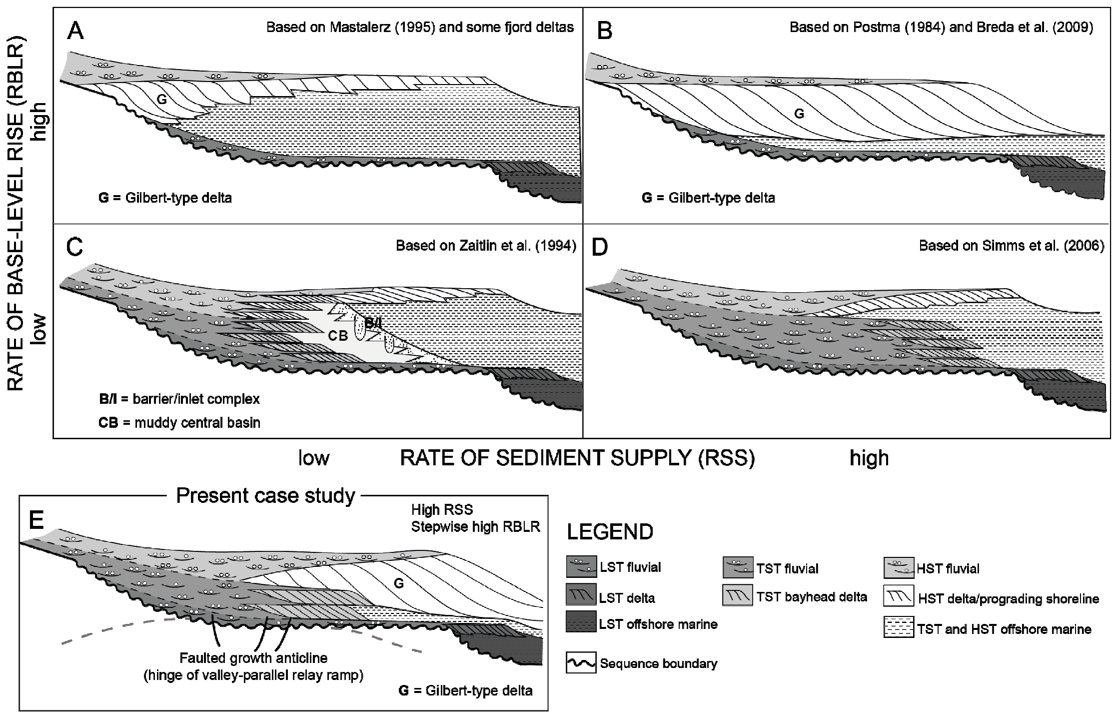

Fig.1. (A−D) Schematic end-member models for incised valley-fill in terms of the relative rates of sediment supply and base-level rise (key references are given in the diagrams). (E) A case-study model from the Corinth Rift's margin, which differs from the end-members by being characterized by a high rate of coarse-sediment supply and a rapid but stepwise relative sea-level rise. The scale is undefined and thought to be a fractal, as the portrayed system scales with the depth ratio of the sediment-supplying stream and the host water basin.

The present study of the Pleistocene Akrata palaeovalley documents a gravelly valley-fill that lacks evidence of tidal activity, shows considerable wave influence and is dominated by bayhead shoal-water deltas succeeded by a Gilbert-type delta. The Akrata palaeovalley was ~3 km long, up to ~2 km wide and at least 120 m deep, incised in similar older syn-rift deposits probably due to the rift margin uplift combined with the OIS 10 eustatic sea-level fall. A stepwise rapid marine invasion drowned the valley, resulting in an infilling in ~30 ka in association with the OIS 7e and 7c eustatic sea-level rises. The age of the valley-fill deposits is estimated from the available chronostratigraphical data (McNeill & Collier, 2004; Rohais et al., 2007) integrated with a new field survey.

The filling of the Akrata valley commenced with a gravelly basal alluvium deposited during the relative sea-level lowstand. The first step of the subsequent marine transgression resulted in a shoal-water bayhead delta comprising mouth bars stacked in a compensational manner, indicating a still limited sediment supply and an autogenic lateral switching of delta distributaries under a rising relative sea level. The second step of rapid marine flooding gave rise to a valley-wide, single-lobe shoal-water delta with a wave-worked front and steeper slope, indicating significant increase in sediment supply. The vertical stacking of the bayhead shoal-water deltas increased the bathymetric relief of the valley. The next step of marine transgression drowned the relief, resulting in a Gilbert-type delta that overstepped the previous ones and reached the valley mouth, while forming the bulk of the valley-fill succession. The advancing delta recorded shorter-term sea-level fluctuations, as evidenced by changes in the delta's brink-zone trajectory and the geometry of its foreset-topset contact.

Since the magnitude of the eustatic sea-level rises OIS 7e and 7c was insufficient to create a 120-m accommodation space (Westaway, 2002), a strong impact of tectonic subsidence is inferred. The formation of a valley-parallel relay ramp is thought to have pinned down the nucleation point of the consecutive deltas and apparently acted as a topographic barrier for marine invasions. As a result, the gravelly alluvium in the upstream segment of the valley was piled up into a monotonous succession combining TST and HST.

All three marine-flooding events were rapid, with a negligible thickness of transgressive deposits, but the stepwise transgression caused a substantial increase in valley-floor relief and prepared the stage for a highstand growth of the Gilbert-type delta. This field case (model E, Fig. 1) would thus represent a variety of the wave-worked, shallow-water fluvio-deltaic system of model D with a stepwise major flooding, turned into the deep-water, Gilbert-type fluvio-deltaic system of model B at sea-level highstand.

References

Breda, A, Mellere, D., Massari, F. and Asioli, A., 2009. Vertically stacked Gilbert-type deltas of Ventimiglia (NW Italy): The Pliocene record of an overfilled Messinian incised valley. Sed. Geol., 219, 58−76.

Mastalerz, K., 1995. Deposits of high-density turbidity currents on fan-delta slopes: an example from the upper Visean Szczawno formation, Intrasudetic Basin, Poland. Sed. Geol., 98, 121−146.

McNeill, L.C., and Collier, R.E.L., 2004. Uplift and slip rates of the eastern Eliki fault segment, Gulf of Corinth, Greece, inferred from Holocene and Pleistocene terraces. J. Geol. Soc. London, 161, 81−92.

Postma, G., 1984. Mass-flow conglomerates in a submarine canyon: Abrioja fan-delta, Pliocene, southeast Spain. In: Sedimentology of Gravels and Conglomerates (Eds. E.H. Koster and R.J. Steel), Can. Soc. Petrol. Geol. Mem., 10, 237−258.

Rohais, S., Eschard, R., Ford, M., Guillocheau, F. and Moretti, I., 2007. Stratigraphic architecture of the Plio−Pleistocene infill of the Corinth Rift: Implications for its structural evolution. Tectonophysics, 440, 5−28.

Simms, A.R., Anderson, J.B., Taha, Z.P. and Rodriguez, A.B., 2006. Over-filled versus under-filled incised valleys: lessons from the Quaternary Gulf of Mexico. In: Incised Valleys through Space and Time (Eds. R.W. Dalrymple, D. Leckie and R. Tillman), SEPM Spec. Publ., 85, 117–139.

Westaway, R., 2002. The Quaternary evolution of the Gulf of Corinth, central Greece: coupling between surface processes and flow in the lower continental crust. Tectonophysics, 348, 269−318.

Zaitlin, B.A., Dalrymple, R.W. and Boyd, R., 1994. The stratigraphic organization of incised-valley systems associated with relative sea-level change In: Incised-Valley Systems: Origin and Sedimentary Sequences (Eds. R.W. Dalrymple et al.), SEPM Spec. Publ., 51, 45–60.

U-Th-Ra SYSTEMATICS AND THE DATING OF LAST INTERGACIAL HIGH SEA-LEVELS

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Amongst methods which may be used for the dating and precise correlation of deposits relating to last interglacial high sea-levels, the U-series dating method stands out. Most other geochronometers (e.g., OSL, fission-track, Ar/Ar dating) lack precision and are not necessarily directly applicable to marine deposits. In principle, modern analytical techniques permit to calculate ^{230}Th-ages with a fairly high precision. Unfortunately, closed chemical systems are rarely secured in such deposits, with the exception of stalagmites directly linked to paleosea-levels. In the general case of marine biogenic carbonates, such as solitary or colonial corals, ^{238}U-^{234}U-^{230}Th and ^{231}Pa/^{235}U data do not permit to assess the closure of the radio-active system with the degree of precision required to estimate age differences of the order of ~10^3 yr, when the time comes to correlate relative sea-level (RSL) data from one site to another. Furthermore, uncertainties of the U-series decay constants already result in an age uncertainty of about 0.5 to ~ 1 ka (2 sigma) depending on the decay constants used, within MIS 5e age ranges. Thus, one must conclude that the precise documenting of temporal offsets between such RSL ages remains practically out of reach. Nevertheless, the assignment of a given high-RSL to a 2 to 3 ka-time window might be possible with a careful assessment of the relative chemical closure of the radioactive system using notably ^{236}Ra/^{230}Th, ^{230}Th/^{234}U and ^{234}U/^{238}U pseudo-concordias, as we intend to illustrate here. Examples include sequential analyses in a multi-growth phase solitary coral of MIS 5e deposits from Sal Island (Cabo Verde), corals from the Barbados MIS 5a/4 high RSL and from Mediterranean MIS 5e deposits.

PRESENT TECTONICS, FLUID DYNAMICS AND CASPIAN SEA LEVEL CHANGE

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The South Caspian is the most active mud volcanic region in the world. Every year up to 1 milliard hydrocarbonaceous gases and millions of cubic meters of mud-volcanic breccia and great amount of oil are discharged into the Caspian Sea during the eruptions. From onshore and offshore mud volcanoes estimations annually erupt more than 109 cubic meters of gases consisting of CH4 (79-98%), and small admixture of C_2H_6, C_3H_8, C_4H_{10}, C_5H_{12}, CO_2, N, H_2S, Ar, He.

The periodicity in eruptions established for a long term interval indicates to a stable dependence of mud volcanism on fluctuations of the Caspian Sea level and seismicity.

Activation of mud volcanism and seismicity in the region corresponds to phases of the Caspian Sea level falls. At the same time, measurements in geodetic test areas and GPS measurements show almost meridional waves of rise and subsidence of block structures in the Caspian region that were responsible for alternating periods of compression and tension in the Caspian Sea depression. The extension phases correspond to sea-level falls. It is remarkable that the rhythms in these vertical movements correlate with phases of seismic and mud volcanism activity, variations in oil and gas production, and sea-level fluctuations.

Recently, reliable and informative data on the periodicity in dynamics of fluid processes were obtained from satellite-based monitoring of Caspian Sea surface. The spectral analysis of the satellite image of the Caspian Sea surface revealed the active fluid dynamics in underwater mud volcanoes and fault. The images clearly show the mass release of hydrocarbons registered as hydrocarbon films (slicks) on the sea surface and changes in water transparency. This cataclysm is related to the seismic, mud volcanic, and solar activation at the end of 2000 beginning of 2001. The South Caspian region experienced several strong earthquakes (M up to 6.8) and a record-breaking number (16) of mud volcanic eruptions at that time. The decrease in the seismic and fluid intensity was synchronous, which is reflected in a self-cleaning of the Caspian Sea water column. This resulted in degradation of the hydrocarbon film in a few months.

The study of recent fluid dynamics in the Caspian Sea mud volcanoes provides an insight into the nature of past unique geological phenomena, e.g., absence of marine macro fauna and scarcity of micro fauna in the Early Pliocene basin. Based on drilling, seismoacoustic, and deep seismic profiling data, the mud volcanism in the South Caspian Basin commenced in the Early Miocene and became most intense at the Miocene-Pliocene boundary. This was accompanied by a dramatic sea level drop by more than 600 m (locally, up to 1500 m) in the Early Pliocene due to the paleo-Caspian sea isolation from the Eastern Paratethys as a result of the intense collision of the Arabian and Eurasian plates and the consequent rise of orogens surrounding the basin. Grandiosity of mud volcanism and fluid dynamics in the Caspian region is confirmed by paleogeologic reconstructions, geochemical studies, and basin modeling. Accordingly to these data, at the end of Miocene-Early Pliocene the Jurassic-Cretaceous rocks were involved into active fluid generation. This sedimentary complex is characterized by a higher gas-generation potential than the Paleogene-Miocene deposits that are source of recent volcanoes. The avalanche sedimentation rate reached 3.0-3.5 km/106 yr (occasionally, >4 km/106 yr) in the Early Pliocene basin. This indicates to extremely high subsidence rates, which are undoubtedly possible under conditions of intense fault tectonics. These faults were responsible for the mud volcanic fluid dynamics and redistribution of material within the sedimentary cover of the South Caspian Basin. They also served as conduits for abyssal fluids. This is evident from the detection of large buried (apparently root-free) columns (3-4 to 10 km across and 8-10 to 20 km high) in seismic time-sections. They penetrate the entire sedimentary cover up to the crystalline basement and are confined to contact zones of deep-seated faults that divide the South Caspian Basin into large blocks. The inflow of abyssal fluids to the Early Pliocene basin should undoubtedly have accompanied the subduction of the South Caspian oceanic crust under the Middle Caspian continental plate that commenced 5.5 Ma ago (at the Pontian-Pliocene boundary).

At the beginning of the Early Pliocene, the dimension and volume of the paleo-Caspian basin reduced by several tens of times down to those of the present-day South Caspian Basin. At the same time, mud volcanism and abyssal fluid dynamics became more active, particularly in the central part of the basin, resulting in over saturation and intoxication of the desalinated basin by methane and the consequent mass extinction mollusks, fishes and other group of sea inhabitants.. This situation is probably responsible for the absence of macrofossils in the 6-7km thick Lower Pliocene sequence that accumulated over 2.0-2.5 Ma.

Special place for fluid dynamics and environment of Caspian Sea and surrounding area have gas hydrates associated with submarine volcanism. The large accumulations of gas hydrates are confined to bottom sediments of the Caspian Sea deposited in mud volcanoes craters (interval of sediments 0-0.4 m, sea depth 480 m) and volcanoes bodies.

Caspian Sea being the closed basin is very sensitive to climatic and tectonic events expressed in the sea level fluctuations. In regressive stages as a result of sea level fall and reducing of hydrostatic pressure the decomposition of gas hydrates and releasing of great volume of HC gases consist mainly of methane are observed. Paleoreconstructions show that good conditions for large gas hydrate formation and accumulations existed in South Caspian basin in late Miocene (Pontian). Consequently, dramatic sea level fall in Lower Pliocene could provoke destabilization of gas hydrates and massive release of hydrocarbon gases to water column that led to strong intoxication of marine water. In other case massive dissociation of gas hydrates could liberate enough methane in atmosphere to cause serious climatic perturbations.

In Upper Pliocene and Quaternary mud volcanism occurred under the conditions of semi-closed basin periodically connected with Black and Mediterranean Seas. The increase of water surface and differently oriented currents stimulated rapid mixing of gas-saturated waters and reduction of background concentrations of hydrocarbon gases. The same picture is observed in the modern Caspian Sea. Such stages of the Caspian Sea history are characterized by the revival of Caspian organic world.

South Caspian sedimentary basin is an unique area with thick Mesozoic-Cenozoic sediments (up to 30-32 km) characterized by an extremely high fluid generation potential. A great amount of active mud volcanoes and volume of their gas emissions prove the vast scale of fluid generation.

The data received show the close relation of mud volcanic fluid dynamics in the South Caspian basin with sea level change and seismicity which provide enormous influence on Caspian Sea environment in geological past and present days.

THE PLIOCENE-PLEISTOCENE TRANSITION IN SOUTHERN PIEDMONT: NEW DATA FROM THE ALESSANDRIA BASIN

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The Plio-Pleistocene Villafranchian succession in the type section of the central Piedmont is divided in two main complexes, separated by a regional unconformity (i.e. Carraro et al., 1996; Vigna et al. 2010). The age of this discontinuity is still debated as well as the filling succession of the upper complex, tentatively ascribed to the Calabrian for the lack of precise chronological constrains. In the whole North-western Italy few data are available for the Pliocene-Pleistocene transition because of the erosional unconformity, associated to a variably lasting time-hiatus, and for the presence of coarse continental sediments, which are normally poor in palaeontological remnants, both above and below the unconformity.

The Alessandria Basin presently represents an isolated sedimentary basin, located in south-eastern Piedmont; during the Pliocene it was connected to the Villafranchian type area, when the marine-transitional succession of the "Asti sands" *Auct.* and the "Ferrere sands" *Auct.* of the Villafranchian lower complex were widespread. In the Alessandria Basin the upper portion of the Villafranchian continental succession shows a continuity likely covering most of the hiatus related to the unconformity in the other sectors. For this reason, in the present study our investigation focused on expanded continental successions at the southern border of the basin, well exposed in gravel pits.

The integration of field data, consisting of geological mapping and stratigraphic analysis, coupled with preliminary palaeomagnetic, palaeobotanical (plant and pollen biostratigraphy) and fresh-water molluscs assemblage analyses allowed us to recognize several sedimentary units, bounded by erosional surfaces, locally showing smooth angular unconformities.

The studied succession forms a gently NNE-dipping monocline. It consists of Piacenzian tide-dominated delta plain sediments ("Ferrere sands" *Auct*.) followed by fluvial deposits, that were up to now undated, and are here referred to as the "Maranzana Formation" (MRZ). Ferrere sand and MRZ are both unconformably followed by terraced fluvial deposits, tentatively ascribed to the Middle Pleistocene from considerations on soil development.

We focused on the MRZ continental deposits, represented by 3 vertically stacked unconformity-bounded stratigraphic units (namely MRZ1, 2, 3), showing sharp facies association changes in terms of fluvial style. At the local scale MRZ 1 and 2 strata dips 3-5° Northward, whereas MRZ 3 strata are sub-horizontal, like those related to the river terraces.

The lowermost unit (MRZ1), 8-10 m thick, unconformably rests through an irregular surface (S1) onto heavily weathered clays and sands, that form the upper part of the Piacenzian tide-dominated delta plain sediments of the "Ferrere sands". MRZ1 consists of cross bedded sands and gravelly sands, that made small to medium scale bars, and clayey silts forming small to large scale lenticular bodies, inferred as abandoned channel fills. Facies association of MRZ 1 suggests a deposition in a (sandy-gravelly) braided fluvial system, whose pebble composition indicates a source area from the alpine metamorphic basement and a possible reworking from the Oligocene successions of the Tertiary Piedmont Basin.

A sharp and abrupt increase in grain-size and in the scale of sedimentary structures is recorded by the basal surface (S2) of MRZ2. This unit forms a 12-15 m thick gravelly body, split into two minor sub-units (MRZ2a and MRZ2b), by an erosional surface (S2'). MRZ2a (8-10m thick) is made up of planar-cross bedded, coarse to very coarse clast-supported gravels and sandy gravels that constitute large scale longitudinal-bars. Up to 10 meters wide and 2 m thick subordinated lenticular bodies, made up of thin laminated clays, silts and sands, are also present; these are interpreted as abandoned channel fills. A remarkable feature is the occurrence of mud-clasts, represented by: **i)** abundant dm-sized rounded clay chips, randomly dispersed in the gravels and **ii)** up to 3-m sized angular mud-blocks, fallen from the river bank in a deep channel. These features indicate the transition to a higher energy fluvial system (if compared to MRZ1) and the past occurrence in the MRZ2a fluvial system of deeply incised pools (at least 6-m deep). This interpretation is supported by the occurrence of large scale dunes at the top of the channel fill sequence. MRZ2a deposits are referable to a low-medium sinuosity fluvial system, that is here interpreted as a wandering system (sensu Miall, 1996). MRZ2b (4-5-m thick) is made up of planar to cross bedded coarse clast-supported gravels and matrix supported gravelly sands, mainly deposited as longitudinal bars. This unit marks the recurrence of a braided fluvial system, but characterized by an higher energy than MRZ 1. The pebble composition of MRZ2 shows a transition to a more extended catchment, including large portions of the Ligurian Alps.

An erosional unconformity (S3) cuts the uppermost portion of MRZ2 unit and marks the base of MRZ3. This surface corresponds to a subtle angular unconformity, clearly indicating its tectonic nature. MRZ3 is introduced by a slightly cemented, cross bedded, gravel, in which, cm-dm sized rounded red-clay pedorelicts, are randomly dispersed. They suggest a relatively prolonged phase of subaerial exposure. MRZ3 shows a thickness increase from 0 to 8m toward the north. It consists of planar cross bedded sands and gravelly sands forming large scale (7-m thick and up to 80-m wide) bars, interpreted as point-bars, and laminated clays and sands (7-m thick and up to 60-m wide) ascribed to abandoned channel fills. Massive to ripple-cross laminated sands are also present and interpreted as crevasse splay deposits. MRZ3 facies association records the sharp transition to a meandering river system, and marks the broadening of fluvial depositional areas. This is also recorded by the increase of variability in pebble composition, suggesting a widening of the river catchment.

The channel-fill deposits, along the whole section, are particularly rich in molluscs, that appear to be dominated by *Unio* sp. and Planorbidae (such as *Planorbarius* or *Gyraulus*).

Preliminary magnetostratigraphic data on fine-grained channel-fill deposits of MRZ3 show, at the bottom reverse polarity and, after a short transitional period, normal polarity to the top. Palaeomagnetic analysis on the fine-grained lenses of MRZ2 yielded normal polarity.

Preliminary pollen data from one sample taken from fine-grained deposits of unit MRZ2a indicate a cool temperate type of vegetation, rich in conifer taxa such as *Pinus*, *Picea*, *Tsuga*, and *Cedrus*; the relative abundance of *Abies* and *Sciadopitys* points to a humid climate.

Plant macrofossils from MRZ2 and MRZ3 confirm the climatic indications of pollen assemblages and provide accurate taxonomic information on several woody and herbaceous plants which allow to formulate an hypothesis on the biochronologic assignment. The features of the cool temperate plant assemblage do not agree with the warmer ones of the Lower Complex of the Villafranchian type-succession. The occurrence in MRZ2 of *Bohemeria lithuanica* and *Scirpus isolepioides*, which are common in Piacenzian assemblages, is particularly interesting because up-to-date they were not reported in the Pleistocene.

The multidisciplinary approach restricted the possible age interval of the succession to two hypotheses:

1) the upper portion of the succession can be ascribed to the Reunion normal polarity (lower part of the Matuyama epoch); in this case the unconformity at the bottom of MRZ3 is referable to the early Gelasian and could be correlated to the intra-Gelasian unconformity (*sensu* Vigna et al., 2010), while the lower sub-units MRZ1-2 are referred to the late Piacenzian.

2) the whole succession can be referred to the Gelasian, with fine-grained sedimentation occurring mostly on normal sub-chrons of Olduvai and Reunion, while the main unconformities at the bottom of MRZ1 and MRZ3 were shaped in the early Gelasian.

References

F. Carraro (Ed.), 1996. Revisione del Villafranchiano nell’area tipo di Villafranca d’Asti. Il Quaternario, 9(1), 5-120.

A.D. Miall 1996. The Geology of Fluvial Deposits. Springer-Verlag, Berlin Heidelberg

B. Vigna, A. Fiorucci and M. Ghielmi, 2010. Relations between stratigraphy, groundwater flow and hydrogeochemistry in Poirino Plateau and Roero areas of the Tertiary Piedmont Basin, Italy. Mem. Desc. Carta Geologica d’Italia, 90, 267-292.

DECADAL-TO-MILLENNIAL SCALE ENVIRONMENTAL CHANGES ON THE NORTHEASTERN BLACK SEA SHELF DURING THE LATE HOLOCENE AND 20TH CENTURY

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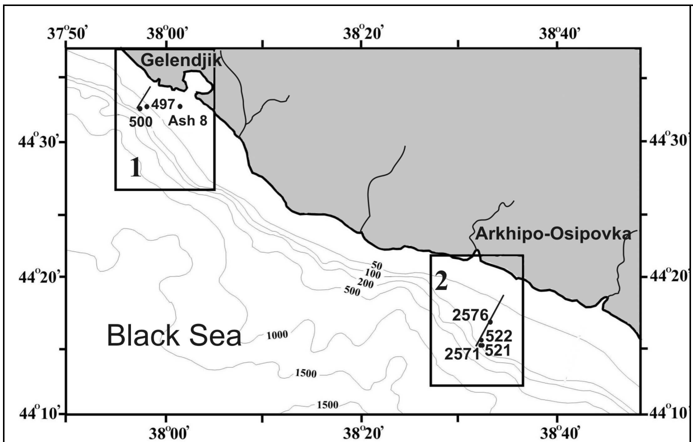
Variations in the Holocene sea-level of the Black Sea is much debated. Using a multi-proxy approach we examined the late Holocene and recent changes in environments and sedimentation on the NE Black Sea shelf to highlight paleoceanographic conditions associated with suggested high and low sea–level stands (Balabanov, 2007), and recent warming. We studied lithology, sedimentation rates, microfossils and constructed the age models for several sediment cores retrieved mostly from the northeastern outer shelf and shelf edge off Gelendzik and Arkhipo-Osipovka during the cruises with the Russian RV *Akvanavt* (Fig. 1). The results suggest that centennial-to millennial variations in bottom-water salinity during the Late Holocene are represented by variations in ostracod and mollusc assemblages (Fig. 2) and supported by changes in benthic foraminifers, stable isotopes and grain size of sediments. According to the relative abundance of polyhaline ostracod species, the bottom-water salinity rose up to modern values by ~6.5 ^{14}C ka BP (~7 cal. ka BP) and 5.3 ^{14}C ka BP (~6 cal. ka BP) with the lower values in between 6.4-5.3 ^{14}C ka BP and minor changes afterwards likely associated with sea-level changes e.g. Kundukian regression at ~ 4 cal ka BP (Ivanova et al., 2012). The increase in sea level and salinity in the early-middle Holocene caused a pronounced change in mollusc assemblage resulting in an appearance of a relatively deep-water species *Modiola phaseolina* on the Caucasian shelf (Fig. 2) likely prior to 4 cal ka BP. The species even replaced a less salinity tolerant *Mytilus galloprovincialis* at some locations. Any of the Caspian molluscs living on the shelf during the Early Holocene survived the salinity rise. A comparison of the linear sedimentation rates estimated from the several outer shelf' cores demonstrate a considerable decrease after ~7 cal. ka BP, when the sea level and bottom-water salinity reached the modern values, relative to the higher early Holocene values between ~ 8 and 7 cal. ka BP.

The decadal environmental variability was investigated in a 28 cm long mini-core Ash-2009-08 retrieved by the Niemisto corer from the inner shelf off the town of Gelendjik, from the water depth 32 m. The core was sampled at 1 cm intervals and analyzed for coarse grain size fractions, ^{210}Pb and ^{137}Cs, TOC, and microfossil assemblages. ^{210}Pb and ^{137}Cs measurements provide very close values of the mean sedimentation rate of 1.9 and 2.1 mm/yr, respectively. Extrapolating the mean value of 2 mm/yr to the entire core length, we assume an age of 140 years BP at the bottom. Hence, the sedimentation rate at core location on the inner shelf is about ten times higher than the Late Holocene values from the outer shelf cores providing the sea floor is tectonically stable. Abundant and diverse ostracods and less diverse benthic foraminifers are found at several levels during the 20th century. *Ammonia* spp., mainly represented by *A. compacta* and *A. tepida* strongly dominates foraminiferal assemblages whereas other genera (like *Quinqueloculina* and *Elphidium*) are accessory. Recent ostracod fauna from the core Ash-2009-08 is more diverse than the late Holocene assemblages from the same area, and represented by 35 species. The dominance of polyhaline and euryhaline species (*Callistocythere diffusa*, *Callistocythere intricatoides*, *Cytheridea neopolitana*, *Pontocythere tchernjawskii*) as well as the species ratio point to rather stable salinity values. No any oligohaline species occurs during the 20th century. Meanwhile, changes in total ostracod abundance might suggest annual-to-decadal scale variations in trophic conditions and, hence in the river run-off from the Caucasian coast. The dominance of polyhaline ostracods and foraminifers, and occurrence of mollusc *Modiola phaseolina* ascertain marine bottom-water conditions with close to present salinity values during the Recent Warming. Organic-walled dinoflagellate cysts, indicators or sea-surface conditions, suggest mesohaline/polyhaline salinities. Preliminary results document assemblages that are dominated by various types of *Spiniferites* and *Lingulodinium machaerophorum*. These assemblages are consistent with mid to late-Holocene Black Sea dinoflagellate cyst studies. This study is partly supported by the Russian Federal Program 'World Ocean' (contract 11.519.11.5012), the Russian Foundation for Basic Research grant 12-05-00617, and the CLIMSEAS project-IRSES-247512.

References

I.P. Balabanov, 2007. Holocene sea-level changes of the Black Sea. In: Yanko-Hombach, V., Gilbert, A.S., Panin, N., Dolukhanov, P.M. (Eds.), The Black Sea Flood Question: Changes in Coastline, Climate, and Human Settlement. Springer, Dordrecht, p. 711-730.

E.V. Ivanova, I.O. Murdmaa, M.S. Karpuk, E.I. Schornikov, F. Marret, T.M. Cronin, I.V. Buynevich, E.A. Platonova, 2012. Environmental changes on the NE and SW Black Sea shelves during the Holocene.Quaternary International, 261: 91-104.



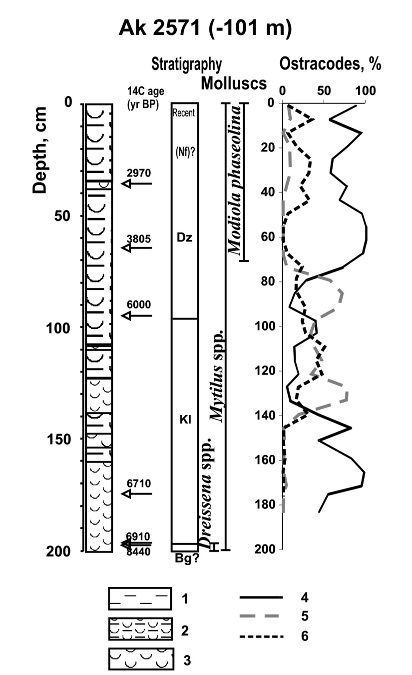


Fig. 1 (left). Location of the seismic profiles and sediments cores studied on the northeastern Black Sea shelf, off Gelendjik (area 1) and Arkhipo-Osipovka (area 2).

