FLUVIAL ARCHIVES GROUP

FLAG Biennial Meeting 2012

Remich, Luxembourg
September 2-7, 2012

New insight on the Quaternary evolution of the Moselle River and its tributaries (Luxembourg, France, Germany)

ABSTRACT BOOK

FLAG 2012 Scientific programme

Monday 3rd September		
09h00-09h30	**Opening of the Conference**	
09h30-09h50	Colbach	*Introduction to the geology and geomorphology of the Moselle River Valley and adjacent areas*
9h50-10h10	Bridgland *et al.*	*Fluvial archives as a framework for the Lower and Middle Palaeolithic: an update*
10h10-10h30	Frouin & Fajon	*How could environmental archaeology take part in the understanding of global changes? Initiation of an integrated approach on the evolution of Holocene landscapes in the Lower Seine Valley*
10h30-11h00	**Coffee break & Posters**	
11h00-11h20	Sobucki *et al.*	*Human induced channel changes of the upper Wisłoka River during last 150 years (Polish Carpathian Mts)*
11h20-11h40	Owczarek *et al.*	*Influence of modern climate changes on the activity of fluvial processes in the High Arctic area (as example of SW Spitsbergen, Svalbard)*
11h40-12h00	Rodrigues *et al.*	*Consequences of alternate bars dynamics on sedimentary archives in large sandy disconnected river channels*
12h-12h20	Laigre *et al.*	*Interests and limits of geoelectrical measurements for reconstruction of palaeodynamics of an Alpine river : the Swiss Rhône River*
12h20-14h00	**Lunch**	
14h00-14h20	Kasse	*Fluvial response to base level changes during the Late Weichselian deglaciation, Ain River, Jura, France*
14h20-14h40	Krupa	*Channel pattern changes in the Czarna Nida valley during the Late Glacial and Holocene, Polish Uplands*
14h40-15h00	Kalicki	*Structure and age of the upper Vistula flood plain near Cracow, southern Poland*
15h00-15h20	Cohen *et al.*	*Separation anxious rivers: abandonment overprints on channel belt architecture in the upper and central Rhine delta, the Netherlands*
15h20-15h50	**Coffee break & Posters**	
15h50-16h10	Richardson *et al.*	*Valley floor confinement as a control on Holocene floodplain development in Northland, New Zealand*
16h10-16h30	Wolf & Faust	*Late Pleistocene and Holocene sedimentation dynamics of selected river systems in Spain – Stratigraphical records and deducible palaeoenvironmental implications*
16h30-16h50	Toonen *et al.*	*A 400-year discharge record of Lower Rhine floods, based on the sedimentary characteristics of flood deposits*

Tuesday 4th^{d} September		
09h10-09h30	Stokes *et al.*	*Patterns of Quaternary river terrace staircase formation and preservation in the south-central High Atlas Mountains, Morocco*
09h30-09h50	Cunha *et al.*	*The Lower Tejo River sedimentary sequences as evidence for landscape, climatic evolution and records of human occupation during the Pleistocene*
9h50-10h10	Stange *et al.*	*External controls on formation and preservation of the Segre River terraces staircase in the Southern Pyrenees foreland*
10h10-10h30	Christol *et al.*	*Highlighting changes in palaeogeography of the Lake Van basin from fluvio-lacustrine archives in the tributary river valleys*
10h30-11h00	**Coffee break & Posters**	
11h00-11h20	Mather *et al*.	*Towards developing a standardised framework for recording and processing river terrace sequences*
11h20-11h40	Westaway & Bridgland	*Global review of fluvial sequences, vertical crustal motions, and crustal properties*
11h40-12h00	Maddy *et al.*	*Landscape-Evolution Modelling: Meeting the challenges via High Performance Computing (HPC)*
12h-12h20	Vandenberghe *et al.*	*Implications of dynamic equilibrium for river management: the Maas and Geul rivers (The Netherlands)*
12h20-14h00	**Lunch**	
14h00-14h20	Anton *et al*.	*Stream capture and channel morphology in the Duero Basin (NW Iberia)*
14h20-14h40	Martins *et al.*	*Transient knickpoints and relict profiles in tributaries of the Tejo River (Portugal): Determination of incision through reconstruction of the pre-rejuvenation profiles*
14h40-15h00	Rodes *et al.*	*Advances in the study of alluvial deposits with cosmogenic depth profiles: Combined surface exposure-burial dating from paired cosmogenic data*
15h00-15h20	Frechen *et al.*	*OSL Chronology of Dust Accumulation along the Mississippi Valley*
15h20-15h50	**Coffee break & Posters**	
15h50-16h10	Lauer *et al.*	*Chronology of the Lower Middle Terrace in the southern Lower Rhine Embayment – New insights from luminescence dating*
16h10-16h30	Harmand *et al.*	*A revised reconstruction of the fluvial response to extrinsic forcing in the Moselle catchment (France, Luxembourg, Germany)*
16h30-16h50	Löhnertz *et al.*	*River incision and uplift of the West Eifel volcanic field (Rhenish Massif, Germany): Evidence from $^{40}Ar/^{39}Ar$ dating on Middle Pleistocene lava flows*
16h50-17h50	**FLAG 2012 Business Meeting**	