Fig. 2 (right). Lithology, ^{14}C dates, stratigraphic units according to Balabanov (2007) and distribution of key molluscan and ostracod species from the core Ak 2571: 1 – silty mud, 2- shelly mud, 3 – muddy shell bed, 4 - polyhaline ostracods, common mesohaline species 5 - *X. cornelii*, 6 - *H. rubra*. Stratigraphic indeces (transgressions): Bg-Bugazian, Kl-Kalamitian, Dz-Dzhemetinian, Nf-Nymphean (modified from Ivanova et al., 2012).

MORPHOLOGICAL AND STRATIGRAPHIC IMPRINTS OF LATE QUATERNARY SHOREFACE MIGRATIONS AND SEA-LEVEL FLUCTUATIONS ON THE EAST-CORSICA MARGIN (NW MEDITERRANEAN)

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The mountainous East Corsica margin is drained by several high-gradient rivers that transport sediments from the island's summits with an elevation of over 2700 meters above sea level to the eastern narrow deltaic plains and continental shelves. The main Golo River (86.9 km) drains a present-day catchment area of more than 1000 km² in the northern part of Corsica and has built a large delta composed of Quaternary seaward-dipping, paired-fill coarse-grained terraces. These alluvial deposits are seaward limited by a wave-dominated shoreline that is about 10-15 kilometres from the shelf edge and the heads of the slope canyons. On the continental shelf, preserved imprints of delta progradations and shoreface migrations have been identified.

From 2008 to 2012, a joint research program between Total, Ifremer, ExxonMobil and Fugro has allowed to intensively explore these marine deposits from the median shelf to the basin floor in about 800 meters of water using high-resolution swath bathymetry, backscattering and high-resolution multi-channel seismic data during the SiGolo (2008). The ground-truthing of the shelfal submerged paleo-deltas has been performed during the GoloDrill drilling survey (2009). In 2010, an academic shallow marine survey allowed to complete the geophysical data sets between 1 and 60 m water depth. Recently, geophysical and sedimentological investigations of the onshore quaternary deltaic deposits have also been realised (ElGolo and GoloBore field surveys). The extension of the data set provides an exceptional source to sink overview of the Golo sedimentary system linking the modern and ancient shallow deltaic complexes to the shelf, slope and deepwater deposits.

The middle and outer continental shelf consists of prograding wedges that we interpret as coastal wedges fed by the Golo River distributaries. These sedimentary prisms display internal reflections showing alternating low and high-angle clinoforms interpreted as the result of alternating deposition of low and high energy (waves?) during late Pleistocene sea-level changes.

The upper sequence (~50-75m thick) shows the accumulated system tracts deposited during the last glacial cycle. The last major regressive sequence, formed during the major sea-level fall associated with the last glaciation, overlies partly preserved bottomsets of the previous highstand deltaic system on the inner shelf. On the outer shelf several morphological features have been recognized as small dunes, cemented sands, evidences of paleo-incisions (incised valleys?) and lobate features that indicate the lowstand position of relic deltaic lobes. These wedges are interpreted as beach-shoreface deposits represented by high-angle clinoforms. As they are very sensitive to base-level changes, they provide evidence of sea-level changes around last glacial period.

Landward, the most superficial sedimentary deposits in front of the Golo river mouth, have recorded discontinuous sea-level rise associated with the last deglaciation. On the middle shelf, a large lobe topped by morphological ridges represents the Golo prodeltaic system that has prograded at around 50 mbsl during a tardi-glacial sea-level stillstand. The methodical survey of the transgressive and highstand wedge, as close as possible to the coast, also provides the accurate distribution of the recent Golo deltaic lobes.

This shelfal investigation contributes to the detailed and integrated pseudo3D study of the Golo sedimentary system from source to sink. These data describe, at different time-scales, the sediment supply and sea-levels changes during late Pleistocene that should be consider as the main controlling factors of sediment transport to the deep basin.

SEDIMENTARY RECORD AND VARIABILITY OF AEOLIAN SEDIMENTS IN THE DIFFERENT CLIMATIC ZONES – PRELIMINARY RESULTS

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The aim of presented study is to explore the role of aeolian processes, grain-mixing and timing of different aeolian sediments by textural feature pattern analysis of quartz grains in a sandy fraction (0.5 - 0.8 mm). The correlation of the selected textural features as grain-size distribution, rounding and frosting of quartz grains and mineral-petrographic composition of sediments give potential information about transport behaviour, size-sorting in numerous environments (Folk and Ward, 1957; Anthony and Héquette, 2007; Flemming, 2007; Mycielska-Dowgiałło and Ludwikowska-Kędzia, 2011), and the duration of aeolian processes (Mycielska-Dowgiałł0, 1993). From five locations (Fuerteventura Island; Central Poland; E Latvia, NE Estonia and W Finland) located in different present day climatic zones 147 samples of sandy aeolian sediments where examined to define a framework of their comparitive analysis. All locations record a slightly differrent geological settings and substratums: (1) Fuerteventura – a raised beach that covers a shore platform on Miocene lavas (Gutiérrez-Elorza *et.al.*, 2011); (2) Poland, Latvia, Estonia - among so called the European Aeolian Sand Belt (Koster, 1988, 2009; Zeeberg, 1998) on the “sandy” glaciolacustrine (Estonia, Latvia), “varved” glaciolacustrine and morainic till (Poland) sediments, and (3) Finland - on a huge glaciofluvial esker formation (Atlas of Finland, 1990; Hellemaa, 1998). All locations also represent a different age frames: (1) Finland – recent time calculated in thousands of years (Aartolahti, 1990), (2) Estonia – holocene time (Raukas, 2011), (3) Fuerteventura, Latvia and Poland correlated with the post-LGM time (Petit-Maire et.al., 1986; Damnati et.al., 1996; Meco et.al., 1997; Criado and Hansen, 2000; Criado et.al., 2004; Nartišs et.al., 2009; Kalińska, 2010; Zelčs et.al., 2011), and (4) Poland – pre-LGM time (Kalińska, 2010). Collected samples where examined under a light microscope at the magnification of 30×. Methodology of Cailleux with the modification of Mycielska-Dowgiałło and Woronko (1998) was used to distinguish seven groups of quartz grains: 1 – well-rounded matt grains (RM); 2 – well-rounded shiny (EL); 3 – partially-rounded matt (EM/RM); 4 – partially-rounded shiny (EM/EL); 5 – angular matt (NU/M), 6 – angular shiny grains (NU/L) and 7 – cracked grains (C). For each sample coefficents between rounded (RM+EM/RM+EL+EM/EL) and non-rounded grains (NU/M+NU/L), as well as between aeolian-type grains (RM+EM/RM+NU/M) and fluvial (“water”)-type grains (EL+EM/EL+NU/L) were calculated to distinguish: (1) two different types of the sedimentary environments (fluvial and aeolian) and (2) two types of the relative transportation: long and short. Clusters of data were recognized among the investigated areas (Fig.1). Group A (Poland and Fuerteventura) with sediments developed on the morainic tills, “varved” glaciolacustrine and the raised beach sediments, represents the highest degree of grains’ transformation and maturity. Group B, widley spread across y-axis, involve aeolian sediments lean on a “sandy” glaciolacustrine basins from Latvia and Estonia, and determines high “aeolization” of sediments with relatively short transportation. Group C (Finland) reveals the smallest transformation of quartz grains by duration of aeolian processes and transportation.

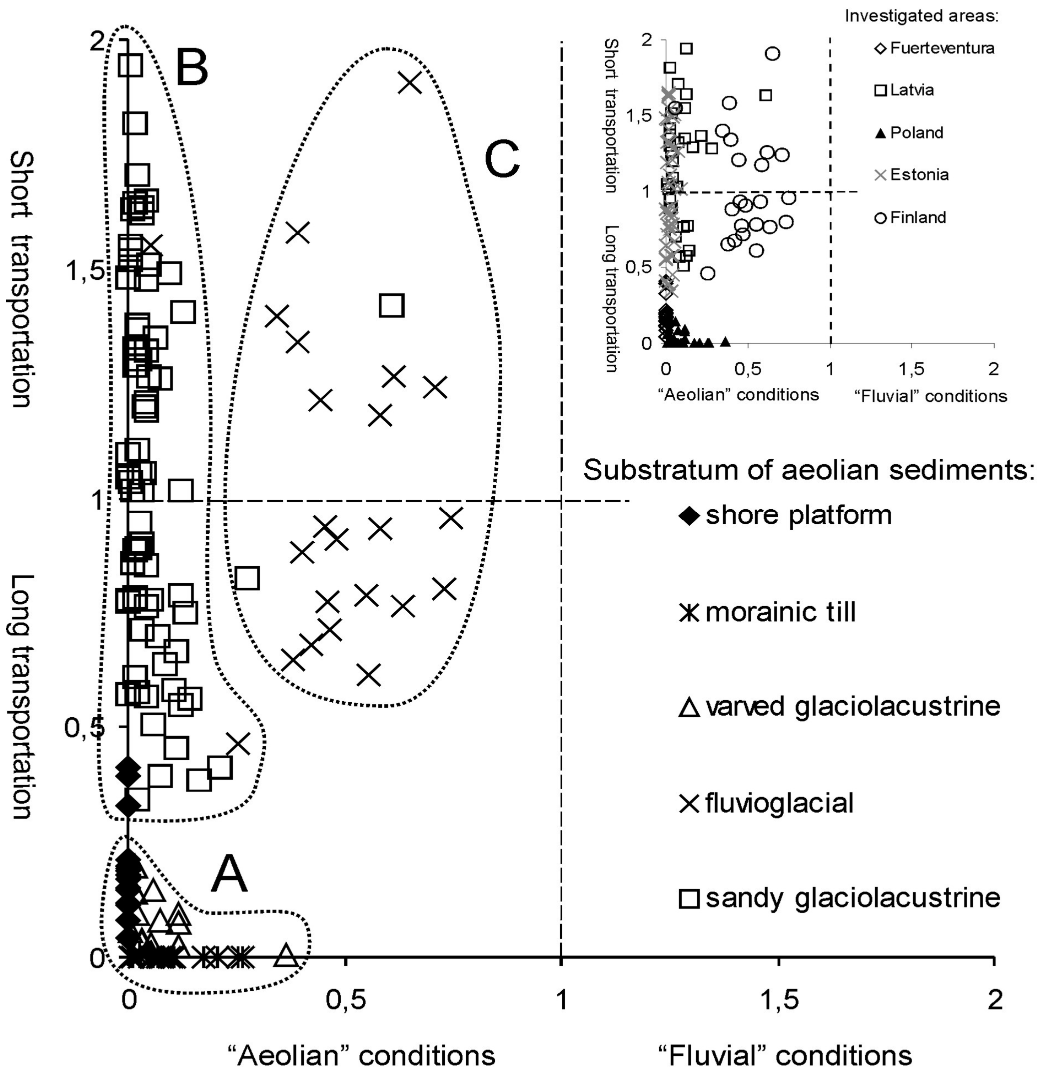

Fig.1. Relationship between the coefficients presening two types of environmental conditions: "aeolian" and "fluvial" and two types of transportation: long and short as recorded in the aeolian sediments of different climatic zones and geological settings/substratums.

References

T. Aartolahti, 1990. Suomen maankamaran vaiheet. Terra 102, 4, 203-219.

E.J. Anthony and A. Héquette, 2007. The grain-size characterisation of coastal sand from Somme estuary to Belgium: Sediment sorting processes and mixing in a tide- and storm-dominated setting. Sedimentary Geology, 202, 369-382.

Atlas of Finland, 1990. Geology (Geologia). National Broad of Survey & Geographical Society of Finland, Helsinki. 58 pp. 2 map appendices, 123-126.

C. Criado and A. Hansen, 2000. Depósitos dunares y periodos de estabilización en las Canarias Orientales durante los últimos 30.000 años. VI Reunión Nacional de Geomorfología, 76.

C. Criado, H. Guillou, A. Hansen, P. Lillo, J.M. Torres and A. Naranjo, 2004. Geomorphological evolution of Parque Natural de las Dunas de Corralejo (Fuertevenutra, Canary Islands). [in:] G. Benito and A. Díez Herrero (eds.), Contribuciones recientes sobre Geomorfología: Actas de la VIII Reunión Nacional de Geomorfología, Toledo-Madrid, 291-297.

B. Damnati, N. Petit-Maire, M. Fontugne, J. Meco and D. Williamson, 1996. Quaternary paleoclimates in the eastern Canary Islands. Quaternary International, 31, 37-46.

B.W. Flemming, 2007. The influence of grain-size analysis methods and sediment mixing on curve shapes and textural parameters: implications for sediment trend analysis. Sedimentary Geology, 202, 425-435.

R.L. Folk and W.C. Ward, 1957. Brazos river bar: A study in the significance of grain size parameters. Journal of Sedimentary Petrology, 16, 5-54.

M. Gutiérrez-Elorza, P. Lucha, F.-Javier Gracia, G. Desir, C. Marín, N. and Petit-Maire, 2011. Palaeoclimatic considerations of talus flatrons and aeolian deposits in Northern Fuerteventura volcanic island (Canary Island, Spain). Geomorphology, doi:10.1016/j.geomorph.2011.09.020.

P. Hellemaa, 1998. The development of coastal dunes and their vegetation in Finland. Fennia, 176.

E. Kalińska, 2010. Rozwój piaszczystych osadów form stożkopodobnych na Nizinie Mazowieckiej w młodszym plejstocenie. Prace Wydziału Nauk o Ziemi Uniwersytetu Śląskiego, 65, 86-96.

E.A. Koster, 1988. Ancient and modern cold-climate aeolian sand deposition. A review. Journal of Quaternary Science, 3, 69-73.

E.A. Koster, 2009. The “European Aeolian Sand Belt”: Geoconservation of drift sand landscapes. Geoheritage, 1, 93-110.

J. Meco, N. Petit-Maire, M. Fontugne, G. Shimmield and A.J. Ramos, 1997. The Quaternary deposits in Lanzarote and Fuerteventura (Eastern Canary Islands, Spain): an overview. [in:] J. Meco and N. Petie-Maire (eds.), Climates of the past. prodeedings CLIP Project. Servicio de Publicaciones, Universidad de Lad Palmas de Gran Canaria, 123-136.

E. Mycielska-Dowgiałło, 1993. Estimates of Late Glacial and Holocene aeolian activity in Belgium, Poland and Sweden. Boreas, 22, 165-170.

E. Mycielska-Dowgiałło and M. Ludwikowska-Kędzia, 2011. Alternative interpretations of grain size data from Quaternary deposits. Geologos, 17(4), 189-203.

E. Mycielska-Dowgiałło and B. Woronko, 2004. The degree of aeolization of Quaternary deposits in Poland as a tool for stratigraphic interpretation. Sedimentary geology, 168, 149-163.

M. Nartišs. I. Celiņš, V. Zelčs and M. Dauškans, 2009. History of the development and palaeogeography of ice-dammed lakes and inland dunes at Seda sandy plain, north-western Vidzeme, Latvia. [in:] V. Kalm, L. Laumets and T. Hang (eds.). Extent and timing of the Weichselian Glaciation southeast of the Baltic Sea: Abstracts & Guidebook. The INQUA Peribaltic Working Group, Field Symposium in southern Estonia and northern Latvia, Sept. 13-17, 2009, 79-81.

N. Petit-Maire, J.C. Rosso, G. Delibrias, J. Meco and S. Pomel, 1987. Paleoclimats de l’île de Fuerteventura (Archipel Canarian). Palaeoecology of Africa, 18, 351-356.

A. Raukas, 2011. Evolution of aeolian landscapes in North-Eastern Estonia under environmental changes. Geographia Polonica, 84(1), 117-126.

V. Zelčs, A. Markots, M. Nartišs and T. Saks, 2011. Pleistocene Glaciations in Latvia. [in] J. Ehlers, P.L. Gibbard and P.D. Hughes (eds.)Developments in Quaternary Science, Vol. 15, Amsterdam, The Netherlands, 221-229.

SEDIMENTOLOGICAL RECORD OF THE LATE VISTULIAN AND EARLY HOLOCENE IN A KETTLE-HOLE (NORTH-CENTRAL POLAND)

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Small ground depressions with no surface outflow are characteristic elements of young post-glacial landscapes, and are common within the impact zone of the Vistulian continental glacier in the European Plain. Their genesis is often associated with melting glacier or overflow (aufeis) ice (so-called kettle-holes). They differ in size, shape, deposits, alimentation, and land-use form, as well as in the extent of natural and anthropogenic transformation. If they are enclosed within a direct catchment area, they can be treated as so-called sedimentation traps. Therefore sediments deposited in the bottoms of drainless sedimentary basins constitute a good object of paleoenvironmental studies.

The research focused on a depression located between the range of the Poznań phase (18.8 ka BP) and the Pomeranian phase (16.2 ka BP after Kozarski 1995) of the Vistulian glaciation in the vicinity of Lake Retno in the Brodnica Lake District, north-central Poland. It aimed to reconstruct paleoenvironmental conditions within this depression and the surrounding area. Particular attention was paid to temporal heterogeneity of sediment deposition during the Late Glacial Period and Early Holocene.

Lacustrine, lacustrine-paludal and paludal sediments with a total thickness of above 6.7 m were found in the central part of the bottom. The following laboratory analyses were performed: palynological, geochemical and analysis of plant macroremains. In addition, the age of the studied sediments was determined applying the ^{14}C method. This paper presents the results obtained for a selected core fragment (4.1-6.7 m bgl).

The analysed sediments represented stratigraphic units of the Late Glacial Period and Early Holocene (Mangerud et al. 1974, Latałowa 2003, Karasiewicz et al. 2011a and b, Karasiewicz et al. 2012), which was also confirmed by radiocarbon dates. Five local stages in the development of the reservoir were distinguished in the bottom of the depression (from ER 1 to ER 5), which were a consequence of climatic and hydrological changes. Accumulation of bottom sediments (mainly mineral and mineral-organic) was related to the presence of a late glacial lake (ER-1 and 2). Processes of mechanical denudation dominated in the drainage basin of that lake (the content of terrigenous silica SiO_{2t} was above 80%) and they were favoured by the presence of initial vegetation cover (Fig. 1). At the beginning of the Holocene (ER-3, 4 and 5), mechanical denudation of the drainage basin was reduced by the presence of dense vegetation cover (SiO_{2t} below 5%). The development of aquatic and rush vegetation induced systematic shallowing of the reservoir, whereas a sudden temperature increase at the turn of Younger Dryas/PreBboreal resulted in gradual draining of the habitat. Sediments representing the aforementioned stages were characterised by a very high content of organic matter (mainly coarse detritus gyttja with wood detritus). The age of organic sediments collected at 5.13 m bgl was estimated at 8490±30 C14 BP (GdA-2108), and the age of sediments deposited 15 cm above – at 8410±30 C14 BP (GdA-2109). This correlates to the middle part of the boreal period (Karasiewicz et al. 2012) – ER-4. At that time, processes of chemical denudation dominated in the drainage basin, as evidenced by the Na:K index values – the highest in the profile, i.e. above 1 (Fig.1). The analysed depression's function as a water reservoir was terminated in the Early Atlantic. The last of the analysed stages (ER-5) can be regarded as a transitional stage, followed by the development of a peat bog (Karasiewicz et al. 2012).

This study was financed by the Ministry of Science and Higher Education (grant no. N N306 282935).

References:

Karasiewicz M.T., Hulisz P., Świtoniak M, (eds.) 2012. Postglacial history of the outflow hollow at Retno reserve, Brodnica Lakeland, in press (in Polish).

Krześlak I., Świtoniak M., Stachowicz-Rybka R. 2011a. Postglacial history of the outflow hollow at Retno Lake, Brodnica Lakeland on the basis of the interdisciplinary study. In: Karasiewicz M.T.,

Hulisz P., Noryśkiewicz A.M. (eds) Man and his impact on the natural environment in the past and in historical times, PIG-PIB, Warsaw: 149–157 (in Polish).
Karasiewicz M.T., Noryśkiewicz A.M., Krześlak I. Hulisz P., Stachowicz-Rybka R. 2011b. Holocene climate changes recorded in sediments of the kettle-hole in the young-glacial landscape. Scientific conference "Palaeoclimatic changes in the geological past (abstracts). 23-24.11.2011, Warsaw: 72.
Latałowa M. 2003. Late Vistulian, Holocene, In: S. Dybowa-Jachowicz, A. Sadowska (eds.) Palinology: 293–299 (in Polish). Karasiewicz M.T., Hulisz P., Noryśkiewicz A.M., Noryśkiewicz B., Mangerud J., Andersen S. T., Berglund B. E., Donner J. J. 1974. Quaternary stratigraphy of Norden, a proposal for terminology and classification, Boreas, t. 3: 109–128.

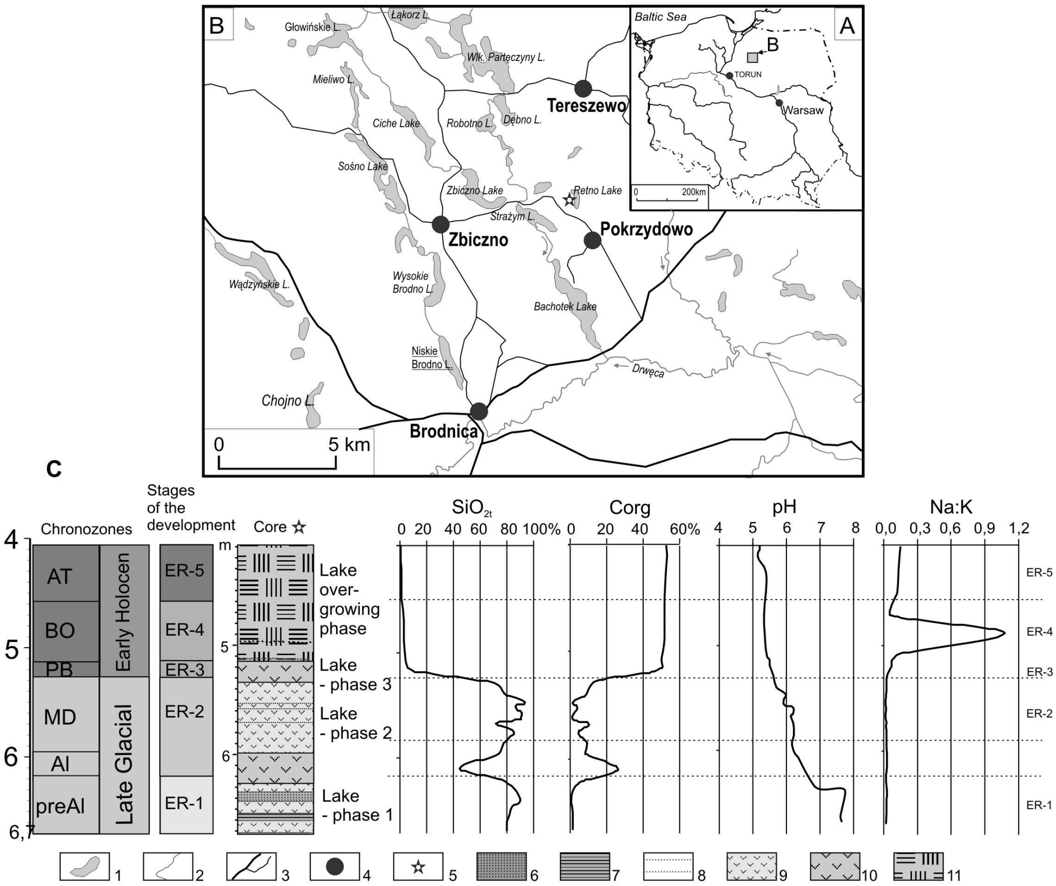

Fig.1. Location (A, B), lithological sketch and vertical distribution of selected sediment properties in the Retno profile (C).
1 – lakes, 2 – rivers, 3 – roads, 4 – villages and towns, 5 – location of the core, 6 – sand, 7 – clay. 8 – sand and silt, 9 – mineral gyttja, 10 – organic gyttja, 11 – coarse-detritus gyttja

CORRELATION BETWEEN QUATERNARY GEOLOGICAL FORMATIONS OF IRAN

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The Iranian territory, with a total land area of 1,648,195 square kilometers, lies between 25º 00´ and 39º 47´ N and 44º 02´ and 63º 20´ E,. According to (Stöklin et al. 1968, 1977) and Nabavi, 1976, Iran can be divided into ten major lithotectonic domains; Makran, the Lut Block, Eastern Iran, Kopet Dagh, the Alborz Mountains, the Central Iran Block, the Urumieh-Dokhtar zone, the Sanandaj-Sirjan zone, the Zagros fold belt, and the Khuzestan plain. The boundaries of these units are usually marked by faults or in some cases (mainly tectonic) depressions (Nabavi, 1976).

A great part of the country is covered by Quaternary rocks comprising gravel fans, flood plains, salt playas, sand dunes, loess, freshwater deposits and Volcanic. Thus the southern half of the country is in the subtropical zone and the northern half of the country in the temperate zone with a desert zone in the middle of the country around 30º N. In geology of Iran, generally, rocks and deposits related to after Pleistocene conglomeratic formations (Hezardarreh and Bakhtiari) have been attributed to Quaternary period, which have been covered older rocks as unconfirmed which alluvial – alluvial fan, eolian and desert – wilderness deposits have more portions among them. That is why there is this belief that after late Alpine tectonic event, Iranian plate has been emerged from water and it has formed its current morphology that one of its results is beginning of erosional cycles which have been imposed on Iran since that time to recent. Also, in some structural – sedimentary zones of Iran, such as Kopet Dagh mountains, mountains in east of Iran and even vast zones in Alborz and Central Iran, beginning of erosion phenomena is very older than Quaternary when Pyrenean event has more fundamental role in accomplishment of that. In addition to clastic accumulated strata in continental, lake and marine environments, magmatic activities in Quaternary period have created igneous rocks in this period. Regarded to factors just like sedimentary environment, origin, type of weathering processes and erosion, quaternary rocks of Iran can be as follow types. Unfortunately, data about Quaternary deposits of Iran are not sufficient because the principal geological study in Iran was begun to know more about minerals and hydrocarbourants materials. Therefore you may not find enough researches about the other geological periods. Another reason for lack of data of Quaternary may be the narrow thickness of these deposits. The scale of the most published geological maps in Iran is 1/250000 and 1/100000; therefore to separate horizons and narrow thickness of the sediments in these maps is difficult.

The difficulties of the study of Iranian Quaternary are: absence of glacial and interglacial phases, absence of marine and alluvial trace corresponding to glacial stages, deployment of great Alpian tectonic activities which distinct the Iranian Quaternary exceptionally from another part of the world, impracticability of palinological witness with attention to desertic condition, continuity evaporitic deposition of interior basin from Pliocene, absence of suitability witness of human tools.

A series of marine heavily eroded mountain ranges surrounding Iran high interior basin. In sharp contrasts are the coastal regions outside the mountain rings. The relative and absolute chronologies have been calculated based on the analysis of sedimentation rates, climate stratigraphy, soil stratigraphy, archeology, and to some extent by biostratigraphy, magnetostratigraphy, and radiometric dating (Pedrami, M., 1988, 1983). (Fattahi et al. 2006) According to (Pedrami, M., 1988), the absolute timetable, preferentially adopted by the author, is essentially based on sedimentation rates derived from varve and sedimentary-cycle analyses. In the Iranian land-based sections, the two data can generally be located with the combined use of climatostratigraphy, tectonostratigraphy, soil stratigraphy, and sedimentation-rate studies (Kelts et al., 1986, Kazancı et al., 2004, Pirazzoli et al., 2004, Djamali et al., 2006, Fattahi et al., 2006 and Mary et al. 2007). The Quaternary deposits comprising semiconsolidated to unconsolidated gravel, sand, silt and clay, occupy the greatest part of Iranian platform. These deposits have been used for example in construction aggregates for the residual, industrial and transportation segments of the population, ceramic clays, and laterites.

Beginning of Quaternary in the all parts of Iran was contemporaneous with tectonic phase of Late Walachian and Upper Pleistocene corresponding to tectonic phase of Pasadenian, which had contemporaneous influence on Iranian basin. These events produced many alluvial types of sediments, up filing mountains and covering valleys. In the Pliocene and Quaternary periods, the orogeny has been changed Iranian platform morphology and has been developed Alborz, Zagros, Makran and Kope-dagh ranges.

The late walachian minor events and pasadenian main pulsation vigorous were caused uplifting of mountains and subsidence of valleys. The Quaternary alluvial deposits have been composed of thick stratigraphic sediments, which formed by conglomerate, coarse gravels, boulders, pebbles, sand, silt and marls. Intervals of different stages have been distinct by changing in sedimentation. In the four distinguished areas of Iranian platform typically different (Makran Range, Zagros Mountains, Northern Alborz range and Alborz range), quaternary deposits had similar characters, which indicated mentioned factors influence contemporaneous all part of Iran (Fig. 1 and Table 1). In the central part of Iran, the Quaternary and recent Formations are mainly presented by extensive gravel sheets, deposited salt-water, brackish-water and fresh water lakes (Lake deposits, Lut and Kavir deposits, Recent salts), and by Aeolian sand, loess occurs in the western foothills of the Alborz and in the western spurs of the Kopet-Dagh. In the north part of Alborz mountains, Mazandran-Gorgan plain has been formed by marine deposits**.**

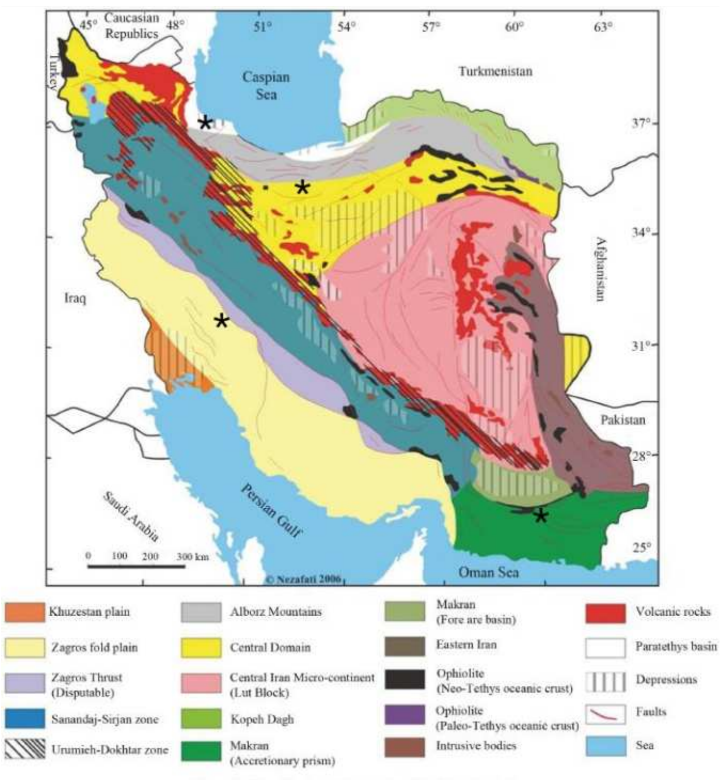

Fig. 1. Location of the studied areas (*).

Chronostratigra-		LITHOSTRATIGRAPHY				Tectono-stratigraphy
		Caspian Region	Piedmont areas			
QUATERNARY	Holocene	Recent Caspian deposits	Holocene alluvium	Holocene stage	Minab alluvium	Pasadenian main Pulsation Vigorous
	Upper Pleistocene	Baku Formation	Tehran alluvial F.	Young alluvial deposits	Sadich alluvium	
			Kahrizak Formation	Old alluvial deposits		
	Lower Pleistocene	Apsheron Formation	Hezardareh Formation	Bakhtyari Conglomerate (Upper half)	Minab Conglomerate (Upper half)	Late Walachian minor events

Table 1. Quaternary Chronostratigraphy of Iran.

References

Pedrami, M., 1988.Quaternary geology and climatology of Arak area.Internal report of the Geological Survey of Iran, 3–11.

Pedrami, M., 1983.Plio–Pleistocene stratigraphy in Iran, prepared in cooperation with IGCP project 41; an internal report of the Geological Survey of Iran.

Kelts, K. and Shahrabi, M.,1986.Holocene sedimentology of hypersaline Lake Urmia, Northwestern Iran.Palaeogeography, Palaeoclimatology, Palaeoecology 54, 105–130.

Kazancı, N., Gulbabazadeh, T., Leroy, S. and Ileri, Ö.,2004. Sedimentary and environmental characteristics of the Gilan–Mazenderan plain, northern Iran: influence of long- and short-term Caspian water level fluctuations on geomorphology. Journal of Marine Systems 46, 145–168.

Pirazzoli, P.A, Reyss, J.-L., Fontugne, J., Haghipour, M., Hilgers, A., Kasper, A., Nazari, H.U., Preusser, F. and Radtke, U., 2004. Quaternary coral-reef terraces from Kish and Qeshm Islands, Persian Gulf: new radiometric ages and tectonic implications. Quaternary International 120, 15–27.

Djamali, M., Soulié-Märsche, I., Esu, D., Gliozzi, E. and Okhravi, .,2006.Palaeoenvironment of a Late Quaternary lacustrine–palustrine carbonate complex: Zarand Basin, Saveh, central Iran.Palaeogeography, Palaeoclimatology, Palaeoecology237, 315–334.

Fattahi, M., Walker, R., Hollingsworth, J., Bahroudi, A., Nazari, H., Talebian, M., Armitage, S. and Stokes, S.,2006. Holocene slip-rate on the Sabzevar thrust fault, NE Iran, determined using optically stimulated luminescence (OSL). Earth and Planetary Science Letters 245, 673–684. B a k u , A z e r b a i j a n | 203 International Journal of Academic Research Vol. 3. No. 3. May, 2011, I Part.

Mary, V., Heyvaert, A. and Baeteman, C.2007.Holocene sedimentary evolution and palaeocoastlines of the Lower Khuzestan plain.Marine Geology 242, 83–108.

Stöklin, J. 1968. Structural history and tectonics of Iran; a review. American Association of Petroleum Geologists Bulletin, 52(7):1229–1258.

Stöklin, J. 1977. Structural correlation of the Alpine ranges between Iran and central Asia. Mem. Hors-serie Soc. Geol. Fr., 8:333-353.

Nabavi, M. H. 1976. An introduction to geology of Iran. (in Persian), Geological Survey of Iran, Tehran.

A RICH MOLLUSKAN AND MAMMALIAN FAUNA FROM THE MIKULINO (EEMIAN) INTERGLACIAL OF THE CENTRAL PART OF THE RUSSIAN PLAIN AT MIKHAILOVKA-5 LOCALITY (KURSK REGION)

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Mikhailovka-5 locality is situated in the northern part of the Mikhailovka quarry, which stretches for over 20 km in the northwestern part of the Kursk region near Zheleznogorsk city. Mikhailovka-5 is part of a series of small mammal localities that span from the late Pliocene to late Pleistocene[1]. The position of the locality allows for precise placing of the studied fauna in the stratigraphic sequence of the region. Rich mollusk fauna was collected along with small mammal remains from the lacustrine deposits overlying the Likhvinian (=Holsteinian) fossil soils. The lacustrine deposits are found in remnants of the Mezin fossil soil, which is overlain by Valdai periglacial deposits[1,3]. Small mammal fauna is diverse and includes numerous rodents and insectivores. It closely corresponds to other Mikulino faunas from the Russian Plain[2,3]. The most numerous rodents are *Arvicola* ex gr. *sapidus* and *Microtus* ex gr. *agrestis*; significant numbers of *Clethrionomys glareolus*, *Terricola* ex gr. *subterraneus*, and *Spermophilus* ex gr. *suslicus* were also recorded. The fauna does not contain archaic early or middle Pleistocene species, but differs from modern fauna as seen by a large percentage of Asian species, including *Ochotona* cf. *pusilla*, *Microtus (Stenocranius) gregalis*, and *Eolagurus* sp. The presence of *Spalax* is also notable as its current distribution is much further south than the location of Mikhailovka. There are significant morphological differences between the rodents from Mikhailovka and modern representatives. The cheek tooth morphology of *Arvicola* from Mikhailovka-5 is intermediate between the Likhvinian *A. mosbachensis* and modern *A. terrestris*. *Microtus* ex gr. *agrestis* from Mikhailovka-5 is much more primitive than the modern *M. agrestis* in the structure of the accessory prism on the M2. *Terricola* also shows differences in the structure of m1 and m2 from the modern morphotype, although the specimens from Mikhailovka are closer to the modern *T. subterraneus* than to the middle Pleistocene *Terricola* from the Don and Dnieper basins. The complete list of small mammals from Mikhailovka-5 follows:

Talpa ex gr. *europaea* L.	16
Sorex cf. *minutus* L.	1
Sorex ex gr. *araneus* L.	19
Sorex sp.	8
Ochotona cf. *pusilla* Pallas	5
Spermophilus ex gr. *suslicus* Güldenstaedt	18
Apodemus ex gr. *sylvaticus* L.	6
Clethrionomys glareolus Schreber	30
Eolagurus sp.	1
Arvicola ex gr. *sapidus* Miller	95
Terricola ex gr. *subterraneus* (Selys-Longchamps)	12
Microtus (Stenocranius) gregalis Pallas	2
Microtus arvalinus Hinton	8
Microtus ex gr. *agrestis* L.	107
Microtus sp.	132
Spalax ex gr. *microphtalmus* Güldenstaedt	11

The mollusk fauna is rich and includes a large number of terrestrial species. Similar to the mammalian fauna, the mollusks indicate extremely favorable conditions. Several species that have more southern and western current distribution are present at Mikhailovka-5, including *Acme polita*, *Ruthenica filograna*, and *Truncatellina costulata*. The fauna is of an interglacial type and lacks any northern species that would indicate a cool climate. The complete list of molluskan taxa from Mikhailovka-5 follows:

Acme (Platyla) polita (Hartmann, 1840)	211
Carychium minimum Müller, 1774	784
Carychium tridentatum (Risso, 1826)	1365
Succinea putris (Linnaeus, 1758)	4
Succinella oblonga (Draparnaud, 1801)	2
Vallonia (Vallonia) costata (Müller, 1774)	453
Vallonia (Vallonia) pulchella (Müller, 1774)	370
Acanthinula aculeata (Müller, 1774)	14
Cochlicopa (Cochlicopa) lubrica (Müller, 1774)	2
Vertigo (Isthmia) pygmaea (Draparnaud, 1801)	19
Vertigo (Vertigo) pusilla Müller, 1774	13
Vertigo (Vertigo) substriata (Jeffreys, 1830)	288
Vertilla angustior (Jeffreys, 1830)	1248
Truncatellina costulata (Nilsson, 1822)	4
Euconulus fulvus (Müller, 1774)	7
Discus ruderatus ruderatus (Studer, 1820)	11
Punctum pygmaeum (Draparnaud, 1801)	117
Macrogastra plicatula (Draparnaud, 1801)	13
Ruthenica filograna (Rossmässler, 1836)	7
Planorbis planorbis (Linnaeus, 1758)	7
Lymnaea (Lymnaea) stagnalis (Linnaeus, 1758)	4

The mollusk fauna does not contain extinct species typically present in the middle Pleistocene faunas of Central Russia indicating that there was a significant molluskan faunal turnover between the middle and late Pleistocene. Both the molluskan and mammal fauna from Mikhailovka-5 indicate favorable climatic conditions, especially in the diversity of insectivores, particularly the moles. Abundant remains of rodents such as *Clethrionomys*, *Apodemus*, and *Terricola* as well mollusks such as *Acme*, *Macrogastra*, *Ruthenica*, *Punctum*, and *Acanthinula* indicate the presence of extensive woodlands of a mixed or broadleaf type, which are typical for this latitude during the Eemian interglacial on the Russian Plain[3]. The abundance of *Microtus* ex gr. *agrestis*, *Vallonia*, and especially *Vertilla angustior* indicate the presence of wet meadows. Based on morphological, paleoecological, and stratigraphic data, we conclude that Mikhailovka-5 belongs to the Mikulino (=Eemian) interglacial.

References

Agadjanian, A.K. 2009. Small Mammals of the Pliocene-Pleistocene of the Russian Plain. Proceedings of the Paleontological Institute, Vol. 289. Nauka Pr., Moscow, 686 pp.

Agadjanian, A.K. and N.I.Glushankova. 1986. Pleistocene of Desna basin [in Russian]. Moscow State University Pr., Moscow, 227 pp.

Markova, A.K. 2000. The Mikulino (= Eemian) mammal faunas of the Russian Plain and Crimea; *in*: Van Kolfschoten, Th. and P.L. Gibbard (eds.), The Eemian – Local Sequences, Global Perspectives. Geologie en Mijnbouw / Netherlands Journal of Geosciences 79:293-301.

THE LATE PLEISTOCENE AND HOLOCENE OF THE NORTH-WESTERN BLACK SEA AREA: PALAEOGEOGRAPHY, PALAEOCLIMATE AND ARCHAEOLOGY

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The latest geological studies of the Black Sea shelf, limans (estuaries) and baymouth barriers have provided the new data on transgressive and regressive phases during the Late Pleistocene and Holocene (Konikov et al., 2007, 2010). During the LGM, the sea level was 80-110 m below the modern one. Then, 18 – 12.5 ky BP, the sea level rise took place at the expense of an increase in river discharge and water overflow from the Caspian Sea. The phases with high rate of the sea level rise were alternated with the phases of the stable level position and even with the regressive phases (Fig.). At 16-14 ky BP, when the sea level was around -40 m, the bilaterial overflow through the Bosporus has started. The eustatic fluctuations and changes in the Black Sea water salinity impacted the liman salinity and the possibilities of human occupation. The Novochernomorean transgression of the Black Sea, corresponding to the Chalcolithic and the Bronze Age, had two peaks: the Lower Novochernomorean (the maximum 5.0 uncal. ky BP or ca. 3950–3710 BC) and the Upper Novochernomorean (3.2 uncal. yr. BP or ca. 1500–1440 BC) transgressions. They were separated by Khadzhibeian regression (3500/3350 – 2290/2150 BC) which reached its peak around 4.2-4.0 uncal. ky BP (or ca. 2570–2475 BC). During the Novochernomorean phase, the salinity of the Black Sea basin was higher than nowadays (Fig.).

The changes in the Holocene vegetation and climate in the Ukrainian steppe are reconstructed on the basis of pollen data (Kremenetsky, 1991-2003; Gerasimenko, 1994-2011; Bezus'ko et al., 2004-2009). They were of an oscillatory type: the warm phases alternate with the cool ones, and humid phases were replaced by wet ones. Subsistence of the Mesolithic, Neolithic, and Chalcolithics is evidenced by ethnobotanical data on assortment of domesticated and wild plants that were used for food (Gerasimenko, Pashkevich, 2011). At the beginning of the Late Atlantic, the settlements of the Gumelnitsa Culture (5810±150, 5300±60 BP at the Vulcanesti III site) existed in the mesophytic steppe under a climate which was warm and wetter than at present. The subsistence was predominantly based on animal rearing, and agriculture was less important. The large-scale agricultural colonization of Ukraine occurred during the Late Atlantic-Early Subboreal, and it has corresponded to the Cucuteni-Trypillya culture (in the area from the Prut to the Southern Bug). The climate was most appropriate for the spread of broad-leaved species in the valley forests. Obviously the ratio of temperatures and precipitation was also the optimum for farming. The dominant species of the Trypillya cultigens were hulled wheats: emmer, einkorn and spelt, supplemented by naked and hulled barley. During the third phase of the Tripyllya culture, the aridification of climate is indicated by spread of typical grassaland. The role of broomcorn millet increased at that time. The sharp climatic change after ca 3000 BC caused a decline of the Trypillya agriculture.

The Usatovo culture first appeared during the transition period between the Atlantic and Subboreal (4.76-4.15 uncal. yr. BP or ca 3640-2880 BC), and it disappeared at the beginning of the Middle Subboreal (SB–2) which was characterized by a considerable aridification. In the steppe, the Yamna culture existed during the Early Subboreal and beginning of the Middle Subboreal, and it corresponds well to the Khadzhibeian regression (4.6-4.0 uncal. yr. BP, or 3300-2100 BC). The Catacomb culture corresponds partly to the Middle Subboreal, i.e. it appeared during the peak of the Khadzhibeian regression and existed until its end (4.0 uncal. yr. BP or 2580-2040 BC). In the North-Western Black Sea area, radiocarbon and archaeological dating show the absence of any lacunas in development of the cultures during the cool Early Subboreal. On the contrary, the majority of the ^{14}C-dates from the sites of the Early Bronze Age correspond to the period of temperature fluctuations.

References

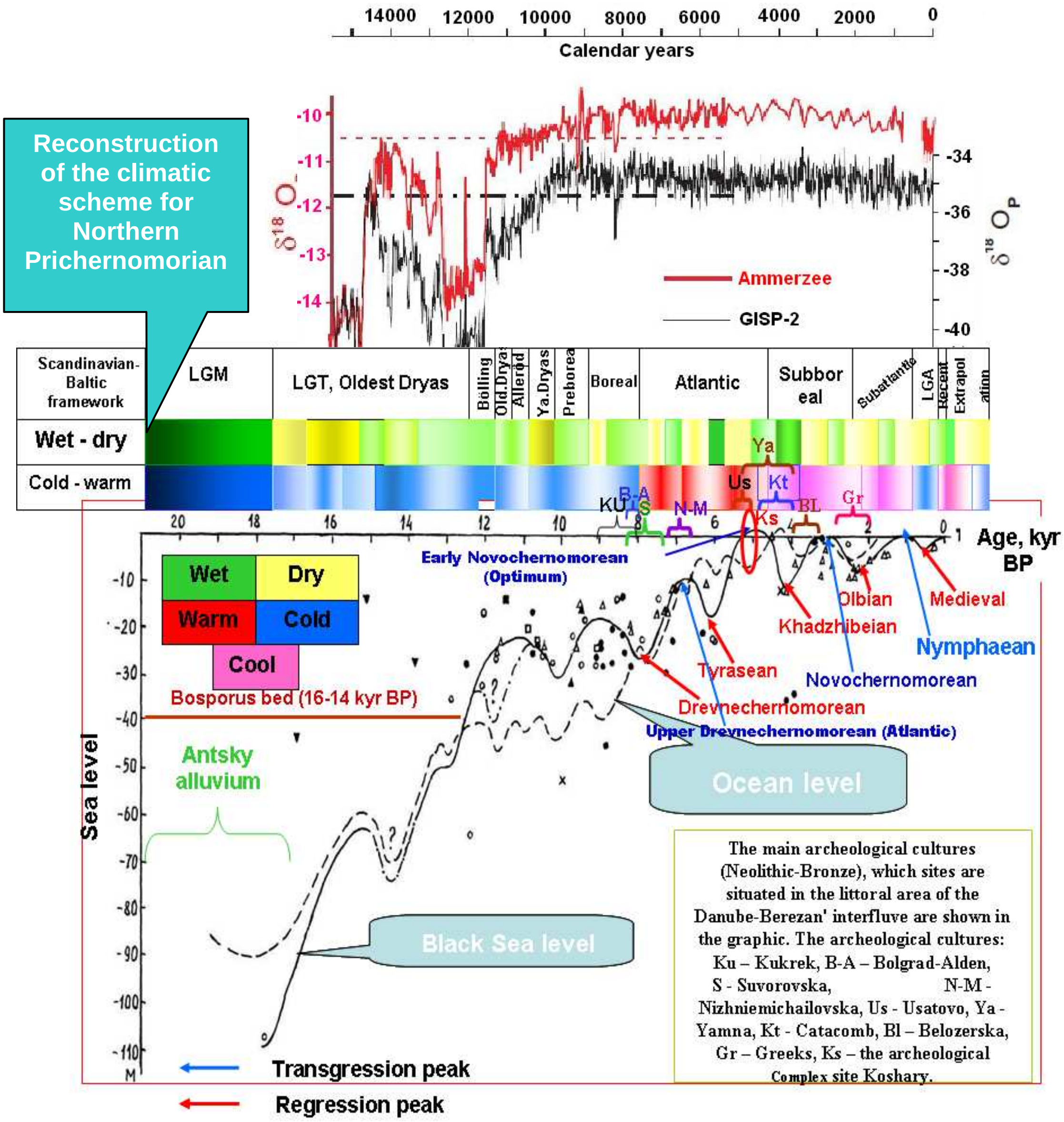
N. Gerasimenko, Pashkevich, G., 2011. Environment and subsistence during the Mesolithic and Chalcolithic in Southern Ukraine (based on palynology and ethnobotany)/ In: INQUA 501 "Caspian-Black-Sea-Mediterranean Corridor during Last 30 Ky: Sea Level Change and Human Adaptive Strategies", 7th Plenary Meeting and Field Trip, Odessa, Ukraine, 2011. – pp. 95-97.

U.V. Grafenstein, Erlenkeusen H., Breuer A., Jouzel J., Johnsen S., 1999. A isotope-climate record from 15,500 to 5,000 yr BP / Science 284, 1654-1657.

E.G. Konikov, Likhodedova O.G., Pedan G.S., 2007. Paleogeographic reconstuctions of sea-level change and coastline migration on the northwestern Black Sea shelf over the past 18 kyr/ Quaternary International, 167 – 168, 49-60.

E. Konikov, Ivanova S, Vinogradova E, Kiosak D, Govedarica B., 2010. The role of the liman-baymouth complexes in human settlement in the Eneolitic to Bronze Age/ In: IGCP-521 „Black Sea - Mediterranean Corridor During The Last 30 ky: Sea Level Change and Human Adaptation " - INQUA 0501"Caspian-Black-Sea-Mediterranean Corridor During Last 30 Ky: Sea Level Change and Human Adaptive Strategies" 6th Plenary Meeting and Field Trip, Rhodes, Greece.– pp. 101-103.

N.A. Mörner, 1971. Eustatic changes during the last 20 000 years and a method of separaiting the isostatic and eustatic factors in an uplifted aera. Paleogeography, paleoclimatology, Paleoecology, 9, 3: 153-181.



Palaeoclimate and sea-level reconstruction for North-Western Black Sea Area over the last 16 ky as compared to the World Ocean (Mörner, 1971). The isotope-climate record from U. Grafenstein et al, 1999.

Luminescence dating of Pleistocene sea level high stands along Mediterranean coastlines: assessment of recent dating technologies

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Pleistocene interglacial high sea level stands are observed, documented, and can be traced for several km but their ages remain difficult to assess. U-Th dating of corals is commonly the first dating target and it is commonly reliable, precise and generally considered exact. Material for robust U-Th dating is rare, therefore alternative dating methods are employed, and among those, luminescence dating methods based on infrared stimulated luminescence of feldspar have shown promising for dating the last 500 000 years. A unique advantage of luminescence is its almost ubiquitous applicability to sediment since the routinely used dosimeters, minerals of quartz and feldspars, can be found about everywhere in the world. Specific methodologies were developed for both minerals, and even though a relatively large body of luminescence ages has recently appeared in the literature, dating applications to sediments from former high sea level beach and coastal dune sediments are still clouded by low accuracy, caused by one or several of the following: early onset of saturation, multimodal age distribution from single aliquots and uncertainties about dosimetry, especially for the correct assessment of water content prevalent during the time of burial or the impact of early diagenesis for carbonate-rich sediment on the dose-rate.

For quartz, a major limitation arises from the near saturation of the natural luminescence level, commonly observed for sediments older than the Last Interglacial. In the case of feldspar, if apparent ages are corrected for anomalous fading (AF), interglacial coastal sediments might be datable up to the earliest part of the Middle Pleistocene. At this stage of research, reliable luminescence chronologies have been obtained for the last three high sea level stands. These AF-corrected ages may suffer from the uncertainty in assessing the fading rate. In which case, uncertainties in the order of several 10's of ka could be propagated in the final ages. Recently, workers from laboratories in Europe and China claim that post-IR IRSL measured at high temperature would apparently remove the unstable component of feldspar IRSL and thus provide a new dating tool for sediments older than the Last Interglacial. These new methods and our fading correction age model approach developed over the last decade will be compared and their reliability discussed, in the light of experimental evidence as well as through a comparison of IRSL ages with known age samples. This presentation will be mainly focused on Mediterranean sites, found in Sardinia, Calabria and Tunisia.

DEFLATION AND TRANSPORTATION OF THE UPPER PLEISTOCENE LOESS PARTICLES BY KATABATIC WINDS DURING THE LOW STANDS OF THE ENGLISH CHANNEL: THEIR CONTROL ON THE NEANDERTALIANS AND HOMO SAPIENS DWELLING

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Study of the submerged Pleistocene conglomerates sampled in the English Channel shows that they correspond to successive beach deposits cemented under a loess cover (Danukalova and Lefort, 2009). Although those loess were latter washed out by the different transgressions, the Northern limit of the conglomerates can be taken as the past offshore extension of the loess cover (Lefort et al., 2011). Onshore, the loess are confined close to the shoreline and never pass beyond the Brittany and Normandy hills, save in a large gully corresponding to a linear topographic depression. Compilation of the offshore and onshore altitudes of the loess shows that the loess particles were deposited by “slices” of winds not thicker than 200 metres. This physical characteristic, the proximity of the British Ice Sheet (BIS), the North or Northwest orientation of the blowing winds (fig.) as well as the various typical dust catching processes, suggest that they were transported by strong katabatic winds (Thorson and Bender, 1985).

Study of the heavy minerals in the preferential zones of accumulation between the BIS, Brittany and Normandy shows that, contrary to the katabatic winds which may have propagated over hundreds of kilometres, the distance of transportation of the dust was limited.

A close look at the age of the loess deposited around the English Channel shows that they did not deposited all at he same time. Three main episodes have been recognized between 30 and 11 Ka. They range successively between 26 and 18 Ka, 18 and 15 Ka and 15 and 11 Ka. It is important to stress that the same phases have been observed in the sandy eolian deposits of Northwest and Central Europe. Using the heavy minerals it is possible to separate and delineate various deflation and accumulation areas which geographic distribution seems to be random. We propose that this distribution is related with an increasing dryness associated with the evolution of the Last Glacial cooling.

In Western Europe, some authors have suggested (Antoine et al., 2003) that, the transportation of the loess dust particles was closely related with typical Eastward drifting storms (Sima et al., 2009). It is actually accepted that high altitude winds already existed during the Weischelian and we know that the approach of a low-pressure centre towards a glacial plateau may accelerate the katabatic velocities and generate particularly strong and gusty winds, but they cannot be at the origin of the loess deposited in the studied area for the reasons given above.

Statistic study of the orientation of the Palaeolithic sites (Monnier, 2006) clearly evidence the control of those winds on the choice of the location of the prehistoric shelters. Those sites which are predominantly oriented towards the South or the Southwest were without any doubts selected to escape the strong winds coming from the Ice Sheet which were sometimes reaching and even exceeding 240 Km/h.

References

P. Antoine, J. Catt, J.P. Lautridou, J. Sommé, 2003. The loess and coversands of northern France and southern England. Journal of Quaternary sciences 18 (3-4), 309-318.

G.A. Danukalova and J.P. Lefort, 2009. Contribution of malacology for dating the Pleistocene submarine levels of the English Channel. Journal of the Geological society 166, 873-878.

J.P. Lefort, G.A Danukalova and J.L. Monnier, 2011. Origin and emplacement of the loess deposited in Northern Brittany and under the English Channel. Quaternary International 240, 117-127.

J.L. Monnier, 2006. Les premiers peuplements de l’Ouest de la France. Cadre chronostratigraphique et paléoenvironnemental. Bulletin du Musée d’Anthropologie Préhistorique de Monaco 46, 3-20.

A. Sima, D.D. Rousseau, M. Kageyama, G. Ramstein, M. Shulz, Y. Balkanski, P. Antoine, P. Dulac and Ch. Hatté, 2009. Imprint of North-Atlantic abrupt climate changes on Western European loess deposits as viewed in a dust emission model. Quaternary Science Review 28, 2851-2866.
R.M. Thorson and G. Bender, 1985. Eolian deflation by ancient katabatic winds: A late Quaternary example from the north Alaska Ranges. Geological Society of America Bulletin, 96, 702-709.

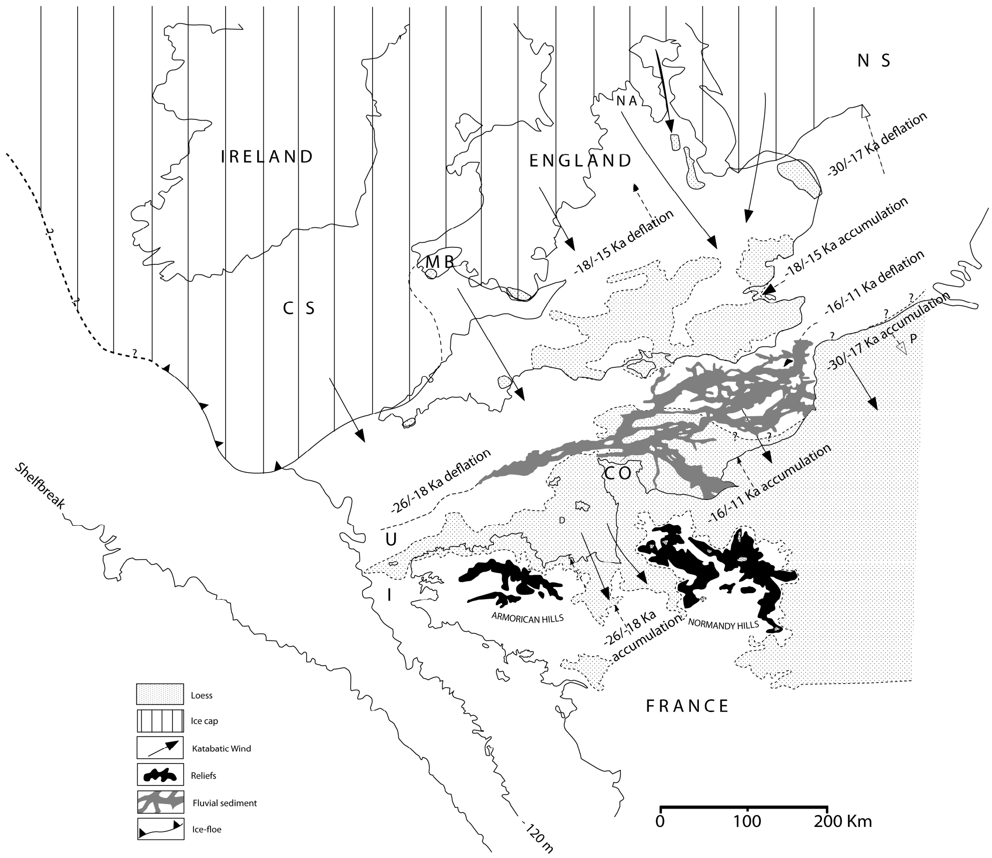

Figure. Reconstruction of the Late Pleistocene relationships which existed between the British Ice Sheet (BIS), the proposed deflation and accumulation zones, the katabatic winds and the Mid-Channel fluvial deposits. CO: Cotentin; I: Iroise Sea; CS: Celtic Sea; MB: Mullock Bridge ice reentrant; NA: North Anston ice re-entrant; NS: North Sea; P: Picardie; U: Ushant Island.

CHRONOLOGY OF SEA TRANSGRESSIONS DURING EEMIAN IN NORTHERN POLAND

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Pleistocene marine sediments in northern Poland have been investigated for over 150 years. A discussion focused mainly on setting of the Eemian marine sequence as well as on chronology of the interglacial marine episodes, namely of the older – the so-called Sztum sea and of the younger – the so-called Tychnowy sea (Makowska, 1979, 1986). To resolve these problems a research borehole was done at Cierpięta near Sztum (Fig. 1), the type section of the so-called Krastudy Interglacial (Makowska, 1986). The core was examined by lithological, palynological, plant macrofossil, diatom, mollusk, ostracod and foram analyses, completed with radiocarbon, OSL and amino-acid analyses. Results of these analyses enabled to reconstruct chronology of geological phenomena since the termination of the Odranian Glaciation (Saalian) until the first ice sheet advance of the Vistulian Glaciation (Weichselian).

The Late Saalian series (depth 118.5 – 140.8 m) is composed of silts and clays with sandy interbeddings and dispersed organic matter, OSL-dated to 102.5-96.6 ka. Both aquatic and terrestrial plants indicate a cool, boreal climate and a scarce vegetation cover. These deposits have been considered previously for representing the older Eemian (or pre-Eemian) marine transgression (Makowska, 1986) but in fact, they are typical for a flood facies of a meandering river in a temperate climate or for a deposition at a river mouth.

The overlying massive sands (depth 109.6 – 118.5 m) are of solifluction origin and OSL-dated to 86.5-70.1 ka. Successive mass movement episodes are indicated by sandy-gravel interbeds; two thin layers of horizontally bedded sands represent occasional but small discharges. These sands are followed (depth 108.0 – 109.6 m) by sands and silts with some inserts of humus and peat, typical for a river floodplain in a temperate climate. A pollen spectrum points out to the oldest pollen zone of the Eemian Interglacial, correlated with RPAZ E2.