ORAL PRESENTATIONS

Stream capture and channel morphology in the Duero Basin (NW Iberia)

Loreto Antón* (1), G. De Vicente (2) & A. Muñoz Martín (2)

* lanton@ccia.uned.es
(1) Facultad de Ciencias. Universidad Nacional de Educación a Distancia (UNED). C/ Senda del Rey 9, 28040 Madrid, Spain.
(2) Instituto de Geociencias. Departamento de Geodinámica. Universidad Complutense de Madrid, Spain.

In fluvial basins, a lowering of base level, induced by tectonic activity, fluvial capture or eustatic or climate variability, is transmitted upstream along fluvial channels in the form of erosional waves. Changes in equilibrium conditions are clearly reflected in channel morphology as changes in main trunk direction and variation in the concavity and steepness of longitudinal profiles. The analysis of present channel valleys and longitudinal profile shapes represent a powerful qualitative tool for a relative quantification of fluvial incision and involved processes.

The Duero River, nowadays draining to the Atlantic Ocean, formerly configured a closed drainage system. The endorheic basin sediments are preserved in central Iberia (Cenozoic Duero basin, CDB) at highs up to 900 m; however the western fringe of the Cenozoic basin (WCB) is a plain area where the Paleozoic litologies crop out and the Cenozoic sediments are not present. In this area, streams form deep gorges which reach more than 400 meters of incision from the former closed basin level.

The longitudinal profiles of rivers flowing through the Cenozoic basin are close to the equilibrium shape, in agreement with the former closed basin base level. Nonetheless, as a consequence of the drainage opening and the dramatic base level lowering, the longitudinal profiles of the rivers flowing through the western fringe of the Cenozoic basin are in a transient state of disequilibrium. Extensive bedrock segments along the active channel include knickzones of steep rapids and short steps, and V-shaped valleys are characteristics.

The lithological homogeneity of the WCB makes it an ideal area to analyze the relationship between the tectonic pattern and the fluvial shapes. In this work we present the analysis of the channel network together with a well constrained geological and tectonic pattern, to analyze the role of tectonics in the development of the drainage in the area. Further studies in fluvial network evolution and its interplay with tectonics in the Duero Basin are currently under study though tectonic, geomorphology, surfaces dating and modeling approaches.

This research was funded by Consolider Ingenio 2006: “Topoiberia” (CSD2006-00041), the Spanish National Research Program: “Topoiberia Foreland” (CGL2006- 13926-C02-01-02).

Reference

Anton, L., Rodes, A., De Vicente, G., Pallas, R., Garcia-Castellanos, D., Stuart, F.M., Braucher, R., Bourles, D., in press. Quantification of fluvial incision in the Duero Basin (NW Iberia) from longitudinal profile analysis and terrestrial cosmogenic nuclide concentrations, Geomorphology, Available online 27 December 2011, ISSN 0169-555X, 10.1016/j.geomorph.2011.12.036.

Fluvial archives as a framework for the Lower and Middle Palaeolithic: an update

David Bridgland* (1), Mark White (2) & Rob Westaway (3,4)

*d.r.bridgland@durham.ac.uk
(1) Department of Geography, Durham University, Durham DH1 3LE, UK
(2) Department of Archaeology, Durham University, Durham DH1 3LE, UK
(3) MCT, The Open University, Abbots Hill, Gateshead NE8 3DF, UK
(4) NIReS, Newcastle University, Newcastle-upon-Tyne NE1 7RU, UK