A marine series (depth 108.0 – 102.85 m) starts with a shellstone (depth 107.1 – 108.0 m), overlain by clays and silts (depth 102.85 – 107.1 m) with sandy streaks and fine pieces of mollusk shells. The sediments contain mollusks, ostracods and foraminifers characteristic for arctic-boreal and boreal climate. Rare freshwater mollusks and ostracods, typical for an oligotrophic reservoir, occurred at depth 105.9 m. Spikes and skeleton plates of sea-urchins, known also from other sites in northern Poland, are the evidence for a high salinity (to 28 psu). The examined faunistic assemblages indicate, both from taxonomic and paleoenvironmental point of view, concise connections with Eemian marine fauna from Denmark and Germany. If compared with mollusks, the Eemian sea transgression was accompanied by easier migration of boreal-arctic foraminifers than of the Lusitanian ones.

A pollen succession is interrupted by interbeds of pollen-barren deposits. No abundant pollen of *Quercus* occurred that could be correlated with RPAZ E3, but there are distinct pollen zones corresponding to RPAZ E4 and E5 (after Mamakowa, 1989). Plant remains indicate quiet deposition in a reservoir to 10 m deep. There was a temperate warm climate at the termination of this period and aquatic vegetation has disappeared. Abundant pollen of trees and bushes and of other terrestrial vegetation indicates a drop of water level.

A diatom record shows two transgressive pulses, characterized by almost equally high salinity (at depths 108.00 – 106.00 m and 104.00-102.50 m). These two marine episodes are apparently separated by a decreased salinity (depth 105.50-104.00 m). In the lower part of the section a content of freshwater forms is rather low and indicates a strong upward increase, apparently related to the varying riverine inflow. Generally, a low content of the planktonic species indicates a shallow water environment, most likely a lagoon-like with a high freshwater discharge. Termination of the marine episode (102.50-101.25 m) indicates rather a rapid salinity decrease, shown by abrupt decrease and finally disappearance of marine and brackish species, accompanied with a strong increase of freshwater taxa. An increasing content of freshwater forms and their dominance in the uppermost part of the section may indicate a deltaic environment.

The overlying peaty sands (depth 98.5 – 102.85 m) pass upwards into fine-grained sands with inserts of peat. A bottom of this series was radiocarbon dated to 44 700 – 43 000 cal BC. This series represents a fine-grained floodplain of river flowing in a temperate climate. A pollen succession indicates already a beginning of the Vistulian Glaciation. There is a high content of terrestrial plants and a renewed appearance of boggy habitats. An occurrence of decidedly thermophilous taxon of *Potamogeton obtusifolius* during a progressing cooling confirms a theory on slower reaction of aquatic plants on a climatic deterioration. The reservoir was subjected to intensive overgrowing and shallowing and its shores were influenced by seasonal water fluctuations.

The overlying sands (depth 87.0 – 98.5 m) are massive and do not contain any organic matter. A vegetation cover must have been reduced and mass movements developed. Abundant quartz grains of aeolian origin, locally over 80%, indicate intensive aeolization, directly before initiation of mass movement processes. Traces of aeolian treatment are visible on edges and corners of quartz grains, therefore aeolian processes must have been active for several hundred years. Sandy deposits above (depth 82.6 – 87.0 m), radiocarbon dated to 52 500 ± 1400 lat BP, are of fluvial origin.

Complex examination of this new borehole supplied with new evidence that contests possible occurrence of the older Eemian (pre-Eemian) marine transgression. It enabled to determine water salinity, to estimate a river discharge into a sea bay in the Lower Vistula Valley region and to define a time of its shallowing and transformation into a lake-boggy reservoir. The diatom analysis indicated in general an early and rapid marine transgression. In connection with other sections with Eemian marine sediments in northern Poland, particularly interesting is the occurrence of two pulses of increased salinity. They prove that transgression of the Eemian sea in southern Baltic region occurred in two steps, with their maxima at about 1000 and 5000 years since the beginning of the Eemian Interglacial (cf. Knudsen et al., 2012). During the transgression a number of diatom species, typical for a tidal plain, has considerably increased. It is evidence not only for flooding of the flat sea-shore areas but also for more intensive tides. However, explanation of this phenomenon is not possible until its wider identification in the whole Baltic Basin.

References

Knudsen, K.L., Jiang, H., Gibbard, P.L., Kristensen, P., Seidenkrantz, M.-S., Janczyk-Kopikowa, Z., Marks, L. 2012. Environmental reconstructions of Eemian-Stage interglacial marine records in the Lower Vistula area, southern Baltic Sea. Boreas, 41 (2): 209-234.

Makowska, A. 1979: Eemian Interglacial in valley of Lower Vistula River. Studia Geologica Polonica,63: 1–90.

Makowska, A. 1986: Pleistocene seas in Poland – sediments, age and palaeogeography. Prace Instytutu Geologicznego,120: 1–74.

Mamakowa, K. 1989. Late Middle Polish Glaciation, Eemian and Early Vistulian vegetation at Imbramowice near Wrocław and the pollen stratigraphy of this part of the Pleistocene in Poland. Acta Palaeobotanica,29 (1): 11-176.

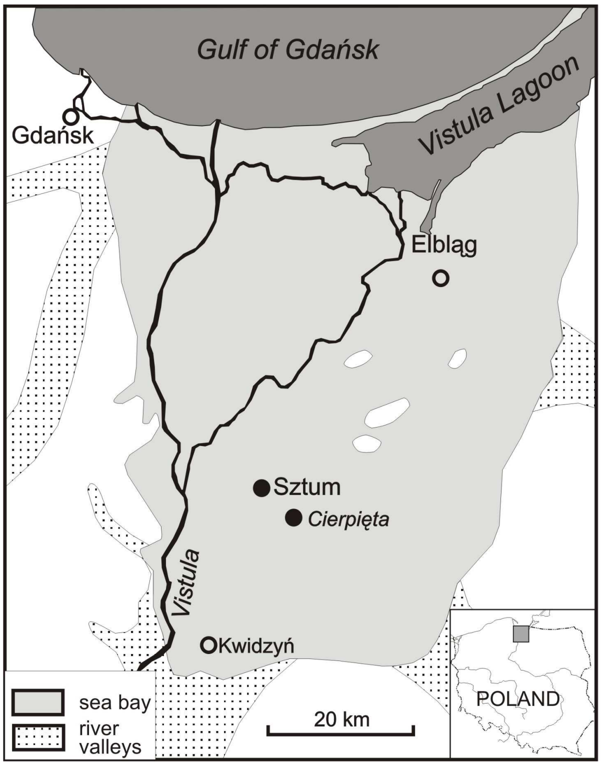

Fig. 1.Paleogeography of the Eemian sea in the Lower Vistula Valley Region and location of the research borehole Cierpięta

THE SU FOSSU DE CANNAS CAVE (SADALI, CENTRAL-EASTERN SARDINIA, ITALY): A KEY SITE FOR INFERRING THE TIMING OF DISPERSAL OF GIANT DEER IN SARDINIA

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The Su Fossu de Cannas Cave, cut into the Mesozoic limestone in the Barbagia of Seulo region, is located in the central sector of the Sadali limestone plateau (Fig1). The geomorphology of the area has been influenced by Cenozoic tectonic movements that affected the development of the hydrographic network and both the deep and superficial karst evolution. The morphology of the plateau is characterized by wide palaeovalleys, aligned in a NE-SW direction, and a number of solution/collapse dolines. The presence, on the plateau surface, of flowstone and stalactite relicts attests to the previous existence of some caves, then affected by an intense process of erosion and alteration of the Mesozoic limestone bedrock. Hypogean karst phenomena are represented by numerous cavities developed along the principal faults. The karst evolution of the Su Fossu de Cannas cave - possibly starting before the Pliocene - was complex and no firm evidence allows to detect the sequence of sedimentation and erosion processes leading to its present status. The uppermost level of the cave, now accessible by a small fissure, consists of a narrow horizontal chamber highly concretionary, developing along a NW-SE fault. A narrow vertical shaft, about 1 m deep, is present at the end of the chamber, and it is partially filled with a thick flowstone, coming from a ceiling fissure. At the shaft bottom a horizontal tunnel, about 60 cm high, develops below the floor of the upper chamber. The ceiling of this tunnel, is formed by a conglomerate, containing several cervid remains, most of which completely covered by a thin concretion. A few bones, imbedded in the red sandy cemented matrix of the conglomerate, were uncovered some years ago during a speleological survey. Successively, an incomplete femur and a metacarpal were recovered, while an hemimandible was studied in situ (Palombo et al., 2003; Palombo and Melis, 2005). The few specimens thus far analyzed show some morphological affinities with the endemic Sardinian megacerine *Praemegaceros cazioti* from which the Sadali cervid differs in its larger size (exceeding the range of variation calculated for this endemic species), and in some morphological features (such as the depth and curved *corpus mandibulae*) (Fig.2), as well as in its proportionally smaller teeth and notably elongated, slender metacarpal. Due to its size and peculiar features, the Su Fossu de Cannas deer *(Praemegaceros* aff. *P. sardus)* can be regarded as the most primitive megacerine hitherto found in Sardinia and the ancestor of the endemic species *P. cazioti*. The later has been reported from several Sardinian and Corsican sites, ranging in age from the late Middle Pleistocene to the early Holocene (see Palombo 2009 and references therein). Although it has been suggested that its mainland ancestor would have colonized Sardinia by the end of the Early Pleistocene, the actual timing of its dispersal is unknown. Aside the Su Fossu de Cannas deer, the oldest Sardinian cervids, ascribed to *Praemegaceros sardus* (= *Megaloceros sardus* in Van der Made and Palombo 2006), are those from some fissures at Monte Tuttavista (Orosei), Capo Figari (Olbia) and Santa Lucia quarry (Fluminimaggiore) (Van der Made and Palombo, 2006 and references therein). In the later locality - yielding also still unstudied remains of a small mustelid, *Cynotherium*, *Prolagus*, *Microtus* (*Tyrrhenicola)*, *Rhagamys* and Amphibia - a tooth of deer dated by ESR, gave a date of 450 ± 90 ka BP (*fide* Van der Made, 1999). Although the Santa Lucia cervid is of particular interest because it provide the only chronological information on the passage from large to smaller endemic deer, hitherto there are not any evidence confirming a presence of giant deer in Sardinia at the beginning of the Middle Pleistocene. Further information about the chronology of the arrival of the ancestor of the megacerine Sardinian lineage, may be obtained from U-Th dating, currently in progress, of concretions covering the Su Fossu de Cannas bones. The data may define a *terminus ante quem* for the sedimentation of the Sadali deer remains, which, for their peculiar features and dimensions, likely represent the most archaic megacerine population among those recorded in Sardinia to date.

References

J. Made, Van der 1999. Biogeography and stratigraphy of the Mio-Pleistocene mammals of Sardinia and the description of some fossils. Deinsea, 7, 377-360.

J. Made, Van der, M.R. Palombo, 2006. Large deer from the Pleistocene of Sardinia. Hellenic Journal of Geosciences, 41,163-176.

M.R. Palombo, 2009. Biochronology, paleobiogeography and faunal turnover in western Mediterranean Cenozoic mammals. Integrative Zoology, 4: 367–386.

M.R. Palombo, R.T Melis, 2005. Su Fossu de Cannas Cave (Sadali, central-eastern Sardinia, Italy): the oldest deposit holding Pleistocene megalocerine remains in Sardinia". In Alcover, J.A. & Bover, P. (eds.), Proceedings of the International Symposium "Insular Vertebrate Evolution: the Palaeontological

M.R Palombo., R.T. Melis., S. Meloni, C. Tuveri (2003) – New cervid in the Pleistocene of Sardinia (Italy). Boll. Soc. Paleontol. It, 42(1-2): 157-162.

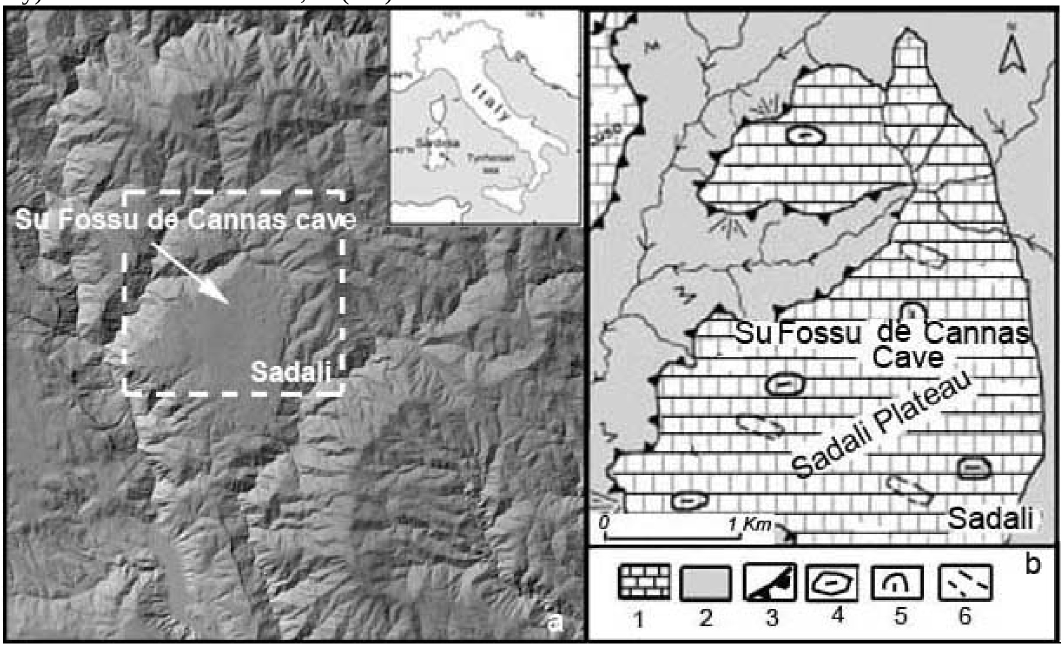

Fig 1. a) Study area in the central eastern Sardinia (Italy); b) Geomorphological sketch map of Sadali Plateau: 1. Mesozoic limestone bedrock, 2. Paleozoic metamorphic bedrock, 3. Escarpment, 4. Doline, 5. Cave, 6. Palaeovalley.

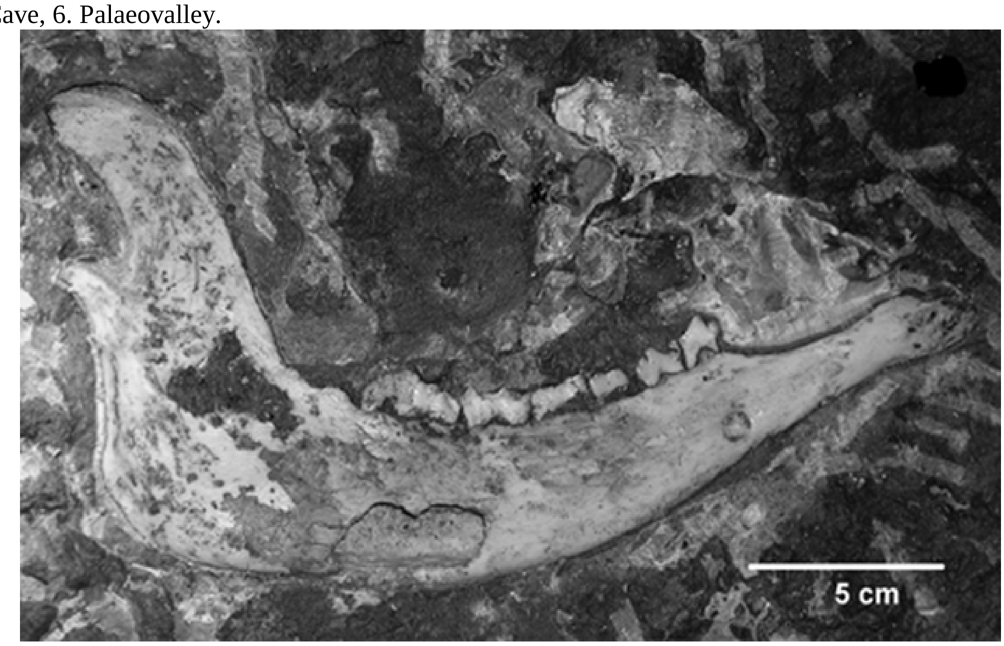

Fig.2.*:* Left hemimandible of *Praemegaceros* aff. *P. sardus* from the Su Fossu de Cannas cave.

LATE-QUATERNARY PALEOENVIRONMENTAL EVIDENCES ALONG THE CENTRAL WESTERN COAST OF SARDINIA (ITALY): PRELIMINARY RESULTS

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The Late Quaternary evolution of coastal systems in the Mediterranean area has been shown to be controlled mostly by relative sea-level changes (Antonioli et al., 2004, Amorosi and Milli, 2001; Anzidei et al., 2011; Faivre et al., 2011; Lambeck et al., 2011; Orrù et al., 2011). In Sardinia (Italy), high-resolution stratigraphic studies of the response of the coastal system to Late Quaternary sea-level fluctuations, obtained from multidisciplinary study of borehole cores, are rare (Del Vais et al., 2008, 2010; Porcu, 2006; Porcu et al., 2008, 2011). In this paper we present the preliminary results of integrated sedimentological, micropaleontological (foraminifera and ostracods) palinological and malacofaunal analyses of one 17 m-thick core (S1) from the central littoral barrier of Mistras Lagoon (Central Western Sardinia) in the Northern sector of the Oristano Gulf (Fig.1). Sedimentological analyses show a vertical cyclic pattern of facies, including continental, paralic and shallow-marine deposits. Particularly, the lower part of the studied succession is characterized by alluvial plain sediments. In contrast, the remaining part of the succession was formed in a variety of depositional environments, from coastal to shallow marine. The benthic foraminifera thanatocoenosis found in the sediments consist of still living species in Mediterranean area, especially in marine environments of paralic domain and of infralittoral and circalittoral plans. Therefore the Pleistocene - Holocene associations of borehole core have been set according to the ecological value represented by the same taxa also present in the actual environment (Cimerman and Langer, 1991; Sgarrella and Moncharmont Zei, 1993, Fiorini and Vaiani, 2001). The statistical analysis has allowed to perform a division into four main groups, characterized by species that can be considered diagnostic of well-defined environments, thus resulting significant for the paleoenvironmental indication. Within the groups then have been recognized three principal associations, which allowed to establish that the deepest sediments are representative of a transition environment between lagoon and infralittoral. Subsequently following one another approximately ten changeovers from a more purely lagoon environment but with marine influences and a marine sublittoral environment with a very close lagoon, up to the latest levels of the sedimentary sequence studied where there is a return to a transition environment between lagoon and infralittoral. The silty-clay core samples analysed yielded ostracod assemblages composed by species presently living in marine, brackish and continental waters of the Mediterranean area. The presence of specimens pertaining to taxa occurring in continental waters is scattered and these forms have been considered allochthonous. Euryhaline and stenohaline marine ostracods occur in all the assemblages indicating an upper infralittoral marine paleoenvironment with a persistent influence of freshwater supply. The relative abundances of low-salinity tolerant taxa increase from the base of the core to the uppermost samples, suggesting a moderate ecological shift toward a transitional paleoenvironment.

The mollusca species, found in the bioclastic sediments of the succession, suggest marine and shallow marine-lagoonal conditions (*Bittium reticulatum*, *Cerastoderma glaucum, Cerithium sp*. and *Rissoa ventricosa).* Fibrous residues of *Posidonia oceanica* occurs in large quantities, mostly in the middle part of the succession.

The pollen analysis from Mistras Lagoon provides one of the first records of mid- and late-Holocene vegetation history in Sardinia. The pollen diagram documents the development of an evergreen vegetation ecosystem and a local coastal salt-marsh under the influence of human impact, geomorphic dynamics and climate processes (Di Rita and Melis, submitted).

AMS radiocarbon dates of *Posidonia* and shells, indicate a Late Pleistocene to Holocene age of the sedimentary succession, in particular, formation of lagoonal deposits can be referred to the Holocene sea-level rise.

*This work is also supported by the operating program of Regione Sardegna (European Social Fund 2007-2013), L.R.7/2007, A*agosto 2007, n. 7 ‘‘*Promozione della ricerca scientifica e dell'innovazione tecnologica in*

Sardegna'', pubblica selezione per il conferimento di borse di ricerca destinate a giovani ricercatori—BandoA 2008.

References

F. Antonioli, K. Lambeck, A. Amorosi, G. Belluomini, A. Correggiani, S. Devot, S. Demuro, C. Monaco, R. Marocco, P. Orrù, S. Silenzi, 2004. Sea level at 8 and 22 ka BP along the Italian coastline – in Climax maps Italy, Explanatory notes – Ed. Antonioli F., Vai G.B. – Firenze 2004

M. Anzidei, F. Antonioli, K. Lambeck, A. Benini, M. Soussi, R. Lakhdar, 2011. New insights on the relative sea level change during Holocene along the coasts of Tunisia and western Libya from archaeological and geomorphological markers. Quaternary International, vol. 232; p. 5-12, ISSN: 1040-6182, doi: 10.1016/j.quaint.2010.03.018

F. Cimerman, M. R. Langer, 1991. Mediterranean foraminifera - Ljubljana, Slovenska akademia, 118 pp., 93 pls.

C. Del Vais, A. Depalmas, A.C. Fariselli, R.T Melis, G. Pisanu, 2008. Ricerche geo-archeologiche nella Penisola del Sinis (OR): aspetti e modificazioni del paesaggio tra preistoria e storia. In Atti del II Simposio Il monitoraggio costiero mediterraneo: problematiche e tecniche di misura (Napoli 4-6 giugno 2008). Firenze: CNR IBIMET, pp. 403-414.

C. Del Vais, A.C. Fariselli, R.T. Melis, G. Pisanu, I. Sanna, 2010. Ricerche e scavi subacquei nella laguna di Mistras (Cabras – OR). ArcheoArte 1, pp. 299-300.

S. Faivre, E. Fouache, M. Ghilardi, F. Antonioli, S. Furlani, V. Kovacic, 2011. Relative sea level change in western Istria (Croatia) during the last millennium. Quaternary International, vol. 232; p. 132-143, ISSN: 1040-6182, doi: 10.1016/j.quaint.2010.05.027

F. Fiorini & S. C. Vaiani, 2001. Benthic foraminifers and transgressive-regressive cycles in the Late Quaternary surface sediments of the Po Plain near Ravenna (Northern Italy). Boll. Soc. Paleont. Ital., 40 (3), 357-403.

K. Lambeck, F. Antonioli, M. Anzidei, L. Ferranti, G. Leoni, G. Scicchitano, S. Silenzi, 2011. Sea level change along the Italian coast during the Holocene and projections for the future. Quaternary International, vol. 232; p. 250-257, ISSN: 1040-6182, doi: 10.1016/j.quaint.2010.04.026

P. E. Orrù, F. Antonioli, P. J. Hearty, U. Radtke, 2011. Chronostratigraphic confirmation of MIS 5 age of a baymouth bar at Is Arenas (Cagliari, Italy). Quaternary International, vol. 232; p. 169-178, ISSN: 1040-6182, doi: 10.1016/j.quaint.2010.04.031

A. M. Porcu, 2006. Analisi della dinamica climatica dell'Olocene basata su differenti metodi (biotici e abiotici) di ricostruzione ricavata dagli archivi sedimentari del Golfo di Cagliari. Paleoitalia, 15, 35-40.

A. M. Porcu, P. Pittau, R. Melis, 2008. Variazioni climatiche e ambientali durante l'Olocene nell'area lagunare di Santa Gilla (Cagliari). Rend. Online Soc. Geol. It., 3, 657-658.

A. M. Porcu, A. Cherchi, P. E. Orrù, P. Pittau, 2011. Climatic and environmental changes of the Santa Gilla Lagoon (Cagliari) during the Holocene. Il Quaternario, Italian Journal of Quaternary Sciences 24 (Abstract AIQUA, Roma 02/2011), 51 – 53.

F. Sgarrella & M. Moncharmont Zei, 1993. Benthic foraminifera of the Gulf of Naples (Italy): systematics and autoecology - Boll. Soc. Paleont. Ital., 32 (2), 145-264.

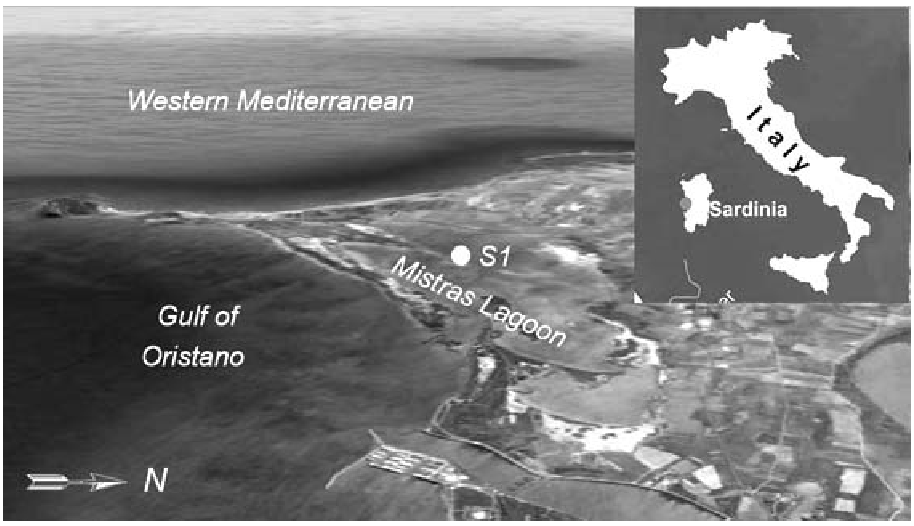

Fig.1 Studied area and location of S1 core in the Mistras Lagoon (Sardinia, Western Mediterranean sea).

NEW INSIGHTS ON THE QUATERNARY STRATIGRAPHY OF THE COARSE-GRAINED GOLO DELTA (EAST-CORSICA MARGIN).

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The Golo river is the main river flowing from northwestern Corsica to the Mediterranean Sea. It takes its source in the highest summit of Corsica, the Monte Cinto (2706m). The very incisive and steep profile (1.72°) of the Golo river runs along a small watershed (1005 km²) composed of hercynian granites and most recent allochthonous ophiolitic and schist sheets. The Golo river shows a well-developed terrace system on the 'Marana-Casinca plain' on the northeast-Corsica. This alluvial plain should be considered as the first depositional area shaped by the major changes of the Quaternary sediment fluxes provided by the Golo watershed.

Previous studies on the deltaic plain provided a detailed geological map based on superficial outcrops. In 1975, Conchon attempted to classify these terraces using the superficial topographic and lithological observations and petrographic and alteration-state of the pebbles and matrix. The Golo deltaic plain is thus constituted on its upstream part by old well-altered or powdered-pebbles tilted terraces then seaward by more recent less-altered-pebbles wide-spread terraces. At the moment delta geochronology is based on association between each terrace with a Quaternary glacial stage. A narrow Holocene beach ridges seaward embed these deltaic formations and constrain the recent and present deposits in the modern Golo valley.

The maximum northward and southward river migrations were also proposed by Conchon (1975) and the suspected palaeovalley locations were determined on the basis of the maximal extension of Golo's terraces and preserved topographic lows. Until today there is no information available on the depth of the substratum underneath the alluvial terrace, even if some authors talk about 150 m to 200 m deep.

This study is based on new geophysical and geological acquisitions performed on the delta plain of the Golo river. The acquisition of an integrated dataset with several electric resistivity tomography (E.R.T.) profiles, H/V measurements, new outcrop descriptions, OSL dating (in process) were realized in 2011 during the ElGolo1, 2 & 3 field works. The ERT surveys have been conducted using different strategies: - wide-range of field investigations to decipher the alluvial stratigraphy, evidence the substratum level and localize the paleovalleys (long profiles up to 1260 m long and penetration around 185 m); - detailed prospections to correlate with outcrops and define the terrace organization at the boundaries (short profiles from 64 to 320 m and decameter penetration). The ERT data is a large non-invasive quickly method to investigate and map all of the terraces on the plain. The combination of the new geophysical data with the synthesis of lithological logging information available on the delta plain (underground database under InfoTerre™, BRGM) alows to propose a refined stratigraphic framework of the Golo delta.

As two adjoining sub-surface bodies are characterized by different ranges of resistivity (between 150 to 750 ohms/m), we are able to distinguish the different terraces and make hypothesis on their composition; Alteration, powdered pebbles, clay content in the matrix and the presence of water can significantly modify the resistivity response of the terraces. As an example, we imaged a succession of stepped terraces in the upstream part of the plain. In depth data provide constraints on the extent and the thickness of the alluvial terraces, about 20 meters for the oldest and less for the more recent ones.

The H/V method was also tested as a complement to the ERT profiles to determine the depth of the basement surface and delineating major interfaces within the deltaic successions. In the downstream part of deltaic plain an important interface was thus determined on the S-waves. This in depth boundary is confirmed by a regional surface imaged on the ERT profiles between the alluvial deposits and an undifferentiated basement.

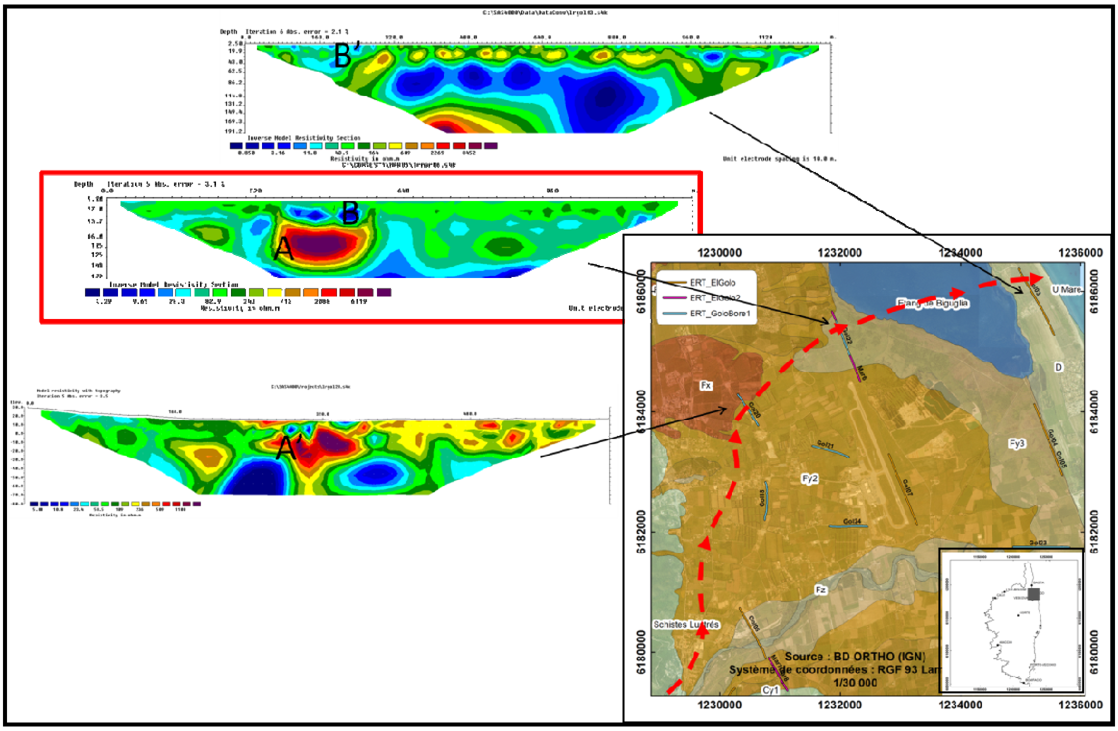
ERT data also allowed the identification in the northern part of the plain of a paleovalley-shape underneath a topographic depression (red dotted line on the figure). 200 meters-width and 150 meters-depth incision can be displayed. The upper layer of this structure shows resistivity between 10 ohms/m to 50 ohms/m. The lower part shows dramatically higher resistivity between 500 ohms/m to 1500 ohms/m. On this section, H/V measurements confirm the resistivity contrast between the conductive and resistive part of this original structure. We interpret this resistivity contrast by a very coarse grain deep infilling topped by a fine grain draped sediment above the channel. The covered deposits are interpreted as a recent alluvial terrace on the Geological map (BRGM Editions).

The new evidences of palaeovalley incisions on the deltaic plain allow to discuss the Quaternary evolution the Golo Delta plain. During this period, the deep incised valleys and the terrace formations have contributed to the local fluvial response to sea-level change. This study shows a new approach in complementary multi-tools study focuses on very heterogeneous environments and the usefulness of combining such different sounding techniques for studying complex deltaic environment.

References

O. Conchon, 1975. Les formations quaternaires de type continental en Corse orientale. Thèse pour obtenir le grade de Docteur ès Sciences Naturelles. Paris, Université de Paris VI, 243pp.

Carte géologique de la France au 1/50 000, carte n°1107 Vescovato, BRGM Editions.



Recognition of a filling of paleovalley on ERT profiles in the alluvial plain of Golo river, High-Corsica.

A: very coarse filling of a paleochannel of Golo river with strong resistive response,

B : filling of the paleochannel by finer materials with slightly resistive response,

A': upstream part of coarse filling A of the paleochannel,

B': downstream part of filling B of the paleochannel by finer materials.

THE MIS 5 HIGHSTANDS ALONG THE NORTHERN ADRIATIC SEA: STRATIGRAPHIC DATA AND PALEOGEOGRAPHIC RECONSTRUCTION

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The north-eastern Adriatic represents the foreland basin of the south-eastern Alps. But the short distance separating the mountains from the sea, in combination with the gentle slope characterizing the Adriatic shelf, created a particular setting which do not exist along the other sides of the Alps and that has very few analogues around the World. In fact, this condition allows to analyse in the same area both the fluvio-glacial deposits related to glacial advances and the sediments connected to marine high stands.

The sedimentary sequence deposited during Late Quaternary was strongly influenced by the alternation of colder and warmer periods, but also the distal tectonic effect of both Alps and Apennines played a constraining role in the stratigraphic evolution of the area (Antonioli et al., 2009). It is important to remark that Pleistocene marine sediments do not crop out in whole coast of the Adriatic, neither in the western nor in the eastern side of the sea, pointing to a general long-term tectonic subsidence.

In the last decade several new cores has been collected along the coastal plain between the Po River Delta and the Karst Highplain, strongly improving the available information about the transition between Middle and Late Pleistocene. The boreholes reached a depth between 50-120 m, but the core AZX arrived at 272 m of depth (Pini et al., 2009; Fontana et al., 2010). In the research also several cores already described in literature were considered, analysing the existing logs in the framework of the new information. For every core the following parameters where described: lithostratigraphy, sedimentary facies, macrofossils assemblages. For most part of the boreholes also a micropaleontological log was realized and, in some selected cores, pollen and paleovegetational analyses were conducted. In particular a new pollen sequence, recording the end of MIS 6 and the MIS 5, has been produced in core ULLOA near Mestre, close to the Lagoon of Venice. An important correlating sequence for vegetational variation occurred at the transition between MIS 6 and 5 is represented by the cores collected in the Fimon Lake, in the Berici Hills (Pini et al., 2010).

In boreholes PNC and BLG, near Marano Lagoon and Grado Lagoon respectively, the MIS 5.5 age of the coastal deposits has been checked with ESR datings. In most of the cores the magnetic susceptibility was measured, obtaining an independent parameter, very helpful in correlating the different sequences, specially in the intervals of the cores where micropaleontological or pollen information is not available.

Considering the general setting, a strong relation between alluvial aggrading phases and the glacial period occurred at the end of MIS 6 is evidenced, whereas during the MIS 5 the sedimentation mainly occurred in the coastal sectors. During the so-called Tyrrhenian transgression (MIS 5.5) the coast reached a more landward position than the present and the inner lagoon margin was about 10-25 km landward than the present one. The top of the MIS 6 alluvial deposits is marked by a well-developed soil, comparable to the soil capping the LGM deposits (the so-called “caranto” in the Venice Lagoon). The new information seems to confirm that the marine highstands occurred during MIS 5.3 and MIS 5.1 do not directly deposited coastal facies in the area northern than Po Delta. But the transition between the final part of MIS 5 and MIS 4 is still characterized by some chrono-stratigraphic uncertainties.

Applying the method used to produce the compilation of the MIS 5.5 high stand (~125 ka) sites spanning the coastline of Italy (Ferranti et al., 2006), the new cores provide many new data about the downlift rates along NE Adriatic coast. 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. (Antonioli, 2012), 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 0.5-0.62 mm/a.

References

F. Antonioli, 2012. Sea level change in western-central Mediterranean since 300 kyr: comparing global sea level curves with observed data. Alpine and Mediterranean Quaternary, 25(1), 15-23.

F. Antonioli, L. Ferranti, A. Fontana, A. Amorosi, A. Bondesan, C. Braitenberg, A. Dutton, G. Fontolan, S. Furlani, K. Lambeck, G. Mastronuzzi, C. Monaco, G. Spada, P. Stocchi, 2009. Holocene relative sea-level changes and vertical movements along the Italian coastline. Quaternary International, 221, 37-51.

L. Ferranti, F. Antonioli, A. Amorosi, G. Dai Prà, G. Mastronuzzi, B. Mauz, C. Monaco, P. Orrù, M. Pappalardo, U. Radtke, P. Renda, P. Romano, P. Sansò, V. Verrubbi, 2006. Elevation of the last interglacial highstand in Italy: A benchmark of coastal tectonics. Quaternary International, 145-146, 30-54.

A. Fontana, P. Mozzi, A. Bondesan, 2010. Late Pleistocene evolution of the Venetian-Friulian Plain. Rendiconti Lincei, Volume 21, suppl.1, 181-196.

R. Pini, C. Ravazzi, M. Donegana, 2009. Pollen stratigraphy, vegetation and climate history of the last 215 ka in the Azzano Decimo core (plain of Friuli, north-eastern Italy). Quaternary Science Review 28, 1268-1290.

R. Pini, C. Ravazzi, P.J. Reimer, 2010. The vegetation and climate history of the last glacial cycle in a new pollen record from Lake Fimon (southern Alpine foreland, N-Italy). Quaternary Science Reviews, 23-24, 3115-3137.

BOTTOM ENVIRONMENT ON THE GIBRALTAR SILL: ARGUS SUBMERSIBLE OBSERVATIONS

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Our research team from the Shirshov Institute of Oceanology, Russian Academy of Sciences, first directly observed the nature of the Gibraltar Sill through the *Argus* submersible illuminator during 25 dives carried out during the Russian R.V. *Rift* cruise in 1994. The exciting visions concaved some ideas concerning the latest geological history and present environment in this only gateway between the Mediterranean to Black Sea system of marine basins and the World Ocean. Unfortunately, chief scientist of the expedition, Dr. Kazimieras Shimkus died in 2001 having not accomplished his studies on the materials collected. Many of his results and valuable ideas have been lost, but something remained and is included in this presentation along with our observations during the *Argus* dives.

The Gibraltar Sill constraining deep water exchange between the Mediterranean Sea and Atlantic Ocean consists of three submarine ridges with deep basins in between. We worked on the highest Camarinal Sill with the maximum water depth of 284 m in the main channel of the subsurface Mediterranean water outflow to the Atlantic. The Camarinal Sill was emerged in the Late Miocene forming an isthmus between the Iberian Peninsula and north-western Africa due to the continental collision that totally isolated the Mediterranean Sea and other relic basins from the World Ocean during the Messinian Salinity Crisis (MSC). The sill submerged due to faulting, opening the Gibraltar Strait at the very end of MSC, at 5.32 Ma. The very high-velocity Atlantic water inflow into the brackish or freshwater Mediterranean lake eroded the sill rocks resulting in additional deepening of transverse channels cutting its crest. The strait configuration still shows some features of the MSC reflecting its extreme terminal phase, i.e. the Zanclian refill of the Mediterranean that lasted only several tens of years or even 10-11 years (Blanc, 2002).

We observed geomorphological effects of this dramatic event, including erosional valleys cut into the bedrock (Cretaceous Numibian flysch), steep escarps, leveled platforms, and vertical walls up to 20 m high and several meters thick, obviously representing hard sandstone beds of the compressed flysch strata. Softer mudstone beds in between the sandstone are like1ly eroded by the awful stream. The bottom surface is covered by a hard finely crystallized magnesian calcite crust which we drilled to a depth up to 12 cm. It cements sandstone pieces and coral fragments, as well as rounded pebbles in erosional valleys. Recent friable sediments are practically absent. Piles of loose coral fragments occur locally over the crust-covered smooth bottom surface. Two radiocarbon dates of individual deep-water corals gen. *Cariophyllia* , 1760 and 2040 uncalibrated years BP constrain the age of the Mg-calcite crust precipitation prior to the late Holocene. We hypothesize that it was formed just after the Zanclian refill event when the mineralized Mediterranean water first reached the sill crest and the outflow to the Atlantic started (Murdmaa et al., 2008). Since that time, the Camarinal Sill represented a non-depositional environment. We don't know, how long the carbonate crust precipitated, but the precipitation apparently ceased before the Holocene.

Today the bedrock ledges arecovered by dense living benthic epifaun, including deep-water colonial and individual corals, hydroids, bryozoans etc. However, biomineral products (mainly carbonates) are totally washed off the sill by the strong outflow and tidal currents When summarized, the bottom currents velocity reaches 4-6 knots or locally even more. Moreover, we experienced during our dives a strong influence of internal waves at the boundary between hypersaline Mediterranean outflow and surface Atlantic water inflow waters. The sedimentological significance of internal waves is not yet fully understood. Anyway, a possible occurrence of shallow-water macrofossil remains in deep-water sediments of neighbour basins may serve as a proxy indicating adjacent non-depositional sill environments.

References

P.-L. Blanc, 2002. The opening of the Plio-Quaternary Gibraltar Strait: assessing the size of cataclysm. Geodinamica Acta, 15, p. 303-317.

I.O. Murdmaa, N.B. Keller, 2004. On the Mediterranean gate sill. Priroda (in Russian), 5, p. 96-98.
I.O. Murdmaa, Yu.D. Evsyukov, N.B. Keller, K.M. Shimkus, 2008. The Gibraltar Sill: gates of the Black Sea-Mediterranean corridor. IGCP 521 – INQUA 0501, Plenary Meeting and Field Trip, Bucharest (Romania)-Varna (Bulgaria), October 4-16, p. 123-124.

GEOMORPHOLOGICAL STRUCTURE AND DYNAMICS OF BARRIER ISLANDS IN THE BARENTS SEA

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Coastal accumulative landforms (spits, barriers) are widespread in the south-east part of Barents Sea among them big barrier islands – Varandei Island, Pesyakov Island. These landforms are thought to be accumulated during the period of climatic optimum at the final stage of the Holocene transgression, when both duration of dynamically active period and hydrodynamic activity were the highest. Clastic material from the upper shelf involved into onshore movement was accumulated in big coastal landforms. Where the wave resultant is nearly normal to the coastline, the typical barrier beaches and barrier islands were formed.

Where the waves are high enough to overflow the coastal accumulative forms, the latter are lower than 2.5-3.0 m. Over considerable stretch of shoreline, eolian processes have built a thick dune belt (avandune) over barrier beaches and islands. Their absolute height averages 4-7 m, but some dunes are up to 10-12 m high. Some researchers take the average height of the dune belt as the height of the ancient coastal ridges formed during maximum of the Holocene (Flandrian) transgression (Avenarius, 2001). Based on this assumption, the Middle Holocene sea-level highstand is estimated as 5-6 m above its present position, and the high fragments of accumulative forms are referred to as the Middle Holocene ones. Therefore, according to this hypothesis, the dune belt partially represents “fragments of paleo-barriers”, that could hardly be a justified assumption.

Detailed geological and geomorphological investigations of the Varandei and Pesyakov islands carried out by the authors included observations on coastal dynamics and accompanying exogenous processes (eolian transportation), lithological and micropaleontological studies of the coastal sections and radiocarbon dating (Ogorodov et al., 2003). This allowed us to carry out the first reconstructions of sedimentation conditions and evolution of big coastal accumulative forms in the Barents Sea.

Barriers of the Varandei and Pesyakov islands have similar structure (Fig. 1). The shoreface of these accumulative forms is covered with the dune belt (avandune) up to 4-10 m high. In the zones of divergence of wave energy, an abrasion bluff formed on the marine slope of avandune evidences relatively high rate of coastal retreat. At the places of sediment transit, marine slope of avandunes is relatively gentle (about 20-50^{o}) due to less intensive wave activity and the influence of slope processes. However, during the years of extremely strong storms it could become steeper for a period of time due to abrasion. A relatively narrow beach (20-100 m) leaning against the marine slope of avandune gradually turns into the tidal flat.

At the distal parts of barriers, the avandune becomes lower and is replaced by a series of inactive coastal ridges marking certain stages in evolution of accumulative landforms. Coastal ridges have been considerably reworked by eolian processes. Where the storm surge overwashes the barrier, the well-developed active coastal ridge is formed.

Laidas or high-water surge berms occupy the inner part of the barrier beach behind the dune belt. They are located at 2.5-3.0 m asl. Two morphological levels correspond to wind surges of low and high recurrence (Fig. 1).In general, barrier beaches of the Pechora Sea are relatively rapidly moving onshore because of shoreface erosion, wave and eolian transportation of sand from the windward to leeward slope. Field observations on the coastal dynamics showed that the coastal retreat rates on the Pesyakov Island which is practically unaffected by human activity equaled 0.5-2.5 m per year. As a result, the so-called “fragments of paleo-barriers” with the width of 50 to 350 m must be completely reworked during 100-400 years. Thus, they could hardly be of Middle Holocene age even if assuming that the rates of coastal retreat have increased during the last century. Radiocarbon dating of wood (MSU-1585) from the lower part of the “peat-grass pillow” of the laida exposed in the basal part of coastal bluff (Fig. 1) corroborates extremely “young” age of the overlying sand layer.

Eolian processes play an important role in formation and evolution of barrier beaches. This role has been previously underestimated. In case wind speed exceeds 12 m/s fine-grained sand material is evacuated from beaches and tidal flats. Observations revealed that during one storm the 3-5 cm thick sand layer could be blown away from the open beach surface. During dynamically active period, deflation removes not less than 1 m^3 of sediments from one square meter of beach surface. Most part of eolian material removed from beaches and tidal flats is accumulated within the dune belt. Specific vegetation growing on avandunes protects it from deflation and favors intensive accumulation of eolian material. It should be noted, that the extent of the opposite eolian transportation – from the dune belt to the beach and tidal flats – is considerably less due to high anti-deflation stability of the dune belt.

During fieldwork in 2000 we measured the rates of eolian sedimentation at the specially equipped monitoring stations. Averaged data on repeated measurements carried out at more than 50 reference marks showed that the sand layer accumulated during the two summer months ranged from 3-16 cm at a distance of 10 m from the avandune edge to 0.5-4 cm - at 100 m. These high rates of eolian accumulation are responsible for considerable height and width of the dune belt previously mistaken for as "fragments of paleo-barriers".

Actually, the sediment sequence exposed in coastal bluffs of the barriers above 1.0-2.0 m is entirely represented by subaerial complex: fine-grained sands with abundant grass remains and traces of soil processes. They are devoid of any pebbles, gravel and other coarse-grained debris. On the contrary, deposits of beaches, active coastal ridges and high-water surge berms in the Pechora Sea consist of less sorted sands with numerous pebbles, gravel, rock debris and single bivalve shells. Coarse-grained material originates from numerous exposures of boulder clays and loams on the submarine coastal slope (Fig. 1). No coarse debris was found in the barrier beach sediments from the cores recovered at considerable distance from the coastal bluffs. Laida deposits with characteristic peat-grass pillow are usually exposed below 1-2 m level. Laida deposits accumulated in the inner parts of barriers under the influence of storm surges up to 2.5-3.5 m high do not give any evidence either for higher than modern sea-level position or the Middle Holocene age of the overlying sand unit.

Diatom analysis of the barrier beach sequence from the Varandei Island revealed the gradual succession of fossil associations indicating changing sedimentation conditions (Ogorodov et al., 2003). Diatom associations indicates changes in sedimentation environment during accumulation of the barrier beach – from nearshore marine, littoral, probably marsches, to swampy laida and, finally, subaerial avandune. Temporary streams played an important role in formation of the lower part of subaerial unit lying above 2.0 m asl. These streams redistributed abundant eolian material and supplied plant debris into shallow lakes and puddles during flood. The plant debris was accumulated in the form of thin interlayers. At present, similar conditions exist in the inner part of the dune belt between the avandune ridge and laida (Fig. 1). The uppermost part of the subaerial unit was accumulated due to active eolian-soil sedimentation typical for the topmost part of the dune belt on the barrier beach.

References

Avenarius, I.G., 2001. Coastlines of the second half of the Holocene as a model for the coastal zone evolution under the global sea-level rise. In: The mankind and the coastal zone in the XXIst century. Moscow, GEOS, P. 266-274. (in Russian).

Ogorodov, S.A., Polyakova, Ye.I. and Kaplin, P.A. Evolution of Barrier Beaches in the Pechora Sea // Doklady Earth Sciences. 2003. Vol. 388, N. 1-3, P. 114-116.

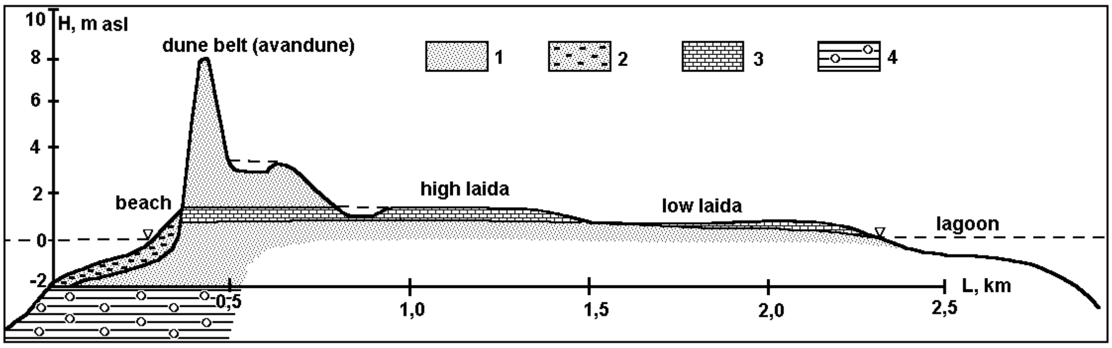

Fig. 1. Lithologycal-geomorphologic transect of the Pesyakov Island: 1 – fine-grained sands; 2 – sands with pebbles; 3 – "peat-grass pillow"; 4 – boulder clays and loams.

QUATERNARY MAMMALS OF SARDINIA: BIOCHRONOLOGY, PALEOBIOGEOGRAPHY AND FAUNAL TURNOVER

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Knowledge on the Quaternary vertebrate fauna from Sardinia has significantly increased in recent years as a result of fieldwork activity, new discoveries and revisions of already known local fauna assemblages (LFAs) which shed new light on the settlement and evolution of the terrestrial endemic mammals. Quaternary remains of fossil mammals have mainly been found in cave deposits, karst fissure fillings and isolated pockets cropping out in quarries or natural sections (whose age is roughly known or undefined), or they come from localized fossiliferous fluvial-lacustrine, either aeolian or beach deposits, and paleosols, sometimes of limited thickness and extension. Such scanty information, makes correlations difficult, the chronological framework fairly approximate, and generates several uncertainties in evaluating the timing of dispersal/colonization and in situ origination and extinction events.

As colonization events, if from one hand, we could confidently assume that Sardinia was definitely isolated from Tuscany by the Late Messinian (because the new immigrants from Europe that reached Italian peninsula and southern Tuscany have not been found in Sardinia), from the other, we cannot rule out the hypothesis that at that time some temporarily connections with the European mainland allowed the colonization of some taxa (e.g. a suid, bovids and a hyaenid) whose descendants were present in the Late Pliocene/earliest Pleistocene Sardinian LFAs. After the opening of the Tyrrhenian Sea (Early Pliocene), Sardinia maintained a permanent isolation. However, sea level drop, resulting in a relatively short distance between Sardinia and the European mainland, permitted discrete passive or sweepstake dispersal events. The arrival through time of new taxa deeply altered the structure of insular palaeocommunities, triggering new intraspecific and interspecific competition. The resulting faunal renewals enable us to detect mammalian faunal complexes (FCs), differing each other as taxonomical composition, biodiversity and structure.

On the basis of at that time available data, Palombo (2009 and references therein) recognized two main FCs: the "*Nesogoral*" (Pliocene/Early Pleistocene partim) and "*Microtus (Tyrrhenicola)*" (late Early Pleistocene/early Holocene) FCs. "*Nesogoral*" FC divides into two subcomplexes: Mandriola and Capo Figari/Orosei1 FSC. The first, mainly Pliocene in age, is characterized by the occurrence of archaic micromammals, and artiodactyls - *Sus sondaari* and bovids of the so-called *Nesogoral* group - found in the Mandriola/Capo Mannu D1 LFA. The second, includes species evolved from some small and large mammals already present in the Mandriola FSC along with new taxa such as large and small carnivores, a macaque and, maybe the problematic bovid *Asoletragus gentryi*. The new settlers (ancestors of *Macaca*, if indeed they had not entered even earlier, *Pannonictis*, *Mustela* and a leporid) reached the island possibly during the Piacentian regressive phase (approximately 2.9 Ma) even if different migratory events, including migration at the end of the Gelasian as well, cannot be excluded. The composition of the Capo Figari I/ Orosei 1 FSC was nearly completed at about 1.8 Ma, as suggested by an ESR date on a *Nesogoral* tooth from Capo Figari I (data reported in Van der Made, 1999).

Throughout the late Early Pleistocene, faunal composition changed due to the progressive extinction of Pliocene/Gelasian taxa and the arrival of new settlers. The transition from *Nesogoral* to *Microtus (Tyrrhenicola)* FC, is marked by the disappearance of about 47% of genera and 76% of species, while approximately 58% of new genera and 71% of species appeared, few because of anagenetic evolution within preexisting lineages, most because of passive/sweepstake dispersal events.

The "*Microtus (Tyrrhenicola)*" FC mainly differ from the "*Nesogoral*" FC by the disappearance of the hyena, suid and most of the endemic bovids and by the appearance of the archaic vole *Microtus (Tyrrhenicola) sondaari*. The occurrence of a primitive vole likely derived from an advanced *Allophaiomys* species, would suggest that its arrival should be younger than 1.3–1.2 Ma, providing indirect arguments for a dating. On the other hand, the hypothesis that the vole and other taxa typical of this faunal complex (e.g. the first representative of *Cynotherium* found at Monte Tuttavista together with *M. sondaari*, and, maybe, *Praemegaceros* aff. *P. sardus* from Sadali) entered Sardinia during the pronounced post-Jaramillo sea level lowering (?MIS 24) cannot be rejected.

The Orosei 2 FSC could be regarded as a transitional phase to the following FSC, because of the persistence of a few pre-existing taxa such as *Rhagapodemus minor, Prolagus figaro, Macaca* cf. *M. majori, Pannonictis* and the leporid, while the Dragonara FSC, unbalanced and clearly endemic, includes the well-known "classic" Sardinian endemic large (*Cynotherium sardous, Mammuthus lamarmorai, Praemegaceros cazioti, Enhydrictis galictoides* and three highly endemic Lutrinae) and small mammals (*Talpa tyrrhenica, "Asoriculus" similis, M. (Tyrrhenicola) henseli, Rhagamys orthodon* and *Prolagus sardus*). The age of the transition from Orosei 2 to Dragonara FSC, marked by the highest species turnover, is problematic due to the incompleteness of stratigraphical and paleontological evidence. *Praemegaceros sardus*, smaller than its presumed continental ancestor but much larger than its descendant *Praemegaceros cazioti*, has been reported about 450 ± 20% ka BP at Santa Lucia (Iglesias, South-western Sardinia) and in other sites, where no voles have been found or studied. In addition a primitive *Cynotherium* (Palombo and Sotnikova unpublished data) is recorded together with *Microtus (Tyrrhenicola) henseli* at Grotta dei Fiori in deposits older than 500 ka (Melis et al., 2012). This LFA likely represents one of the oldest faunas included in the Dragonara FSC.

A noticeable turnover followed the arrival of Neolithic man and his accompanying fauna. Nonetheless, *Praemegaceros cazioti* was still present at about 7000 years BP (Benzi et al. 2007), while *Microtus (Tyrrhenicola) henseli* and *Prolagus sardus* are respectively recorded in the Bronze and Iron Ages (Wilkens and Delussu, 2002).

References

V. Benzi, L. Abbazzi, P. Bartolomei, M. Esposito, C. Fassò, O. Fonzo, R. Giampieri, F. Murgia, J.-L. Reyss, 2007. Radiocarbon and U-series dating of the endemic deer *Praemegaceros cazioti* (Depéret) from "Grotta Juntu", Sardinia. Journal of Archaeological Science, 34, 790–4.

R.T. Melis, B. Ghaleb, R. Boldrini, M.R. Palombo, 2012. The Grotta dei Fiori (Sardinia, Italy) stratigraphical successions: A key for inferring palaeoenvironment evolution and updating the biochronology of the Pleistocene mammalian fauna from Sardinia. Quaternary International doi:10.1016/j.quaint.2012.04.032

M.R. Palombo, 2009. Biochronology, paleobiogeography and faunal turnover in western Mediterranean Cenozoic mammals. Integrative Zoology, 4, 367-386.

J. Van der Made, 1999. Biogeography and stratigraphy of the Mio-Pleistocene mammals of Sardinia and the description of some fossils. In: J.W.F. Reumer, J. De Vos (Eds.), Elephants have a snorkel! Papers in honour of Paul J. Sondaar. Deinsea, 7, 337–360.

B. Wilkens, F. Delussu, 2002. Les mammifères sauvages de la Sardaigne: Extinctions et nouvelles arrives au cours de l'Holocène. BAR International Series, 1017, 23–31.

UPPER PLEISTOCENE TO HOLOCENE COASTAL EVOLUTION OF NW SARDINIA (MEDITERRANEAN SEA, ITALY)

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The modern coast of Northwest Sardinia is characterized by small cliff-bounded bays with marine terraces or sand and/or gravelly pocket beaches. At the average depth of -4 m a sandy submerged plain with extensive sea-grass meadows occurs on the shallow shelf. The bulk of sediment feeding the coastal system is bioclastic sand produced in the sea-grass meadows and deposited on the beaches during major storms.

This framework was more or less the same during the last interglacial time; that is, MIS5.

In this study we analyze the evolution of the last interglacial-glacial-interglacial deposits in order to define similarities and controversies with the modern climate trend.

The analyzed late Quaternary-Holocene deposits crop out almost continuously along the NW coast of Sardinia. Our studies have been focussed on those outcropping close to Alghero and Argentiera (Porto Palmas) with the purpose to analyse the relationships between climate changes, sea level fluctuations and sediment supply in controlling the sequences development. It has been proved that local (wet/dry) and worldwide (seal level) environmental variations have influenced the deposition and preservation of the deposits. Deposits have been dated with Optically Stimulated Luminescence using both quartz and feldspar grains; the most recent ones also using ^{14}C.

The outcropping succession has been grouped in five major stratigraphic units, recognized and subdivided by unconformities and facies characteristics: U1 U2 (interglacial MIS5) U3, U4 (glacial MIS4-3) and U5 (interglacial MIS1).

U1 is the less continuous and mostly characterized by warm fauna fossil rich carbonate (bioherm) with dispersed sandy and gravelly layers. It deposited during the MIS5e (125ky); that is during the maximum Eeminan highstand. It records warm climatic conditions and experienced a sea level at least 4.5m higher than the modern.

U2 is continuous and almost always present at the base of the glacial succession. It is normally characterized by sandy, gravelly coastal/beach deposit. It crops out about 1.5 m above the modern and deposited during MIS5c (100ky).

U3 can be either represented by a well developed paleosol (Alghero) dated at 70ky (Dansgaard–Oeschger DO-19) on top of which rests a well coastal dune system (dated at 68 ky) or by debris-flow dominated fan-deposits (Argentiera) dated at 74-65 ka. They are both representative of the beginning of MIS 4 and indicative of climate deterioration.

U4 can be either represented by coastal dunes (Alghero) or by water flow dominated alluvial fan deposits (Argentiera). This last are characterized by mixed windblown and alluvial deposits. They are both referred at MIS3 and have OSL ages spanning from 47 and 23 ky.

U5 is represented by wind-blown, predominantly bioclastic deposits (derived from the shelf) reworked and preserved as sheet sands and dunes on slightly more elevated areas along the coast. They are dated at 8 to 5 ka: MIS1.

Data interpretation allow some consideration on climate change during the last 125ky. During MIS5e high stand temperature was higher than today as well as the sea level (about 4.5 m higher). During the following MIS5c high stand sea level dropped at bout 1.5 m above the modern and temperature reached very closely the today values.

During MIS 4, at the beginning of the glacial phase, a climatic deterioration occurred; temperature dropped down to -6 °C in about 5 ka and led to a progressive disruption of inland vegetation cover and to repeated denudation of the valley slopes. The sea-level regression creates the accommodation space for fan development in sheltered and cliffy areas where debris flows developed and filled almost completely the terminal parts of the narrow coastal valleys/coves with gravelly-silty deposits. In the more exposed areas, however, coastal dune fields developed. It is worthy to note that local morphology can thus mitigate the climate offering some moistly conditions in a general arid environment.