It has long been known that, in some parts of the world, river gravels are an important repository for Palaeolithic artefacts. Even in the days of rather low-key, collector-based research it was also known that certain bodies of gravel (usually forming terraces) were prime artefact sources and that particular types of tools and debitage occurred in some deposits and not in others. With the adoption of a 'long chronology' for the Middle Pleistocene, based on the marine oxygen isotope stages (MIS) from deep ocean cores, came the recognition of a meaningful progression of artefact types, something that could not be achieved with reference to the previous 'short chronology' (Bridgland *et al*., 2006; Mishra *et al*., 2007). Rather more controversial has been the use of the archaeological record from fluvial sequences to provide chronological pinning points for the uplift modelling of terrace sequences with the aim of achieving a pattern of dating (Westaway *et al*., 2006). Although reservations have been expressed (Briant *et al*., 2006, 2009), the results of such modelling appear robust and, if anything, have proved prescient in the light of later findings (Bridgland *et al*., 2012; Harding *et al*., 2012). In NW Europe, at least, it seems that Levallois appeared in MIS 9–8, that *bout coupé* handaxes are indicative of MIS 3 and that assemblages with twisted ovate handaxes in significant numbers represent MIS 11 occupation. Added to this, it is now possible to suggest that further tool types occur preferentially in deposits of particular age: assemblages with significant proportions of cleavers and 'ficron' handaxes appear to correlated with deposits formed at around the time of the MIS 9 interglacial (Pettitt & White, 2012). There has been a change of view about hominin environmental preferences, with an increasing acceptance that occupation generally coincided with forested interglacial phases (Preece *et al*., 2006). The authors would wish to emphasize that the archaeological record should only be seen as dating evidence 'of last resort'.

References

Briant, R.M., Bates, M.R., Schwenninger, J.-L., Wenban-Smith, F.F., 2006. A long optically-stimulated luminescence dated Middle to Late Pleistocene fluvial sequence from the western Solent Basin, southern England. *Journal of Quaternary Science* 21, 507–523.

Briant, R.M., Wenban-Smith, F.F., Schwenninger, J-L., 2009. Solent River gravels at Barton on Sea, Hampshire SZ 230 930. In: *The Quaternary of the Solent Basin and West Sussex Raised Beaches* (Briant, R.M., Bates, M.R., Hosfield, R., Wenban-Smith, F.F. (Eds.), Field Guide, Quaternary Research Association, London, pp 161–170.Bridgland, D.R., Antoine, P., Limondin-Lozouet, N., Santisteban, J.I., Westaway, R., White, M.J., 2006. The Palaeolithic occupation of Europe as revealed by evidence from the rivers: data from IGCP 449. Journal of Quaternary Science 21, 437–455.

Bridgland, D.R., Harding, P., Allen, P., Candy, I., Cherry, C., Horne, D., Keen, D.H., Penkman, K.E.H., Preece, R.C., Rhodes, E.J., Scaife, R., Schreve, D.C., Schwenninger, J.-L., Slipper, I., Ward, G., White, M.J., White, T.S., Whittaker, J.E., 2012. An enhanced record of MIS 9 environments, geochronology and geoarchaeology: data from construction of the High Speed 1 (London–Channel Tunnel) rail-link and other recent investigations at Purfleet, Essex, UK. *Proceedings of the Geologists' Association* doi:10.1016/j.pgeola.2012.03.006

Harding, P., Bridgland, D.R., Allen, P., Bradley, P., Granta, M.J., Peat, D., Schwenninger, J.-L., Scott, R., Westaway, R., White, T. 2012. Chronology of the Lower and Middle Palaeolithic in NW Europe: developer-funded investigations at Dunbridge, Hampshire, southern England. Proceedings of the Geologists' Association, doi:10.1016/j.pgeola.2012.03.003Mishra, S., White, M.J., Beaumont, P., Antoine, P., Bridgland, D.R., Howard, A.J., Limondin-Lozouet, N., Santisteban, J.I., Schreve, D.C., Shaw, A.D., Wenban-Smith, F.F., Westaway, R.W.C., White, T., 2007. Fluvial deposits as an archive of early human activity. Quaternary Science Reviews 26, 2996–3016.

Pettitt, P., White, M., 2012. The British Palaeolithic. Routledge: London.

Preece, R.C., Gowlett, J.A.J., Parfitt, S.A., Bridgland, D.R., Lewis, S.G. 2006. Humans in the Hoxnian: habitat, context, and fire use at Beeches Pit, West Stow, Suffolk, UK. *Journal of Quaternary Science* 21, 485–496.

Westaway, R., Bridgland, D., White, M., 2006. The Quaternary uplift history of central southern England: evidence from the terraces of the Solent River system and nearby raised beaches. Quaternary Science Reviews 25, 2212–2250.