During the MIS 3 sea-level dropped sufficiently to expose extensive bioclastic sands formed and accumulated on the shallow western Sardinia shelf. These were blown inland, by strong

N-NW wind. Dunefield systems, dominated the coasts of the West Mediterranean basin under cold and relatively dry conditions. Localized water flow-sand dunes interaction occurred, although in some areas (Argentiera) the dunefield system was almost completely dismantled and reworked into water-flow dominated alluvial fans by catastrophic rainfall events (flash floods). Thus, the climate, switched locally and quickly from arid to humid conditions possibly related with wet/arid Dansagar-Oeschger (D/O) cycles: D/O 13 (ca 47 ka), D/O 8 (ca 39 ka) and D/O 2 (ca 23 ka). High reliefs along the coast acted as shelter, increasing the local moistly condition and the frequency of rainstorms. Finally, during the Holocene transgression (MIS1) (about 100 m in 10 ka) bioclastic sands were progressively moved landward and wind-blown inland to build up a coastal dunefield on the southernmost part of the study area.

LOWER DELTA OF THE RIVER RHINE DURING THE LAST INTERGLACIAL: ARCHITECTURE, FACIES DISTRIBUTION AND PRESERVATION IN A NEAR-COASTAL DELTAIC SETTING IN THE SOUTHERN NORTH SEA BASIN, THE NETHERLANDS.

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Within near-coastal environments, the fluvial-tidal transition zone is one of the most complex zones due to mixture of processes and sediments of different source and depositional styles. Despite a large number of excellent Holocene fluvial-estuarine cases, transferring sedimentary concepts into the fluvial-estuarine palaeo-records remains a major challenge.

The Last Interglacial Rhine near-coastal area in The Netherlands constitutes a promising natural archive (Wiggers, 1955) for improving the understanding of this near-coastal deltaic setting. First, there is a well investigated Holocene Rhine-Meuse delta (Berendsen & Stouthamer, 2001 and Stouthamer *et al.*, 2013 *in prep*) that could be used for analogue studies. Second, concepts of preservation potential can be directly tested since the Holocene record can be compared with sediments that experienced an entire glacial-interglacial cycle of eustatic sea level variation and climate change. Lastly, a vast amount of sedimentary and first order chronological control is already available for the Eemian record, helping future mapping and dating issues.

Comparing the Last Interglacial and Holocene fluvial-estuarine transition zones of the River Rhine, might lead to more insights in the development of older near-coastal deltaic areas and hence of better understanding the stratigraphic architecture of hydrocarbon resource reservoirs.

Huge datasets available at Utrecht University and GSN-TNO, together with new continuous cores, Cone Penetration Tests, gamma well logs, offshore and onshore seismics and 3D geological models (Busschers *et al.* 2012 *in prep*) are used to architecturally characterize the near-coastal deposits. Optically Stimulated Luminescence dating, palaeomagnetism (Sier *et al.* 2012 *in prep*), U/Th dating and biostratigraphy are used for age determination.

Here, we present the characterization of Last Interglacial near-coastal deltaic deposits in The Netherlands (ca. 128-115 kyr BP) that are influenced by both coastal and fluvial processes, with the use of multiple cross-sections (Peeters *et al.* 2012 *in prep*).

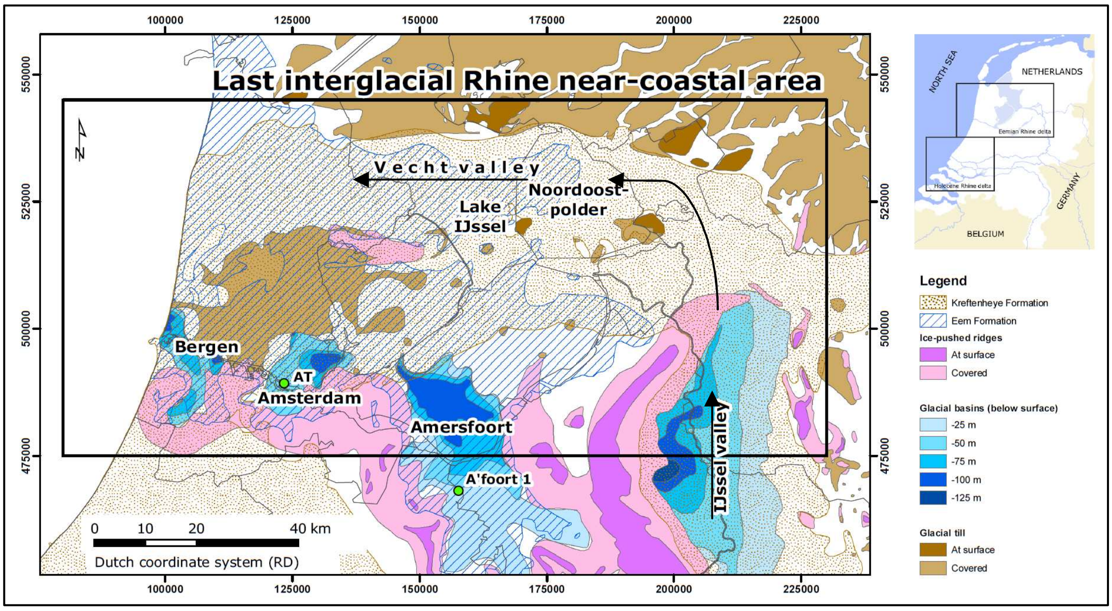
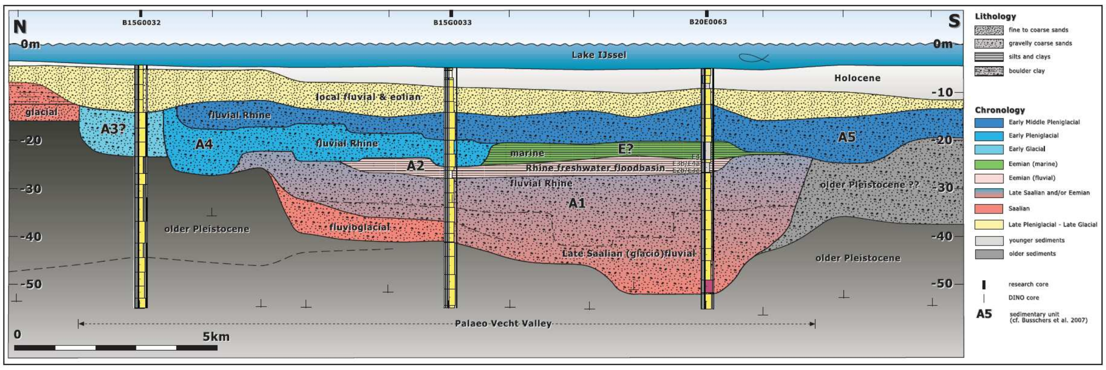


Figure 1. Last Interglacial Rhine near-coastal area in The Netherlands, including important geological features.

The lower delta of the River Rhine during the Last Interglacial is situated in the central Netherlands. Its deposits are found in the present IJssel valley, Noordoostpolder and Lake IJssel area (Fig. 1). The research area is in the direct vicinity of the Eem Formation holostratotype locality (Fig. 1) at Amersfoort (= A'foort 1) (Zagwijn, 1961) and the Eem Formation parastratotype locality at Amsterdam Terminal (= AT) (Van Leeuwen *et al.*, 2000), which is awaiting ratification to become the *Eemian S*tage unit-stratotype (Gibbard, 2003).



Cross-sectional architectural characterization of N-S section in the Lake Ijssel

The Last Interglacial Rhine near-coastal area occupies and buries a palaeo ice-margnial river valley originating from the preceding glacial period (MIS6), which is incised in older Pleistocene sediments. This so called Vecht Valley became already partly filled with glaciofluvial deposits (Unit A1) before the River Rhine took its northern course.

The depositioning continued during the *Eemian* and is mainly characterized by floodbasin fines (Unit A2) which spans a major part of palaeo-valley width. These fresh-water deposits gradually show more marine influence towards their top and finally progrades into a marine sequence (Unit E1), deposited during the Eemian sea-level high-stand.

These *Eemian* deposits, although partly eroded by activity of the River Rhine, are fully covered by Rhine sediments (Unit A3; A4 & A5) during the Early- to Middle (Pleni-)Glacial and that of more local fluvial and eolian origin during the Late (Pleni-)Glacial. The Sedimentary sequence is finalized by Holocene age lagoonal and fluvio-deltaic deposits.

References

H.J.A. Berendsen and E. Stouthamer, 2001. Palaeogeographic development of the Rhine-Meuse delta, The Netherlands. Assen: Koninklijke Van Gorcum, 268 pp.

F.S. Busschers, C. Kasse, R.T. van Balen, J. Vandenberghe, K.M. Cohen, H.J.T. Weerts, J. Wallinga, C. Johns, P. Cleveringa and F.P.M. Bunnik, 2007. Late Pleistocene evolution of the Rhine-Meuse system in the southern North Sea basin: imprints of climate change, sea-level oscillation and glacio-isostasy. Quaternary Science Reviews 26, p. 3216-3248.

F.S. Busschers, J. Stafleu, D. Maljers, J. Schokker and J. Peeters, 2012. *In preparation.*

P.L. Gibbard, 2003. Definition of the Middle-Upper Pleistocene boundary. Global and Planetary Change 36, p. 201-208.

J. Peeters, F.S. Busschers, J.H.A. Bosch, M.W. van den Berg, J. Schokker, F.P.M. Bunnik and E. Stouthamer, 2012. *In preparation.*

E. Stouthamer, K.M. Cohen, W.Z. Hoek, H.J. Pierik and A.H. Geurts, 2013. *In preparation.*

R.J.W. Van Leeuwen, D.J. Beets, J.H.A. Bosch, A.W. Burger, P. Cleveringa, D. van Harten, G.F. Waldemar Herngreen, R.W. Kruk, C.G. Langereis, T. Meyer, R. Pouwer and H. de Wolf, 2000. Stratigraphy and integrated facies analysis of the Saalian and Eemian deposits in the Amsterdam-Terminal borehole, the Netherlands. Netherlands Journal of Geosciences 79, p. 161-196.

M.J. Sier, J. Peeters, M.J. Dekkers, F.S. Busschers, J.M. Parés, F. Bunnik, and W. Roebroeks, 2012. *In preparation.*

A.J. Wiggers, 1955. De wording van het noordoostpoldergebied – een onderzoek naar de physisch-geografische ontwikkeling van een sedimentair gebied. Van zee tot land 14, Zwolle, 216 pp.

W.H. Zagwijn, 1961. Vegetation, climate and radiocarbon datings in the Late Pleistocene of The Netherlands, Part I: Eemian and Early Weichselian. Mededelingen Geologische Stichting 14, p. 15-45.

THE LATEGLACIAL WÜRMIAN DEGLACIATION IN THE ITALIAN ALPS. A NEW ACCURATE GEOCHRONOLOGICAL FRAMEWORK AND EVIDENCE OF TREE COLONIZATION OF THE DEGLACIATED TERRAIN

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We present new accurate AMS ages for the last glacial culmination from two end-moraine systems on the Italian side of the Alps. Ages from terrestrial plant remains were obtained either from paraglacial deposits within one end-moraine system of the Oglio valley glacier, and from an ice-contact lake of the Garda glacier. They allow constraining an early stage of the last deglaciation. In the Lombardy Alps, early stabilisation of alluvial fans and lake filling promoted expansion of cembran pine. This is an unprecedented evidence of tree pioneering a paraglacial landsystem during the early lateglacial, and also documents the cembran pine survival in the mountain belt of the Italian Alps during the last glaciation. A distinct primary succession of steppe and forest vegetation has been detected just after deglaciation of the Alpine foothills of the Garda glacial amphitheatre, but here the role of cembran pine is limited.

The chronology of the Oglio and Garda glacier compares closely with other major piedmont glaciers on the Central and Eastern Alpine forelands. The results of the present study withdraw the hypothesis of a reduced LGM glacier extent, promoted by the authors of the recent geological mapping of the Central Italian Alps. The new evidences imply an overall chronostratigraphic re-assessment of the Quaternary sequence.

JAŁÓWKA – A NEW EEMIAN INTERGLACIAL SITE IN NE POLAND

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The site Jałówka is located in the northern part of the Sokółka Hills in northeastern Poland, about 60 km to the north of Białystok (Fig.1). The site is located at 194 m a.s.l in a terminal basin limited by end moraines. It was examined during the Polish–Belarusian cross-border mapping project (Marks et al., 2011).

The examined section is composed of three series; they are from the top: 1. glacial diamicton transformed by mass movements (depth 0.00 – 3.90 m), 2. silty sand deposit (depth 3.90 – 4.13 m) and 3. lake and bog sediments depth 4.13 – 4.47 m); the latter are underlain by sands (. The upper and the middle series are of periglacial origin. The lowermost series was accumulated in a lake during Eemian Interglacial and is composed of gyttja (depth 4.26-4.47m) and peat (depth 4.13-4.26 m).

These lake and bog deposits were strongly compressed. They were subjected to several paleobotanic and physicochemical analyses: palynology, plant macrofossils, organic matter content (OM), reaction (pH), contents of $CaCO_3$, organic carbon (C_{org}), total nitrogen (N_t), terrigenic and biogenic silica, selected elements (Na, Ca, Mg, K, Mn and Fe), ES and AAS method. Ratios of stable isotopes δO^{18} and δC^{13} were determined for the carbonate sediments.

Palynological analyses of sediments (depth 4.13-4.26 m) indicate a characteristic Eemian pollen succession. The pollen succession makes possible a correlation with the younger part of the Eemian Interglacial, typical for north-eastern Poland, well known from Solniki (Kupryjanowicz 2008; Fig. 1).

Organic deposition has been initiated during late Saalian and continued until the optimum of the Eemian Interglacial. The data from the bottom part of the Jałówka section are similar to the pollen succession of late Saalian that was recorded at Skupowo (Kupryjanowicz 2008; Fig. 1).

Synchronic changes of $\delta^{18}O$ and $\delta^{13}C$ curves in the initial part of the interglacial sequence indicate a closed hydrologic system. Drop of $\delta^{13}C$ argue for the increased productivity when a light isotope of C was preferably assimilated. A drop of $\delta^{18}O$ at depth 432 cm, connected with a lower content of thermophilous tree pollen, suggest a cooling episode occurring in the initial part of the Eemian Interglacial.

Results of the physicochemical analyses of the organic deposits refer to the results of the palynological analyses. They indicate that the greatest biological activity was during the middle Eemian and that abundant vegetation stopped has limited a mechanical denudation in the catchement. The latter process played an important role at the turn of late Saalian and Eemian and at the end of Eemian. It was connected with a scarce vegetation cover and a cold climate. The lake was shallow and, as indicated, heavily overgrown by vegetation as proved by the plant macrofossils analysis.

Contents of Fe and Mn indicate a varying mobility which depended on oxidation-reduction conditions (Borówka 1992, 2007, Boyle 2001). High values of the ratio of Fe and Mn were connected with accumulation of peats and gyttja.

Results of investigation clearly indicate biogenic deposition during late Saalian and Eemian Interglacial. The catchement denudation rate and varying biological productivity were connected with improving climate conditions.

References:

Borówka R.K. 1992. The pattern and magnitude of denudation in interplateau sedimentary basins during the Late Vistulian and Holocene. Seria Geografia, 54. Wydawnictwo UAM, Poznań, p. 177 (in Polish,with English summary).

Borówka R.K. 2007, Geochemical research on lacustrine deposits in moderate zone. Studia Limnologica et Telmatologica, 1, 1: 33-42 (in Polish,with English summary).

Boyle J.F. 2001. Inorganic geochemical methods in palaeolimnology [w:] Tracking environmental change using lake sediments. (red.) Last W. M. and Smol J. P. Phys. Geochem. Methods. 2. Kluwer Acad. Publ. Dordrecht–Boston–London: 83–141.

Kupryjanowicz M. 2008. Vegetation and climate of the Eemian and Early Vistulian Lakelandin northern Podlasie. Acta Palaeobot., 48 (1): 3-130.

Marks L., Karabanov A. (eds.) 2011. Geological map of northern part of Polish-Belarusian cross-border area, 1: 250 000. Polish Geological Institute-National Research Institute, Warsaw (in Polish,with English summary).

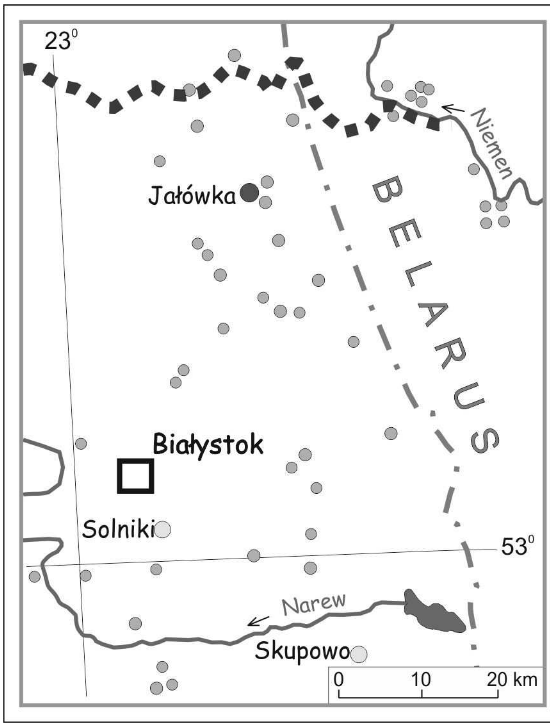

Fig.1. Location of the site Jałówka.

PLIO-PLEISTOCENE FLUVIOKARST CANYON DEEPENING IN CENTRAL EAST SARDINIA.

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Central East Sardinia is characterised by the outcropping of Mesozoic carbonates that overly a Palaeozoic Variscan basement composed of granites and phyllites. These Mesozoic rocks are often covered with Plio-Pleistocene volcanic rocks and alluvial and periglacial deposits. This area is a typical fluviokarst, which hosts some of the most important cave systems of the island constituted by abandoned upper conduits and an active lower level with various phases of entrenchment in response to river erosion, over some millions of years. The main surface features are major canyons, deeply cut into the dolostones and limestones, with allogenic recharge, characterised by low or absent water flow during most of the year and sporadic flood pulses during which discharge can increase two orders of magnitude: Flumineddu Gorge and Cedrino valley in the internal part of the Supramonte karst massif and Codula Fuili, Codula Ilune and Codula Sisine in the coastal sector of Gulf of Orosei are the most important of those canyons. This almost dry hydrographic network is a relict of the ancient drainage pattern related to wetter (thus warmer) periods and continues also on the continental shelf for several kilometres up to a water depth of at least 120 metres.

It is debated if these canyons are inherited from the Messinian period ("Salinity crisis") when Mediterranean sea level dropped dramatically due to the closure of Gibraltar Strait, or if they were entrenched during Quaternary sea level low stands, such as the LGM around 22,000 years ago. The pre-Quaternary age of the beginning of cave formation is indicated by quartz pebbles sampled in the uppermost phreatic passages of Codula Ilune cave system that gave a cosmogenic burial date of around 2 million years.

From a morphological point of view, the landscape is enriched not only by typical karst landforms, but also by volcanic morphologies such as flat basaltic plateaux and by strong contrasting relieves between volcanic rocks and fluviokarst.

In Central East Sardinia, Plio-Quaternary volcanic rocks outcrop on a surface of about 150 km^2, one of the volumetrically most important areas of the island. This magmatic cycle has recently been interpreted as a product of deep mantle melt, with magmas rising during extensional tectonic phases related to the formation of the southern Tyrrhenian basin within a continental plate context. The effusive products of this sector are mainly represented by alkaline affinity lava flows (about 75%), emitted from fissures, aligned along two main opposite tectonic directions, NE-SW and NW-SE respectively. Basaltic flows lie unconformably on Mesozoic marine successions and sometimes directly on the Paleozoic basement. These basalts are massif and tabular lava bodies, which fossilize palaeo-valleys. Selective erosion of the limestone has caused a relief inversion, and these basalts are currently located at the highest altitudes.

In the north-western part of the karst area, the Gollei plateau, with a mean altitude of about 200 m asl, represents the widest continuous basaltic outcrop, constituted by very fluid lavas repeatedly overflown in different times on the palaeo, alluvial plain of Cedrino River, that nowadays flows at 100 m asl on carbonate bedrock.

In the central part of Supramonte, another extensive basic lava flow, mostly erupted from the S. Elene volcano, rests in the Oddoene valley at 230 m asl on the palaeo, alluvial sediments of the Flumineddu River (125 m asl).

The NE elongate Fruncu 'e Pala lava flow (300 m asl) in the eastern part of the karst area overlooks Codula Fuili that flows at an altitude of about 150 m asl.

Also the Codula Ilune canyon crosses some volcanic outcrops downstream: Bidunie on the right side of the valley at 225 m asl and Fruncu Nieddu on the left side (120 m asl), while the talweg elevation is 50 m and 0 m asl respectively.

On the southern coast of Orosei Gulf, alkaline basalt flows of about 5 km in length outcrop at a average elevation of about 350 m asl near S. Pietro – Baunei, entrenched by Codula Sisine river that flows at 240 m asl along a NW-SE fault.

The basalts of the Orosei-Dorgali volcanic province have a radiometric age ranging from 3.6 to 2.0 Ma: the oldest concern the Cedrino outcrops (2.1-3.0 Ma) near Dorgali, whereas younger ages are given for S. Pietro Baunei (2.5 Ma) and Codula Ilune, Cala Fuili (2.0-2.3 Ma) basalts.

The analysis of the fluviokarst deepening respect to the volcanic rocks shows that the canyon entrenchment ranges between 170 and 150 m of Codula Ilune and Codula Fuili, respectively, and 100 m in Flumineddu River and Cedrino valleys, with an average of about 120 m. This slight variation can be related to the different influence of sea level fluctuations with the distance from the coast line. While in the internal parts of the karst area, cave passage level adjustment is closely related to river incision, in turn caused by crustal movements, geological constraints, local base level and sea level change, in the coastal areas the eustatic variations have a predominant role.

The interaction between volcanic activity and karst is also confirmed by the basalts filling phreatic conduits at Bue Marino cave, the Golgo shaft and Su Molente cave. Fluviokarst entrenchment has taken place after the emplacement of the basalts, during Middle to Late Pleistocene, and is probably related to sea level drops during glacial stages, such as the Last Glacial Maximum stage.

References

L. Beccaluva, G. Bianchini, M. Coltorti, W.T. Perkins, F. Siena, C. Vaccaro, M. Wilson, 2001. Multistage evolution of the European lithospheric mantle: new evidence from Sardinian peridotite xenoliths. Contrib. Mineral. Petrol., 142, 284-297.

J. De Waele, 2004. Geomorphologic evolution of a caostal karst: the Gulf of Orosei (Central-East Sardinia, Italy). Acta Carsologica, 33(2), 37-54.

J. De Waele, G.A. Brook and A. Oertel, 2009. Monk Seal (*Monachus Monachus*) bones in Bel Torrente cave (Central-East Sardinia) and their paleogeographical significance. Journal of Cave and Karst Studies, 71(1), 16-23

J. De Waele and D. Granger, 2009. The age of cave systems in Central-East Sardinia: preliminary data. In: White, W. B. (Ed.), 15th International Congress of Speleology, 2: Kerrville (Texas, USA), National Speleological Society, 838-842.

M. Lustrino, L. Melluso, Morra V., 2002. The transitino from alkaline to tholeiitic magmas: a case study from the Orosei-Dorgali Pliocene volcanic district (NE Sardinia, Italy). Lithos, 63, 83-113

F. Massari and I. Dieni, 1973. La formazione fluvio-lacustre di Nuraghe Casteddu e i suoi rapporti con i basalti di Orosei-Dorgali (Sardegna). Memorie della Società Geologica Italiana, 12, 377-410.

P. Orrù and A. Ulzega, 1987. Rilevamento geomorfologico costiero e sottomarino applicato alla definizione delle risorse ambientali (Golfo di Orosei, Sardegna orientale). Memorie della Società Geologica Italiana, 37, 471-479.

C. Savelli and G. Pasini, 1973. Preliminary results of K-Ar dating of basalts from Eastern Sardinia and the Gulf of Orosei. Giornale di Geologia, 39, 303-312.

NEW RESULTS FROM A CLASSIC LOCALITY: SEDIMENTOLOGY, BIOSTRATIGRAPHY AND DATING OF EEMIAN TO EARLY WEICHSELIAN DEPOSITS AT AMERSFOORT, THE NETHERLANDS

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The Netherlands hosts a long tradition in Quaternary research. Being situated at the southern edge of the subsiding North Sea Basin, a thick stack of Pleistocene glacial and interglacial deposits has been preserved. As such, the area is also one of the classic areas to study the Last Interglacial. Last Interglacial (MIS 5e) deposits have been exceptionally well preserved in deep glacial basins that were formed during the Saalian (MIS 6) glaciation in the central Netherlands. Already as early as in the 19th century, Harting studied these diatom and mollusc-rich deposits in both the Amsterdam and Amersfoort Basins (Harting, 1852; 1874). Based on the occurrence of Lusitanian mollusc faunas in a core near the river Eem in Amersfoort, he introduced the stratigraphic term 'Eemian'. Internationally renowned research by Van der Vlerk & Florschütz (1950, 1953) and Zagwijn (1961; Fig. 1) made Amersfoort the informal stratotype of the Last Interglacial in North-Western Europe. Recently, new data has been collected from a core in the immediate vicinity of Amersfoort, shedding new light on this classic locality.

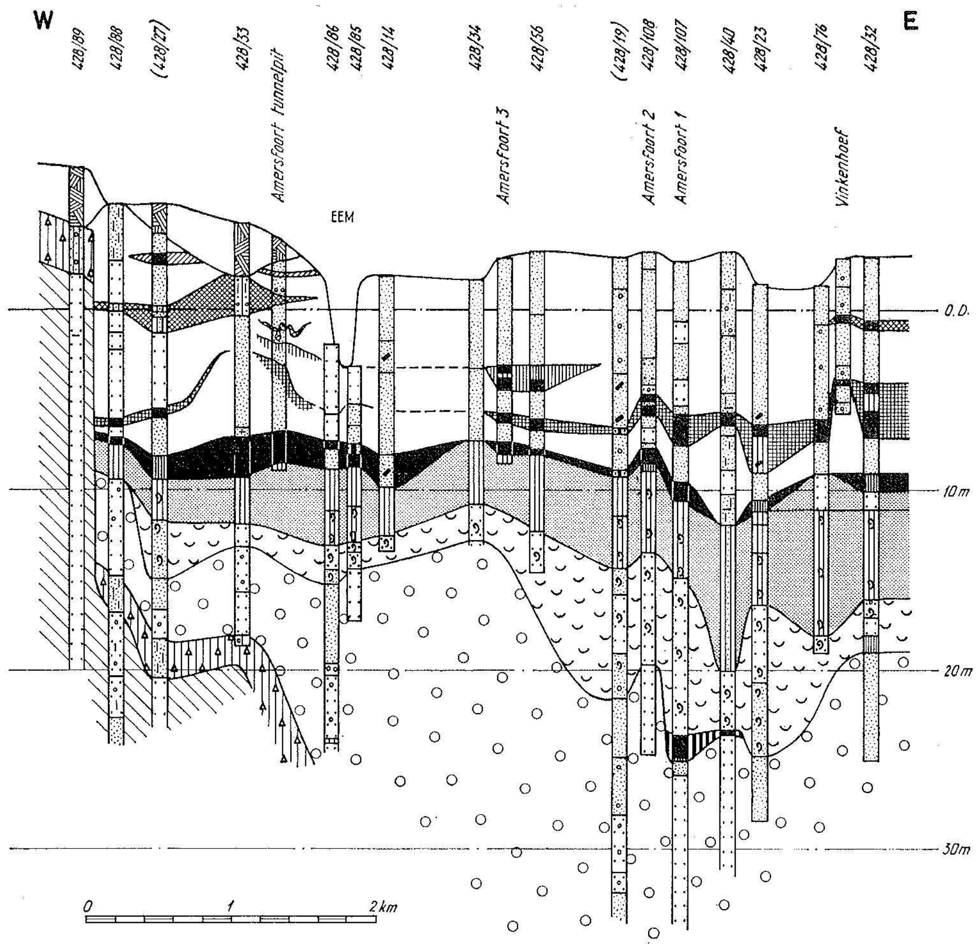

Figure 1. East-West section through part of the Amersfoort Basin, showing the context of the classic type locality Amersfoort. In the traditional interpretation, the Eemian stage starts with peat formation (~25 m below O.D. in core Amersfoort 1), followed by deposition of marine shell-rich sand and clay layers. Eventually, continental conditions return to the basin, as evidenced by the widespread formation of peat (~10 m below O.D.) (after: Zagwijn, 1961).

Close to core locality Amersfoort 1 (Fig. 1), a new undisturbed core was taken that extends downward to the base of the glacial basin. The core material was described in detail and interpreted in terms of sedimentology and lithostratigraphy. Grain-size analyses were performed and bulk geochemistry was determined. Selected intervals were also sampled for pollen and diatom analyses and optically stimulated luminescence dates were obtained. Also the entire glacial basin was modelled in 3D to enable a better insight in the geometry and extent of the different geological units and to be able to reconstruct the palaeogeographical development before, during and after the Eemian stage.

The lithology and the results of biostratigraphical analyses generally show a very good correlation between the new core and core Amersfoort 1 (cf. Zagwijn, 1961; Cleveringa et al., 2000). However, because of the high quality of the new core material, more insight into the sedimentological properties of the deposits could be obtained. The new core clearly shows that the upper part of the basal peat sequence is not *in situ*, but consists of reworked peat clasts, giving clear evidence of the force with which the sea entered the inner part of the basin during sea-level rise at the beginning of the Eemian (Regional Pollen Assemblage Zone (RPAZ) E3-E4a; cf. Zagwijn, 1961; 1983). As the rate of sea-level rise slowed down, an abrupt shift appeared from sandy to clayey sedimentation (RPAZ E4b-E5). This may be the result of a partial closure of the basin by the development of a beach-barrier system further seaward of Amersfoort. Finally, when the climate was already deteriorating and sea-level was falling, continental conditions returned to the basin. In our opinion, these conditions, represented by RPAZ 6, might well correspond to the onset of MIS5d.

We conclude that revisiting the classic locality Amersfoort has greatly contributed to our understanding of the conditions that prevailed in the area during MIS 5e. The study of undisturbed core material and the use of modern geochemical and dating techniques added knowledge to the coastal development and sea-level response in the basin. Eventually, this may lead to a better correlation between land and sea records spanning the Last Interglacial and the Last Interglacial-Glacial transition.

References

Cleveringa, P., T. Meijer, R.J.W. van Leeuwen, H. De Wolf, R. Pouwer, T. Lissenberg and A.W. Burger, 2000. The Eemian stratotype locality at Amersfoort in the central Netherlands: a re-evaluation of old and new data. Geologie en Mijnbouw / Netherlands Journal of Geosciences 79: 197-216.

Harting, P., 1852. De bodem onder Amsterdam onderzocht en beschreven. Verhandelingen 1e klas Koninklijk Nederlands Instituut van Wetenschappen, 3e Reeks 5: 73-232. (in Dutch)

Harting, P., 1874. De bodem van het Eemdal. Verslagen en Verhandelingen Koninklijke Academie van Wetenschappen, 2e Reeks 8: 282-290. (in Dutch)

Van der Vlerk, I.M. and F. Florschütz, 1950. Nederland in het ijstijdvak. De Haan, Utrecht: 287 p. (in Dutch)

Van der Vlerk, I.M. and F. Florschütz, 1953. The Palaeontological base of the sub-division of the Pleistocene in the Netherlands. Verhandelingen Koninklijke Akademie van Wetenschappen, Afdeling Natuurkunde 1, 20: 1-58.

Zagwijn, W.H., 1961. Vegetation, climate and radiocarbon datings in the Late Pleistocene of the Netherlands. Part I: Eemian and Early Weichselian. Mededelingen van de Geologische Stichting, Nieuwe Serie 14: 15-45.

Zagwijn, W.H., 1983. Sea-level changes in the Netherlands during the Eemian. Geologie en Mijnbouw 62: 437-450.

A PALAEOMAGNETIC SIGNAL FROM THE LAST INTERGLACIAL

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Until recently, the Eemian (Last) interglacial was generally seen as the terrestrial equivalent of Marine Isotope Stage (MIS) 5e. However, studies of the MD952042 core off the Iberian coast did show a delay of the Eemian in relation to its inferred MIS counterpart and placed the base of the Eemian as defined by the pollenzones within the MIS 5e plateau (Sánchez-Goñi et al., 1999; Shackleton et al., 2002; Shackleton et al., 2003). Other workers argued for placing the base of the Eemian well before the MIS 5e plateau (Beets et al., 2006).

A recent study indicated that the MD952042 delay is even larger than expected, at least in the middle latitudes (Sier et al., 2011). The high resolution sequence from the Neumark Nord 2 (NN2) archaeological site (Germany) provided data that enabled precise terrestrial-marine correlation for the Eemian stage in central Europe. Terrestrial-marine correlation was done by means of the identification of the palaeomagnetic Blake Event. In combination with the local Eemian pollen zones it showed a surprising time lag between the MIS 5e 'peak' in the marine record and the start of the Last Interglacial in this region. If correct, such a large time lag would have consequences for our views on the development of the Eemian in Central Europe and possible North Western Europe. Furthermore, our high-resolution positioning of the Blake Event within a Last Interglacial pollen succession holds potential for the correlation of Last Interglacial archaeological sites on a very fine time scale. Hence, it became imperative to test our reading of the Neumark-Nord 2 data at other Last Interglacial locations. In this contribution, we present results obtained from an onshore orientated (25 meter long) continuous core containing Eemian sediments near the village of Rutten (The Netherlands), in the area of the type locality of the Eemian Interglacial The core was located on a N-S section across the Eemian River Rhine palaeo-valley, containing Eemian floodbasin deposits consisting of a thick organic-rich clayey sequence. Palynological studies indicate the presence of a complete Eemian pollen sequence, with the Last Interglacial age of the deposits confirmed by Optically Stimulated Luminescence dating. Palaeomagnetic studies on the orientated core indicate the presence of a palaeomagnetic excursion which we have interpreted as the Blake Event. The similarities and differences between the Neumark-Nord 2 and Rutten Gemaalweg record, as well as their possible implications, will be presented in this contribution.

References

Beets, D. J., Beets, C. J., and Cleveringa, P. (2006). Age and climate of the late Saalian and early Eemian in the type-area, Amsterdam basin, The Netherlands. *Quaternary Science Reviews* 25, 876-885.
Sánchez-Goñi, M. F., Eynaud, F., Turon, J. L., and Shackleton, N. J. (1999). High resolution palynological record off the Iberian margin: direct land-sea correlation for the Last Interglacial complex. Earth and Planetary Science Letters 171, 123-137.
Shackleton, N. J., Chapman, M., Sánchez-Goñi, M. F., Pailler, D., and Lancelot, Y. (2002). The Classic Marine Isotope Substage 5e. Quaternary Research 58, 14-16.
Shackleton, N. J., Sánchez-Goñi, M. F., Pailler, D., and Lancelot, Y. (2003). Marine Isotope Substage 5e and the Eemian Interglacial. Global and Planetary Change 36, 151-155.
Sier, M. J., Roebroeks, W., Bakels, C. C., Dekkers, M. J., Brühl, E., De Loecker, D., Gaudzinski-Windheuser, S., Hesse, N., Jagich, A., Kindler, L., Kuijper, W. J., Laurat, T., Mücher, H. J., Penkman, K. E. H., Richter, D., and van Hinsbergen, D. J. J. (2011). Direct terrestrial–marine correlation demonstrates surprisingly late onset of the last interglacial in central Europe. Quaternary Research 75, 213-218.

NEW PALEOFLORISTIC DATA FROM MARINE LATE PLIOCENE - PLEISTOCENE DEPOSITS OF WESTERN SYRIA

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Marine Pliocene sediments are widespread in the south-western part of the Al-Latheqiyeh tectonic depression of the north-western Syria. A series of Pliocene outcrops extends along the Nahr el-Kabir River being represented by calcareous clays, usually with silty material (Krasheninnikov, 2005).

In the Nahr el-Kabir river valley, the Pliocene clays expose at the base of 70-110 m high alluvial terraces of (Rudo, Dzhendarie). Some new palaeofloristic (pollen, dinocyst, nannoplankton) data from the Pliocene clay deposits of the Jabryoun section (35°36 N; 35°55E) were received (obtained). This is the high terrace (103 m above the river level) in the middle reaches of the Nahr el-Kabir River.

From the top of terrace the modern soil (loamy-sandy sediments with carbonate interlayers) is exposed (0.5 m of thickness). Below are pebble and gravel conglomerates with sand are daylighted (1.5 m), underlying by carbonate cemented crust (10 - 15 cm). Alluvial deposits are underlied by grey clays, with the observed thickness of 3.5 m. A Middle Acheulian stone tool was found at the boundary between the alluvial and marine deposits.

The most complete pollen spectra were obtained from the clay deposits. It was accompanied by a rich complex of dinocysts and nannoplankton forms, clearly indicating marine origin of the clay deposits. The paleofloristic spectra include redeposited forms of the Upper Paleogene and Miocene age.

The pollen spectra from the bottom of the clay deposits (2.2-4.0 m) show 90-97% dominance of tree pollen with pine being the most important element. Conifers are presented by pollen *Pinus* sg. *Dyploxylon, P*. sg. *Haploxylon, Podocarpus, Tsuga, Cedrus, Abies,* and *Picea*. The deciduous species such as Sapotaceae, Oleaceae, Betulaceae, Moraceae, *Tilia,* and *Ulmus* occurred in the arboreal group. Herbs group includes Asteraceae, Poaceae, Chenopodiaceae, Apiaceae, Dipsacaceae, and *Ephedra*. The spectra indicate the widespread coniferous and deciduous forests in combination with small patches of meadow-steppe vegetation.

In the pollen spectra from the upper part of the clay deposits (1.5-2.2 m) the amount of arboreal pollen reduces. *Podocarpus, Tsuga, Cedrus, Pinus* sg. *Haploxylon* disappears in the pollen-spectra composition. Myrtaceae, *Ostrya, Alnus, and Salix*, the typical components of maquis vegetation association, occur.

In the dinocysts complex from the lower part of the section *Spiniferites* spp., *Operculodinium* spp., *Lingulodinium machaerophorum, Hystrichokolpoma* spp. dominate. In the upper part of the clay deposits *Homotriblium* (including *H. vallum*) and *Impagidinium patulum* begin to prevail in among dinocysts.

The first appearance of the *Impagidinium patulum* occurred in the Early Pliocene (Williams, 1978). In the Late Pliocene *Homotriblium vallum* disappears, and *Lingulodinium machaerophorum* is present in the significant quantities (Dybkjaen, 2006). Thus, according the dinocysts data, the age of the terrace base is defined as the Early Pliocene. The nannofossil assemblage includes abundant *Sphenolithus abies, S. moriformis, Coccolithus pelagicus, Discoaster brouweri, D. pentaradiatus, D. surculus, Pontosphaera multipora, P. discopora, Rhabdosphaera clavigera, Reticulofenstra pseudoumbilica,* small *Reticulofenestra, Scyphosphaera sp., Dictyococcites* spp., and a few *Discoaster tamalis.* This assemblage of nannoplankton corresponds to the MNN14/15 Zone according calcareous nannofossil biostratigraphic scheme for the Pliocene–Pleistocene Mediterranean record from Rio et al. (1990).

Thus, the age of the clays at the base of the alluvial terrace of the Nahr el-Kabir River is the Early Pliocene by pollen and dinocysts data, according to nannoplankton data is 4.2-3.8 million years and corresponds to Zanclean of the Mediterranean time scale. The obtained paleofloristic data are similar to floristic complex from the bottom of the marine Pliocene clays of the alluvial terraces Dzhendariya (80 m), located in the lower reaches of the Nahr el-Kabir River (Simakova, 1993; Devyatkin et al., 1996).

The absence of dinocysts in the uppermost part of the clay deposits, obtained pollen spectra similar to the spectra from the Middle Pleistocene sediments in Western Syria (Simakova, 1993), and the occurrence of middle Acheulian stone tool suggest that the upper part of the clay bed formed in terrestrial or shallow water conditions with the active reworking of Pliocene sediments. The age of the overlying sands and conglomerates are not older than 800-500 - 350 thousand years according archeological data.

References

Krasheninnikov V.A. 2005. F. Neogene. In Krasheninnikov et al. :Geological Framework of the Levant. Vol.1:Cyprus and Syria. Jerusalem, p. 343-392.

Devyatkin E.V., Dodonov A.E., Gablina S.S., Golovina L.A., Kurenkova V.G., Simakova A.N., Trubikhin V.M., Yasamanov N.A., Khatib K., and Nseir H. 1996. Upper Pliocene-Lower Pleistocene marine deposits of Western Syria: Stratigraphy and paleogeography. Stratigraphy and Geological Correlation. Vol. 4, No. 1, p. 67-77.

Dybkjær, K., 2004. Morphological and abundance variations in Homotryblium-cyst assemblages related to depositional environments; uppermost Oligocene-Lower Miocene, Jylland, Denmark.
Palaeogeogr., Palaeoclim., Palaeoecol., 206: 41-58.

Simakova A.N. Palynology and the Pliocene – Quaternary climate history of the north-western Syria. Stratigraphy and Geological Correlation. Vol. 1, No. 3, p. 125-131.

Williams, G.L., 1978, Palynological biostratigraphy, Deep Sea Drilling Project Sites 367 and 370: Initial Reports of theDeep Sea Drilling Project. Vol. 11, p. 783-813.

SUBMERGED SPELEOTHEMS AS ARCHIVES OF SEA LEVEL CHANGES ON CROATIAN ADRIATIC COAST

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Croatian Adriatic coast is typical ingressional karstic coast rich in various sea-level indicators eligible for the sea-level changes reconstruction. However, its position in tectonically active region i.e. on Adria (Apulian) microplate (located between converging African and Eurasian plates), makes it unsuitable for the eustatic sea-level reconstruction. Therefore, global sea-level curve, together with the related glacio-hydro-isostatic models, is used in order to reconstruct relative sea-level changes and regional/local tectonics.

So far, more than 235 submerged caves were discovered along the Croatian coast and islands, and comparing to the situation on the mainland, probably thousands of them are yet to be found below the sea level. More than 140 explored caves contain speleothems – typical subaerial features, formed during the low sea stands. Alteration of depositional and non-depositional phases within speleothems can offer an insight into sea-level fluctuation.

Until now, 18 speleothems were examined from 4 caves, 4 pits and 1 submerged spring, collected from the depths of -1.5 m to -53 m. Radiometric (U-Th, ^{14}C) dating obtained ages from ~310 ka to 3,3 ka BP (Nita et al., 2012; Surić et al., 2009, 2010; Surić & Juračić, 2010). A pair of stalagmites from Krk Island provided the most detailed signal of MIS 5.1 sea-level fluctuations pointing to possible episodic uplift of that region. Lately, researches are focused to the deepest and the oldest finding – stalagmite from -53 m from Šolta Island which covers MIS 9.1, and to shallow (-4 m) and relatively young (~7 ka) stalagmite from Dubrovnik area which should apparently resolve the most recent submersion history.

References

D. Nita, D. Richards, M. Surić, J. De Waele, 2012. MC-ICPMS U-Th age determinations on altered submerged speleothems from Croatia, NSF Workshop "Sea-level Changes into MIS 5: from observations to prediction", 10-14 April 2012, Palma de Mallorca, Spain

M. Surić, D.A. Richards, D.L. Hoffmann, D. Tibljaš, M. Juračić, 2009. Sea-level change during MIS 5a based on submerged speleothems from the eastern Adriatic Sea (Croatia), Marine Geology, 262, 62-67.

M. Surić, R. Lončarić, N. Lončar, 2010. Submerged caves of Croatia – distribution, classification and origin, Environmental Earth Sciences, 61/7, 1473-1480.

M. Surić, M. Juračić, 2010. Late Pleistocene – Holocene environmental changes – records from submerged speleothems along the Eastern Adriatic coast (Croatia), Geologia Croatica, 63,2, 155-169.

DIATOM ECOLOGICAL GROUPS AS A TOOL FOR RECONSTRUCTING HOLOCENE COASTAL SEDIMENTARY ENVIRONMENTS IN THE NOTH-WESTERN SHELF OF THE BLACK SEA

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The Postglacial transformation of the Holocene coastal sedimentary environments in the North-Western Black Sea shelf had an effect on the taxonomic structure of diatom assemblages. Diatoms are known to be very sensitive to changes in environmental variables. Therefore the study of diatom ecological groups is a valuable tool in reconstructing palaeoecological changes near marine coasts.

Two sediment cores were taken from a depth 13.1-14.5 m in the northern part of the Karkinitskii Bay near Jarylgach Island, Ukrainian Black Sea Shelf. To study fossil diatom assemblages, Holocene horizons in cores were sub-sampled at some intervals. The material was treated in accordance with standard techniques.

For the reconstruction of sedimentary environments in the Black Sea coastal deposits, the method of quantitative diatom analysis was carried out. Based on the factors 'life form' and 'salinity tolerance', diatoms were classified into 13 ecological groups (Vos&De Wolf, 1988). There were groups of marine, marine-brackish, brackish-freshwater and freshwater diatoms of planktonic, epiphytic, epipelic and aerophilic forms (Vos&De Wolf, 1993). In accordance with method, the amount of diatom frustules counted per sample was restricted to 200 valves. The results of the diatom analysis were synthesized in the form of percentage diagrams for ecological groups. The palaeoenvironmental interpretation is based on the trend of relative abundance of ecological groups.

Based on the results of the diatom analysis, the vertical succession of the diatom ecological groups was revealed. The relation between ecological groups and sedimentary environments (Vos&De Wolf, 1988; Vos&De Wolf, 1993) made it possible to reconstruct the vertical transgressive transformation of paleoenvironments in the Northern coastal part of the Karkinitskii Bay.

In the Upper Pleistocene horizon of coarse-grained silt was formed the freshwater diatom assemblage. Most abundant are groups of freshwater and brackish-freshwater epiphytes, and brackish-freshwater epipelon. Epiphytic which live on macrophytes are characteristic of shallow low-dynamic environments with low range of salinity, e.g. freshwater lagoons and lakes. Dominant taxa are *Epithemia turgida* (Ehr.) Kütz., *E. adnata* (Kütz.) Breb., *E. sorex* Kütz., *Cocconeis placentula* Ehr., *Rhopalodia gibba* (Ehr.) O.Müll., *Anomoeoneis sphaerophora* (Ehr.) Pfit.

The lowest part of the Lower Holocene sediments contains diatom assemblage with mixture of freshwater epiphytes, marine-brackish to freshwater epipelon and brackish-freshwater aerophilous. Dominant taxa are *A. sphaerophora*, *Pinnularia viridis* (Nitz.) Ehr., *E. turgida*, *E. adnata*. Such ecological groups can be found in shallow ponds with low saline water and irregularly flooding. Diatom assemblages show a gradual disappearance of freshwater species.

The assemblages of middle part of the Lower Holocene silts and muds is characterized by the dominance of marine-brackish epipelon: *Campylodiscus echeneis* Ehr., *C. clypeus* Ehr., *C. daemelianus* Grun. Such ecological group is characteristic of shallow lagoons and estuaries with range of salinity 5-17 ‰.

Diatom assemblages of upper part of the Lower Holocene-the Middle Holocene mud sediments are characterized by disappearance of freshwater species and appearance marine ones in planktonic group. Most abundant is group of marine-brackish epipelon. The diversity of the taxonomic composition is low. Dominant taxa are *C. echeneis*, *C. daemelianus*, *C. clypeus*. This ecological group occurs in mud flats and lagoons with shallow clear water and salinity range of 5-17 ‰.

In the Upper Holocene muds was formed the diatom assemblage with prevalence of allochthonous group of marine plankton. Dominant taxa are *Actinocyclus octonarius* Ehr., *Paralia sulcata* (Ehr.) Cl. Major autochthonous group is marine-brackish epipelon. The marine planktonic group is formed in marine littoral environments with water salinity of 15-17 ‰ and in low-tidal lagoons.

On the base of diatom analysis, the Postglacial paleoenvironmental evolution in the Northern part of the Karkinitskii bay was reconstructed. The gradual transformation of coastal sedimentary environments was trace in vertical succession of diatom ecological groups. The Upper Pleistocene freshwater estuarine conditions were changed to irregularly flooding in the Early Holocene. Then, the rise of the sea level and salinity brought to occurrence of shallow brackish lagoon in Early-Middle Holocene with appearance of 'campylodiscus' assemblages. Now, in Upper Holocene, conditions of marine littoral are prevailed.

References

P.C. Vos, H. De Wolf, 1993. Diatoms as a tool for reconstructing sedimentary environments in coastal wetlands; methodological aspects. In: Hydrobiologia, 296/270, 285-296.

P.C. Vos, H. De Wolf, 1988. Methodological aspects of paleoecological diatom research in coastal areas of the Netherlands. In: Geol. Mijnbouw, 67, 31-40.

Scheme of sediment cores location in the Karkinitskii Bay, North-Western Black Sea

PALAEOECOLOGY OF THE COASTAL BLACK SEA LAKE DURANKULAK, NORTHEASTERN BULGARIA

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The complex palaeoecological investigations of Holocene sediments from the Bulgarian coastal lakes revealed the main stages in environmental development, vegetation history, human impact and Black Sea influence (see Tonkov et al., 2011). A couple of sediment cores from Lake Durankulak, the northernmost located site, were analyzed by various proxies such as pollen and plant macroremains (Bozilova, Tonkov, 1998; Marinova, 2003; Marinova, Atanassova, 2006), fossil molluscs (Shopov, Jankova, 1987), supplemented by radiocarbon dating. The results are summarized and correlated with the rich archaeological (Todorova, 2002) and palaeoethnobotanical (Popova, 1991) information from the area since the Neolithic period. A reconstruction of the local landscape, vegetation dynamics, interactions with the sea, human impact and economy activities since 6000 cal. BC is presented.

The palynological evidence indicated that the early Holocene vegetation in the vicinity of the lake was dominated by Chenopodiaceae species, together with various representatives of Asteraceae and Poaceae, resembling a xerothermic steppe. This vegetation type included also groups of deciduous trees (*Quercus*, *Corylus*, *Carpinus betulus*, *Ulmus*) in moisture rich habitats and was gradually transformed into forest-steppe after 4000 cal. BC. The subsequent changes in the natural vegetation cover, including periods of deforestation and abandonment of the arable land, resulted in the widespread of secondary in origin xerothermic herbaceous communities. The palaeoethnobotanical records from the archaeological sites in the study area comprised wood fragments, fruits and seeds from various wild and cultivated species. The archaeopalynological record and the plant macroremains pointed to three distinct stages of human occupation - Late Neolithic and Eneolithic (5300-4200 cal. BC), transition to Early Bronze Age (3500-3000 cal. BC) and after 1300 cal. BC (Late Bronze Age).

The fluctuations of the lake level caused by the periodical connections with the Black Sea had influenced the human occupation and economy. The fossil molluscan fauna indicated three stages of sedimentation and interactions with the sea. The first stage around 5300-4500 cal. BC reflected typical liman sedimentation, followed by a lowering of the lake water level when the peripheral parts were dried up. The recent development of the area was associated with the New Black Sea transgression undoubtedly proved by the appearance of typical marine molluscs.

The present investigation is a contribution to project DID 02/26/2009 *Ecological Crises in Bulgaria during the Holocene – VII-III millennium BC* supported by the National Science Fund, Ministry of Education, Youth and Science in Sofia.

References

E. Bozilova, S. Tonkov, 1998. Towards the vegetation and settlement history of the southern Dobrudza coastal region, north-eastern Bulgaria: a pollen diagram from Lake Durankulak. Vegetation History and Archaeobotany, 7, 141-148.

E. Marinova, 2003. The new pollen core Lake Durankulak-3: a contribution to the vegetation history and human impact in Northeastern Bulgaria. In: Aspects of Palynology and Palaeoecology. Pensoft, Sofia-Moscow, pp. 257-268.

E. Marinova, J. Atanassova, 2006. Anthropogenic impact on vegetation and environment during the Bronze Age in the area of Lake Durankulak, NE Bulgaria: Pollen, microscopic charcoal, non-pollen palynomorphs and plant macrofossils. Review Palaeobotany & Palynology, 141, (1-2), 165-178

H. Todorova, 2002. Durankulak. Band II. Sofia.

S. Tonkov, H.-J. Beug, E. Bozilova. M. Filipova, H. Jungner, 2011. Palaeoecological studies at the Kaliakra area, northeastern Bulgarian Black Sea coast: 6000 yeras of natural and anthropogenic change. Vegetation History and Archaeobotany, 20, 29-40.

Tz. Popova, 2009. Paleobotanical catalogue of sites and studied vegetative remains (debris) on the territory of Bulgaria (1980-2008). Interdisciplinary Studies, XX-XXI, 71-165.

V. Shopov, D. Yankova, 1987. Holocene gastropod fauna from the lakes Durankulak and Shabla-Ezeretz. Paleontology, Stratigraphy & Lithology, 24, 70-89.

LATE QUATERNARY EVOLUTION AND PALEOSEISMICITY IN THE NE AEGEAN SEA: NEW INSIGHTS FROM THE COASTAL AREA OF LESVOS ISLAND

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Since 2009, we started carrying out a detailed coastal mapping in Lesvos, one of the largest Greek islands, where data related to realative sea level (RSL) changes and coastal tectonics were lacking. The island is located in the northeastern Aegean region, that is a complex area from a geotectonic perspective. Its geodynamic status is directly affected both by the westward continuation in the Aegean Sea of the North Anatolian Fault (NAT, North Aegean Trough) and the West Anatolia Graben System (WAGS, in Asia Minor) which produced a significant historical seismicity (Kiratzi and Louvari, 2003). As a result of the interaction between those tectonic systems, there is a strong diversity in fault trending and character of the broad Lesvos area which is presently characterized by the activity of both normal and strike slip faults (Roumelioti et al., 2011).Within this study, we evaluated the elevation of paleo-shorelines on different sectors of Lesvos Island, and we detected that RSL changes at Lesvos were not homogenous and variations in the tectonic regime played a crucial role in coastal evolution. The NW-SE trending faults on the southern shore of the island strongly control the coastal uplift observed between *Plomari* and the gulf of *Kalloni*. On the contrary, northeastern sector tectonics, mainly related to the right-lateral *Aghia Paraskevi* fault (Zouros et al., 2008), did not produce significant vertical displacements. This is also confirmed by the RSL stability indicated by the morphology of modern notches observed in the *Gavathas* area. Some radiocarbon dates allowed to constrain the paleoseismicity of the SE sector: results provided evidence that the SE Lesvos was affected by events of co-seismic uplift during Late Quaternary. Here, a Ms=6.67 earthquake took place between 3365 and 3963 calY BP producing ~0.75 m of vertical displacement. This confirms the potential seismic activity calculated in this sector of the island using fault geometry and seismic sources (Fig. 1). Indicators of this co-seismic event have been found from the entrance of the *Kalloni* gulf to *Plomari*. Thus, activity of the offshore Lesvos Fault produced vertical displacements along more than 30 km of coastline. These data represent the first quantitative information on this fault and necessitate a reconsideration of its relevance in the structural setting of this sector of the North Aegean basin. In addition, these results are a significant contribution to the knowledge of the offshore active faults of the Aegean region, presently very limited because many epicenters are located under the sea (Pavlides and Caputo, 2004). We coupled our data with those available in the NE Aegean area. This allowed us to evaluate the complex variability of late Quaternary RSL changes in this sector located on the boundary between the North Aegean Trough and the West Anatolia Graben System.

In conclusion, we have provided the first field evidence of the coastal evolution of Lesvos, a region particularly representative of the neotectonics of the NE Aegean. Additionally, we have now further information on the paleosesmicity of the third largest Aegean Island. These results represent the basis for further investigation which should improve our data with new chronological constraints and new field data on other coastal tracts. This study is essential both to corroborate our results and to provide information on the neotectonic behavior of this active sector of the Mediterranean.

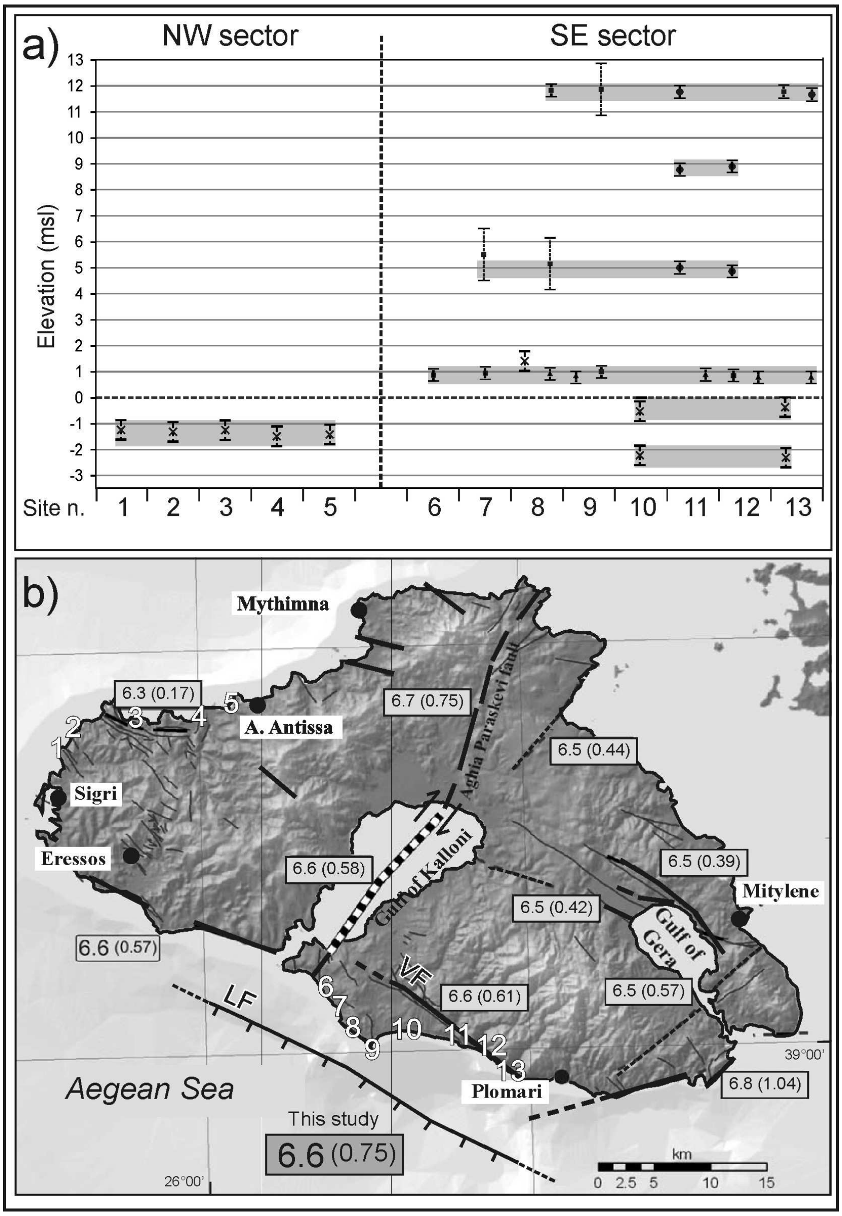
References

S. Pavlides, R. Caputo, 2004. Magnitude versus faults' surface parameters: quantitative relationships from the Aegean Region. Tectonophysics 380 (3-4), 159-188.

Z. Roumelioti, A. Kiratzi, C. Benetatos, 2011. Time domain moment tensors of earth- quakes in the broader Aegean Sea for the years 2006–2007: the database of the Aristotle University of Thessaloniki. Journal of Geodynamics 51, 179–189.

N. Zouros, S. Pavlides, A. Kiratzi, et al., 2008. Active fault and seismicity maps of the North Aegean

Region (6 maps, 1:200.000, 1:100.000). Research project ﬁnal report: Use of modern research tools in geosciences for seismic hazard management in NE Aegean islands, Natural History Museum of the Lesvos Petriﬁed Forest, Mytilene, Lesvos, Greece. http://naseismic.geo.aegean.gr.
A. Kiratzi, E. Louvari, 2003. Focal mechanisms of shallow earthquakes in the Aegean Sea and the surrounding lands determined by waveform modelling: a new database. Journal of Geodynamics 36 (1–2), 251–274.



a) markers elevation (with relative error) and related altimetric intervals of the reconstructed paleo-shorelines (gray bands). Triangles and dots represent respectively tidal notches and upper limit of L. lithophaga bands whereas squares and crosses indicate shore platforms and beachrocks. b) Potential earthquake magnitude and displacement (m, in parenthesis) according to the results of this study.

THE GLACIMARGINAL ZONE IN THE NORTHERN PART OF POLISH HIGHLANDS BETWEEN RADOMSKO AND PRZEDBÓRZ: SEDIMENTS, GEOMORPHOLOGY, TECTONICS AND STRATIGRAPHY IN QUATERNARY STUDIES

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The investigated area is located on the border between the Polish Highlands and Lowlands, on the northern slopes of the remnant Mesozoic hills of the Przedbórz Highland. The marginal zone formed during the last glacial episode in this region, from glaciation and deglaciation of the Warta Stadial of the Middle Polish Glaciations, the Odranian Glaciation (Saalian, MIS 6). Sediments for analysis were selected from different genetic forms, located between Radomsko in the West and Przedbórz vicinity in the East, on a 40 km distance.

Glacimarginal zone is located on the transverse Radomsko Elevation (Pożaryski 1971) in Central Poland, oriented W-E, 40-50 km long. This is a regional system of faults (Krzyszkowski 1989, 1993) dividing the Łódź and the Miechów Synclines. In the East there is the Northern part of Mesozoic border of the Holy Cross Mountains. The tectonic development of faults was continued from Variscian or the early Alpine Orogeny (Pożaryski 1971) to this day. According to Krzyszkowski (1989, 1993) the main phase of tectonic development of the Quaternary occurred during the Saalian (Pilica Interstadial).

Sedimentological analysis was performed using the lithofacial code after Rust&Miall as modified by Zieliński (1995) and textural analysis, grain size distribution with calculated indicators according to Folk&Ward (1957) using the Gradistat 8.0 program and the morphoscopy analysis after Cailleux as modified by Goździk (1995). Additionally, found was the content of calcium carbonate.

The maginal forms are built of diamictons *DSm*, *Dm* and it indicates a direct contact with the ice-sheet during deglaciation. Lithofacies *SGh*, *Sh* are dominant, and also *Sr*, indicating the deposition of overbank deposits. They point either a highly energetic flow (sites: Ochotnik, Masłowice and Stobiecko Szlacheckie), lagoons under the upper layer, flat bottom (sites: Ludwików and Dobryszyce Malutkie), or low flow, or its decay (sites: Miejskie Pola and Kmieńsk). The lithofacies *St*, *Sp* can be mainly observed in the Upper Widawka outwash plain (Rzejowice and Biestrzyków sites) in the central part of the area investigated. The presence of glacitectonic structures confirms a varied deglaciation in time and space.

The glacial plateau contains boulder clay, boulders, gravels and coarse sands ($Mz \leq 0$ phi). Fluvioglacial forms are built by gravels, sands and silts ($Mz \geq 0$ phi). Varied skewness and weak sorting underlines a strong momentum of sedimentation. The bi- and trimodal chart indicates the frequency of different sources of marginal forms.

The morphoscopic features of shape and surface of grains confirm that the sediment was created primarily in the aquatic or glacial environment. EM grains are dominant. A small number of RM grains, rounded and matted, points that the sediment was not subject to aeolian treatment. The high content of calcium carbonate in the sediments (2-10%) highlights a large proportion of local material in the inner construction of the hillocks.

The area investigated can be divided in three parts. In the West, near Radomsko, the glacimarginal forms are diversified. At Kamieńsk a moraine hill?/dead-ice moraine? with squeezed kernels can be recognized. At Dobryszyce Malutkie a frontal moraine with glacioctonic structures was recognized, and at Stobiecko Szlacheckie a terminoglacial cone of accumulation moraine and a kame at Wola Niechcicka Stara.

In the centre, the Upper Widawka outwash plain with marginal valley, W-E oriented, cuts through the glacial plateau.

In the East, in the third part near Przedbórz, glacial marginal forms are an amphitheater surrounded by the remnant Mesozoic hills of the Polish Highlands. In the North we have *Bąkowa Mt.* (279,8 m asl), in the SW and S, *Chełmo Mt.* (323 m asl), in the SE, *Sokola Mt.* (240,8 m asl), *Brzóstek* (267,7 m asl) and *Czartowska Mt.* (267,9 masl), in the East, *Majowa Mt.* (245,8 m asl), *Miejskie Pola* (247,2 m asl) and *Nosalewice* (249,2 masl). A terminal moraine accumulation was identified at Masłowice, a surface of the moraine plateau at Ochotnik, a dead-ice moraine of terminoglacial cone at Ludwików and a kame at Miejskie Pola near Przedbórz.

According to the Polish geologists and geomorphologists the glacial forms near Radomsko were formed in the marginal part of the ice-sheet of the Widawka Lobe during the Late Saalian (MIS 6, named differently by Polish authors: Warta Stage (e.g. articles in *Acta Geographica Lodzensia, 68* (1995)) or Warta Glaciation (Klatkowa 1972; Krzemiński 1988; Rdzany 2009) or Warta Stadial (Turkowska 2006) or Mazovian-Podlasie Stadial (Baraniecka 1971)).

In the East, in Przedbórz vicinity, the glacial forms were connected with older glaciation, the Odranian advance ice-sheet (Lower Saalian, MIS 8) and its recessional phases, Wieniawa and Odrzywół Phases (Różycki 1972).

New TL/OSL data, detailed investigations (e.g. petrographical analysis) in the Lodz Region brought a new concept showing three Wartian lobes, covering the Central Poland, the Bzura, the Widawka and the Rawka, Pilica and Luciąża Lobes, which reached the northern part of the Przedbórz Highlands (excluding the Bzura Lobe). This is consistent with a new proposition of climato-stratigraphic subdivision of the Pleistocene Middle Complex in Poland by Marks and Lindner (2012). It leads to the assumption, that all the described glacimarginal forms were created during the Odranian Glaciation of the Middle Polish Complex, at some stage of the Warta Stadial (MIS 6, 180-120 kBP).

The highlighted significant role of the Radomsko Elevation and Northern slopes of the Polish Highlands has been stressed as expressed on the course and the mixed nature of the deglaciation. The marginal forms, frontal accumulated moraine, moraine plateau, alleged dead-ice moraine, kame and Upper Widawka outwash plain (sandur) are well characterized by lithogical and lithofacial diversity connected by high dynamics of the Wartian ice-sheet (Late Saalian, MIS 6) in its frontal part of the interlobal zone between the Widawka and the Rawka, Pilica and Luciąża Lobes near Radomsko. According to Turkowska (2006) these forms from Radomsko to Przedbórz, oriented W-E, make the Ist zone of main clusters of glacial accumulation and/or fluvioglacial forms in the Lodz Region in Central Poland.

Investigation funded by grant No N N306 721140

References:

Acta Geographica Lodzensia, 68, 1995. The COLD WARTA STAGE (Special Issue after The International Symposium of INQUA (SEQS), Łódź, October 11-15, 1994): 1-225.

M. D. Baraniecka, 1971. Dorzecze Widawki na tle obszaru marginalnego stadiału mazowiecko-podlaskiego (Warty) w Polsce [The Widawka basin in the marginal zone of the Mazovian-Podlasie Stadial]. *Biul. Inst. Geol.,* 254, 13; 1-36.

R. L. Folk, W. C. Ward, 1957. Brazos River bar: a study in the significance of grain size parameters. *Jour. Sed. Petrol.,* 27.

J. Goździk, 1995. Wybrane metody analizy kształtu ziarn piasków dla celów paleogeograficznych i stratygraficznych. (W:) Badania osadów czwartorzędowych (red. Mycielska - Dowgiałło E.) [Selected methods of analysis of the sand grain shape for paleogeographic and stratigraphic studies. (In:) Research of Quaternary sediments]. UW, Warszawa, 115-131.

H. Klatkowa, 1972. Paleogeografia Wyżyny Łódzkiej i obszarów sąsiednich podczas zlodowacenia warciańskiego. [Palaeogeograpgy of The Łódź Plateau and vicinity during the Warta Glaciation]. *Acta Geogr. Lodz.,* 28, 1-220.

T. Krzemiński, 1988. Quaternary stratygraphy of the interfluve between the Warta and Widawka Rivers. *Quatern. Stud.,* 8.

D. Krzyszkowski, 1989. The tectonic deformation of Quaternary deposits within the Kleszczow Graben, central Poland. *Tectonophysics*, 163: 285-287.

D. Krzyszkowski, 1993. Pleistocene glaciolacustrine sedimentation in a tectonically active zone, Kleszczów Graben, central Poland. *Sedimentology,* 40: 623-644.

L. Lindner, L. Marks, 2012. O podziale klimatostratygraficznym kompleksu środkowopolskiego w plejstocenie Polski [Climatostratigraphic subdivision of the Pleistocene Middle Complex in Poland]. *Przegląd. Geologiczny.* 60 (1): 36-45.

W. Pożaryski, 1971. Tektonika elewacji radomskowskiej [Tectonics of the Radomsko elevation]. *Rocz. Pol. Tow. Geol.,* 41, 1.

Z. Rdzany, 2009. Rekonstrukcja przebiegu zlodowacenia warty w regionie łódzkim [Reconstruction of the course of the Warta Glaciation in the łódż Region]. *Wyd. UŁ*, Łódź: 1-310.
S. Z. Różycki, 1972. Plejstocen Polski środkowej na tle przeszłości w górnym trzeciorzędzie [Pleistocene of the Central Poland on the background of the Late Tertiary]. PWN, Warszawa: 1-315.
K. Turkowska, 2006. Geomorfologia regionu łódzkiego [Geomorphology of the Lodz region]. *Wyd. UŁ*, Łódź: 1-238.
T. Zieliński, 1995. Kod litofacjalny i litogenetyczny - konstrukcja i zastosowanie (W:) Badania osadów czwartorzędowych (red. Mycielska-Dowgiałło E.), [Lithofacial and lithogenetic code – construction and using (In:) Research of Quaternary sediments]. UW, Warszawa: 220-235.

CLIMATIC CONTROL ON SAALIAN GLACILACUSTRINE SEDIMENTATION IN THE KLESZCZÓW GRABEN, CENTRAL POLAND, CAUSE OF THE ŁAWKI FORMATION

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Glaciolacustrine deposits of the Ławki Formation lie on the top of the lower structural unit of the active, tectonic Kleszczów Graben (Krzyszkowski 1991, 1992, 1993, 1995, 1995; Allen, Krzyszkowski 2008). The present study is based on observation in the mid-eastern part of the open-cast mine of the new Szczercow field at the PARCHLINY site. The new outcrop of the Bełchatów exploitation area is 8-10 km^2, and about 150-200 m deep. The sediments were observed on a distance of over 300 m (163-173 m asl). The deposits were formed during a phase of the Lower Saalian (Odranian) ice advance. The thickness of the formation varies from 8 to 10 m. The sequence contains silt, varved clay, sometimes with extremely thick summer layers (up to 1m), varved clay with dropstones and massive and laminated diamicton and also fine-grained sands. The glaciolacustrine sediments are separated by an erosion line, below which are the sandy-silts of the Kuców Formation (Elsterian, Sanian). The Ławki Formation are cut on the top. We can see the main discordance between the upper structural unit with undeformed deposits and the lower one, with many deformations. The tills of the Rogowiec Formation (Wartanian, Younger Saalian) and the river sands of the Piaski Formation (Weichselian) cover the Ławki Formation deposits.

At the Parchliny site the sediments investigated show small differences in lithofacies and lithogenesis. Fine-grained and silty sands start the sequence, which passes upwards into the dark and/or light clay/silt, and next black massive clay *Sh(FSh)→Fh→Fm*. Lithofacies *Fh* and *Fm* and change from light, horizontally laminated silty clay/silt to massive, dark clay 0,5-5 cm thickness. They indicate sedimentation on the bottom of a cold lake and turbidity of low-energy currents.

In the marginal part of the paleolake 20 samples were collected from varves in the profile about 100 cm thick. The waterways fauna was investigated. During the study it appeared, that fauna remnants were scarce. Specimens for the most part were fragmented, and snails shell had crushed turns. Ostracods carapaxies were also destroyed.

Only freshwater species (molluscs) were found in the Odranian glaciolacuctrine sediments, in varved clays and silts, such as: *Ancylus fluviatilis*, *Anisus spirorbis*, lids: *Bithynia tentaculata*, *Gyraulus sp.*, *Theodoxus fluviatilis*, *Valvata piscinalis*, *Pisidium sp.*, glochidia *Anodonta cygnaea* and species of ostracods: *Candona neglecta*, *Candona protzi*, *Cyclocypris laevis*, *Cypridopsis vidua*, *Darwinula stevensoni*, *Limnocythere inopinata*, *Limnocytherina sanctipatricii* i *Metacypris cordata.* Those species inhabit both litoral and profundal environments. They also occur in small, sometimes drying reservoirs. *Theoodoxus fluviatilis* is a snail, which lives in rivers, lakes, estuaries and brackish water, can withstand salinity up to 19 psu. *Valvata pulchella* and *Valvata piscinalis* occur in the coastal zone of lakes and slow flowing rivers (Piechocki 1979).

Coexistence of cryophiles ostracod species such as: *Candona neglecta*, *Cypridopsis vidua*, *Darwinula stevensoni* and *Metacypris cordata* can indicate shallow, overgrown and rich in calcium carbonates reservoir. The presence of glochidies *Anodonta cygnea* in sediment can suggest that the lake could be about 7 m deep. (Aldridge & Horne 1998, Piechocki & Dyduch-Falniowska 1993). Analyzing the annual cycle of reproduction of contemporary *Unionidae*, it can be assumed that the glochidia found can serve as indicators of the reservoir water temperature. Because females throw massively glochidia into the water in the spring-summer season, it can be assumed that the sedimentation of sludge containing glochidia also took place during the warm (Brodniewicz 1968). In most samples only isolated fragments of the mollusc shells were found. We have no fauna at the 3 cm (No 1 sample) and 63 cm (No 16 sample) depth.

The sequences with lithofacies *Fh/Fm* i *SFr/Sr/(Src)* describe the distal part of lake. During the warmer season on the bottom of this reservoir thanks to turbidities current and low water flow could occur very fine-grained sand and silt sedimentation. In cooler season, during winter, black clay was deposited. In this lake probably occurred a quiet, but seasonally varied sedimentation, accentuated by the presence of fauna species of molluscs and cryophiles ostracods. Basing on the results it can be said, that the Ławki Formation deposits were formed in the cold, shallow, lacustrine reservoir, overgrown and rich in carbonates, in a close proximity of the Odranian (Saalian) ice sheet in the active tectonic Kleszczów Graben.

These results complement the study of the field of the Bełchatów outcrop, which were previously carried out by Krzyszkowski (1991, 1992, 1993, 1995) and Brodzikowski, Van Loon&Zieliński (1997), in which investigation no fauna was found and provide new facts on the conditions of palaeogeographic of the glacilacustrine sedimentation in the distal part of the lake, in the frontal zone (in the foreland) of the Odranian ice-sheet in the Kleszczów Graben.

References:

D.C., Aldridge D.C., Horne 1998. Fossil glochidia (Bivalvia, Unionidae): identification and value in palaeoenvironmental reconstructions. *Journal of Micropalaentology*, 17: 179-182.

P., Allen, D., Krzyszkowski, 2008. Till base deformation and fabric variation in Lower Rogowiec (Wartanian, Younger Saalian) Till, Bełchatow outcrop, central Poland. *Annales Societatis Geologorum Poloniae,* 78: 19-35.

I.Brodniewicz, 1968. On glochidia of the genera *Unio* and *Anodonta* from the Quaternary fresh-water sediments of Poland. *Acta Palaeontologica Polonica*. Vol. XIII, No 4, 619-630.

K. Brodzikowski, A.J. Van Loon, T. Zieliński, 1997. Development of a lake in a subsiding basin in front of a Saalian ice sheet (Kleszczów Graben, central Poland). *Sedimantary Geology*, 113, 55-80.

D. Krzyszkowski, 1991. Saalian sediments of the Bełchatów outcrop, central Poland. *Boreas*, 20, 29-46.

D. Krzyszkowski, 1992. Czwartorzęd Rowu Kleszczowa: litostratygrafia i tektonika. Zarys problematyki na podstawie obserwacji w odkrywce KWB „Bełchatów" [Quaternary of the Kleszczów Graben. Lithostratigraphy and tectonic]. *Acta Universitatis Wratislaviensis No 1252, Studia Geograficzne*, 54, 1-158.

D. Krzyszkowski, 1993. Pleistocene glaciolacustrine sedimentation in a tectonically active zone, Kleszczów Graben. Central Poland. *Sedimentology,* 40, 623-644.

D. Krzyszkowski, , 1995 – Odranian glaciolacustrine sedimentation in the Kleszczów Graben, central Poland. *Annales Societatis Geologorum Poloniae*, 64, 1-14.

A. Piechocki, 1979. Fauna słodkowodna [Freshwater fauna]. Mięczaki (Mollusca) Ślimaki (Gastropoda). Z. 7. PWN. Warszawa-Poznań.

A.Piechocki, A. Dyduch-Falniowska, 1993. Fauna słodkowodna [Freshwater fauna]. Mięczaki (Mollusca) Małże (Bivalvia). Z. 7a.Wydawnictwo Naukowe PWN. Warszawa.

IS THE MEINWEG SECTION (NETHERLANDS) STILL VALID FOR THE ONSET OF THE QUATERNARY?

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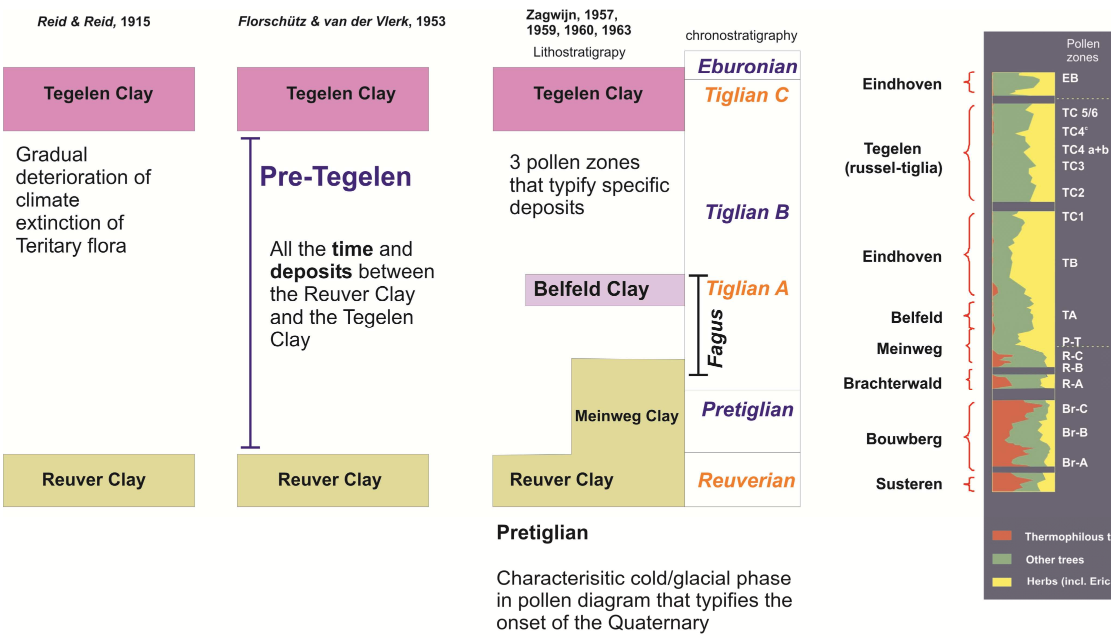
Since the late 1950's the Plio-Pleistocene fluvial sequence of the Meinweg is regarded as reflecting the onset of the Quaternary by marked changes in the vegetation composition. However, a recent re-evaluation of key-reference sites of Pliocene and Pleistocene Stages in the SE Netherlands has questioned their significance for a climate-based stratigraphical subdivision.

In the case of the Meinweg section, mapping, sedimentological, lithostratigraphical and heavy mineral data show that the fluvial deposits of the Pliocene Rhine-Meuse system here are overlain by Lower Pleistocene deposits originating from rivers draining the northern part of Belgium. In between a major hiatus exists. Heavy mineral analysis indicates that the investigated sequence of the Meinweg lacks any sign of the Upper Pliocene instable heavy mineral association that reflects the southward extension of the Rhine catchment towards the Alpine region. This shift in petrological composition of Rhine sediments is regionally well-studied and took place during the Late Pliocene. Consequently, it is concluded that the formerly as Pretiglian defined part of the sequence in fact has formed during the Pliocene, and that the recorded changes in vegetation should be interpreted as a result of varying local environmental conditions in stead of a major change of the climate.



Classical interpretations for the onset of the Quaternary in the Netherlands

STRATIGRAPHY AND GEOLOGICAL SETTING OF THE MAASVLAKTE SAND-EXTRACTION AREA.

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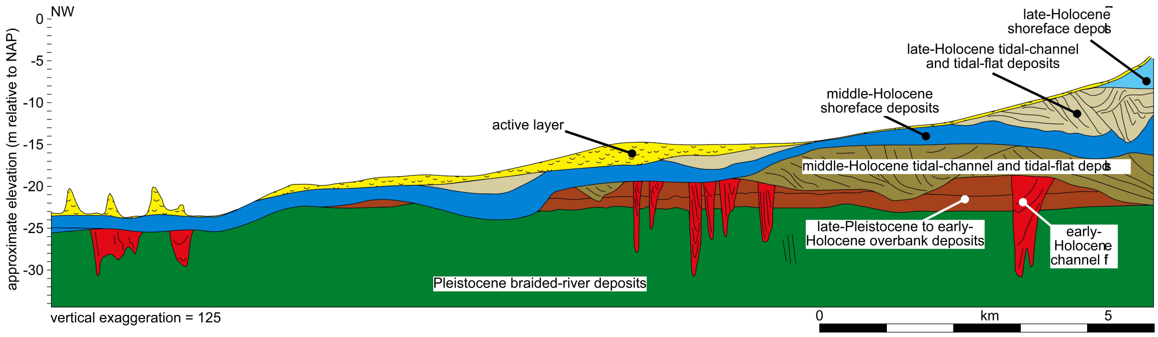
The southern part of the North Sea is well known for its rich fossil-bearing localities. Abundant Pleistocene mammal remains are retrieved by fishing and during large-scale sand-extraction projects. Archaeological artefacts are found regularly as well, albeit in lower quantities. Little is known about the geological background and stratigraphical context of these finds and that hampers the reconstruction of the natural palaeoenvironment as well as the accurate determination of the associated age. In general the older units, located deeper under the seabed, are sampled only by destructive coring techniques, preserving little of the geological and stratigraphical context recorded in the sedimentary succession.

Here we present preliminary results of a unique multidisciplinary study in and around the offshore sand-extraction pit created for the extension of the Maasvlakte harbour area southwest of Rotterdam. A series of minimally disturbed vibrocores collected perpendicular to the slope of this 20-m-deep (300 million m^3) pit shows a main stratigraphical sequence of fluvial Rhine-Meuse deposits dating back to the Middle Pleistocene, preserved between 25 and 46 m below NAP. As part of on-going work, phases of reworking resulting in mixing and concentration of fossils and artefacts are identified by analysing the coarse residue of core samples. Ages of individual units are constrained by a variety of laboratory analyses, including OSL dating. Acoustic data are used to show the morphology of the extraction pit, coarse clasts on the seabed and details of the sediment architecture. The results are linked to the well-know stratigraphy of the adjacent onshore area, to the result of 'bone' trawling surveys, and to analyses of the dumped sediment at the Maasvlakte extension. All data will be used to reconstruct the Middle- to Late-Pleistocene palaeolandscapes that characterized this part of the Southern Bight.



General stratigraphy of the offshore situated sand extraction area

QUATERNARY CORRELATION ALONG THE RHINE

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Our propositions base on the results of projects regarding the Quaternary of southwest Germany, and the newly developed lithostratigraphic scheme for the Quaternary clastics along the Rhine from the Alps and through the Upper Rhine Graben (URG):

(1) The “Heidelberg Basin Drilling Project“ to investigate a succession of > 500 m of Quaternary sediments in the Heidelberg Basin (northern Upper Rhine Graben, URG, Gabriel et al. 2009, Weidenfeller & Kärcher 2008);

(2) A sequence stratigraphical correlation between subglacial overdeepening in the alpine foreland (area of the Pleistocene Rhineglacier) and sediment units in the southern URG (Ellwanger et al. 2011);

(3) Lithostratigraphical units for the Quaternary from Lake Constance to the Middle Rhine Valley (formations and members along the Rhine, cf. Litholex 2011 ff.).

Expansion of (2) towards a South-North-correlation, including alpine and North European glacial units, is one of the objectives of the „Heidelberg Basin Drilling Project“. We want to stress that our considerations regarding the North Sea and the Bay of Biscay are solely based on published data and views (cf. Gibbard 2007, Busschers 2007, Toucanne et al. 2009).

Our hypothesis: All three major ice advances (glaciations) of the Rhine glacier in the Middle and Late Pleistocene (i.e. Hoßkirch, Riss, Würm) terminate with a major subglacial erosion event. There are correlative sediment input events into the southern URG representing huge impulses of sediment transport. Also at the northern end of the URG, there as part of the Mannheim Formation, two phases of strong erosion indicate highly dynamic impulses. How do these impulses continue further North?

The middle part of the North Sea was blocked by ice during the Elsterian and Saalian advances. This led to a huge meltwater-lake along the present coastline, dammed by ice in the North and East and by the adjoining highlands resp. hill ridges in the South and West. Its largest tributary next to the Elbe glacial valley, was the Rhine. The lake eventually was due to overflow towards the Bay of Biscay, cutting the preglacial ridge of lowly hills between Calais and Dover. This happened first at the termination of the Elsterian, and once again in the Saalian. – Question: of what origin were the triggers controlling the overflow? Is it solely due to the nearby British and Scandinavian ice shields, or may impulses from the Rhine have played a role?

We suggest that an alpine meltwater pulse of the Rhine actuated the overflow of the Elsterian meltwater lake in the southern North Sea Basin. This correlates subglacial overdeepening at the alpine margin, sediment input and erosion in the URG, the cutting of the street of Dover and the first input of alpine debris into the bay of Biscay; all as a single event.

Discussion: The downmelting of alpine glaciers may have started somewhat earlier than the Scandinavian glaciers so that the overflow may have started with the Rhenish impuls. – Regarding spatial patterns, it seems interesting though not surprising that at both ends of the system, alpine margin and North Sea, the great European watersheds are affected: at the alpine side, the Danube-Rhine divide in southwest Germany and the Rhine-Rhone divide in western Switzerland. In the North Sea, the breakthrough between Calais and Dover interrupts the continental divide towards the Atlantic Ocean, formerly a continuous element from Northern Scotland to the Southern Vosges.

Final remarks concerning the relevance of the correlation: If accepted, there is a close link between the Alps and the North European marine realms with strong implications towards chronostratigraphy, e.g. regarding the chronological position of the Hoßkirch/Holsteinian.

Yet, if not accepted, the normally applied multi-step model of transportation of debris from the Alps to the Sea has to be used throughout. In this case, the „Fleuve Manche“ input of alpine debris into the Bay of Biscay should at least include elderly Rhine deposits (pre-

Hoßkirch). Without the event-correlation, the Rhine remains a sediment transportation system, with an entirely time-marker-dependant stratigraphy.

References

F.S. Busschers, 2007. Unravelling the Rhine – Response of a fluvial system to climate change, sea – level oscillation and glaciation. Ph.D. dissertation, Vrije Universiteit Amsterdam.

D. Ellwanger, U. Wielandt-Schuster, M. Franz, T. Simon, 2011. The Quaternary of the southwest German Alpine Foreland. Eiszeitalter und Gegenwart / Quaternary Science Journal, 60/2, 306-328.

G. Gabriel, D. Ellwanger, C. Hoselmann, M. Weidenfeller, 2009. The Heidelberg Basin Drilling Project. Eiszeitalter und Gegenwart / Quaternary Science Journal, Special Issue 57/3-4, Hannover.

P. Gibbard, 2007. Europe cut adrift. Nature 448, Issue 7151, p. 259-260.

Litholex (2011 ff.): http://www.bgr.bund.de/litholex

S. Toucanne, S. Zaragosi, J.F. Bourillet, P. Gibbard, F. Eynaud, J. Giraudeau, J.L. Turon, M. Cremer, E. Cortijo, P. Martinez, L. Rossignol, 2009. A 1.2 Ma record of glaciation and fluvial discharge from the West European Atlantic margin. Quaternary Science Reviews, Quaternary Science Reviews, 28/25-26, p. 2974-2981.

M. Weidenfeller ,T. Kärcher, 2008. Tectonic influence on fluvial preservation: aspects of the architecture of Middle and Late Pleistocene sediments in the northern Upper Rhine Graben, Germany. Netherlands Journal of Geosciences - Geologie en Mijnbouw, 87/1, 33-40.

PALAEOENVIRONMENTAL IMPLICATIONS THROUGH THE STUDY OF AN EEMIAN PALAEOSOL IN NORTHWESTERN SARDINIA (ITALY)

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Sardinia is one of the main islands of the Mediterranean Sea where it occupies a central position. The Island has been considered tectonically stable since the last 2My and, therefore represents a key area to perform studies on climate and palaeonvironmental changes that have occurred during the Quaternary. A multidisciplinary approach was followed to study a palaeosol belonging to a succession located along the Alghero Gulf (North-Western Sardinia). This gulf is open to the sea on the west and laterally bordered by Mesozoic limestone cliffs. The embayment is dominated by a 5 km long sandy beach-ridge system backing a N-S oriented lagoon system named Calick The studied succession is dominated by a prograding sandy beach ridge system referred, based on Optically Stimulated Luminescence (OSL) dating, to the Eemian Interglacial (128 ±5 ka). In detail, the succession is characterized by shallow marine deposits at the base , followed by a clayey lagoon sediments and by colluvial strata. The succession is capped by a relatively thick aeolianite.

The aim of this work is to define the palaeoenvironmental changes related to the soil formation phases observed by means of an in-depth micromorphological study.

In particular, the presence of this palaeosol is associated to the fast climatic fluctuations that took place during the Eemian stage. Three main climatic pulses were highlighted. A wet moment, with intense carbonate leaching, was followed by the establishment of a very dry climate and by the formation of a thick calcrete horizon. Finally, warm and wet climatic conditions lead to the rapid weathering of the calcrete top layer and to the formation of reddish horizons showing moderate pedogenetic development. The preliminary results suggest the warm Eemian interglacial was characterized by rapid wet and dry high frequency alternations and, dominated by physical and biological pedogenetic processes with limited chemical weathering.