Highlighting changes in palaeogeography of the Lake Van basin from fluvio-lacustrine archives in the tributary river valleys

Aurélien Christol* (1,2), Catherine Kuzucuoglu (1), Monique Fort (2) & Michel Lamothe (3)

*Aurelien.christol@cnrs-bellevue.fr
(1) Laboratoire de Géographie Physique (UMR 8591) - 1, Place Aristide Briand 92195 Meudon Cedex
(2) Université Paris-Diderot - Dalle "les Olympiades", Immeuble Montréal, 105, rue de Tolbiac 75013 Paris
(3) Laboratoire LUX, UQUAM.

The Lake Van (1648 m) is a palaeoclimatic and palaeoenvironmental reference for the Middle East. According to previous studies, its evolution since the last 20000 years appears close-related to post-Glacial climatic changes. This presentation aims at reconstructing ancient lake levels and correlated environmental changes at the end of the Upper Pleistocene. We adopt a geomorphological approach including sedimentary facies and stratigraphic analysis, altimetric measurements on field, dating, allowed interpretation of sedimentary and morphological records still preserved in three studied valleys in the eastern part (rivers Karasu and Engil) and in the western part of the lake basin (river Kotum).
The geochronological approach is focused on dating fluvio-lacustrine sequences. OSL ages have been obtained from silty and sandy units in two of the valleys under study.
The morphosedimentary archives in the valleys have recorded high amplitude variations of the Lake Van level and volume, with five main transgressions, each one being followed by important regressions. These latter are induced by an incision of the former lacustrine sediments and the development of erosional terraces on both sides of the valleys.
Our results show that the highest lake level recorded (≥1750 m, i.e. more than 100 m above the present lake level) seems to be slightly older than the previous Interglacial, as suggested by an OSL dating (135 ka-MIS6). This transgression is post-dated by a plinian fall (115.8±3.7 ka) and a travertine (102.2±3.8 ka) which marks a regression phase. This first transgression (in our chronology) does not respond to climate forcing, but to palaeohydrographical changes related to volcanic activity in the south-west part of the lake (with an old basin topographical threshold at 1760-65 m). Between this old transgression and the Last Glacial Maximum, the Lake Van experienced one large transgression. This one, which has an estimated age of 39-33 ka (MIS3), from Ar/Ar and OSL, reached the maximum elevation controlled by a 1735 m topographical threshold. This transgression responds to climate forcing. During the Late Glacial Maximum the Lake Van experienced a third (29.8-25 ka, from ^{14}C cal BP and OSL ages) and a fourth transgression (21-17.5 ka, from ^{14}C cal BP and OSL) with high levels ≥1715 m and ≥1725 m respectively. A fifth transgression has been highlighted during the Late Glacial (13.7-11.5 ka, from ^{14}C cal BP and OSL). A low level regression (<1648 m) has followed this last main transgression and after the lake level has reached levels close to the present one.

References

Kuzucuoğlu C., Christol A., Mouralis D., Doğu A-F., Fort M., Brunstein D., Scaillet S., Karabiyikoğlu M., Akköprü E., Guillou H., Reyss J.-L. et Zorer, H**.,** 2010 – Upper Pleistocene terraces of Van lake (Eastern Anatolia, Turkey) and their relationships to climate forcing, recent tectonic impacts and volcanic activity during Upper Pleistocene. Journal of Quaternary Sciences, 25-7, 1124-1137.
Christol A., KuzucuoğluC., Fort M., Mouralis D., Doğu A.-F., Akköprü E., Brunstein D., Fontugne M., Karabiyikoğlu M., Scaillet S. et Zorer H., 2010 – Indicateurs morphosédimentaires des variations de niveau lacustre dans les terrasses du lac de Van (Turquie). Quaternaire, 21, 4, 443-458.

Separation anxious rivers: abandonment overprints on channel belt architecture in the Upper and Central Rhine delta, The Netherlands

Kim M. Cohen*, W.H.J. Toonen, H.J. Pierik, M.G. Kleinhans & E. Stouthamer

* k.m.cohen@uu.nl
Utrecht University, Dept. Physical Geography. PO BOX 80.115 Utrecht, Netherlands.

The mapping and dating of channel belts in the Rhine delta is a traditional subject at our department at Utrecht University. In 2011-2012 we ran a major updating and revision project of our digital mapping. The project aimed (i) to systematically update the dating information for beginning and ending of individual channel belts, from geological and archaeological studies completed since 2000; (ii) to update the mapping of the channel belts, honouring merged institutional borehole description databases and high-resolution geomorphological information obtained from Lidar imagery; and (iii) to incorporate new insights into the abandonment process of larger channel belts in the avulsively evolving network that is the delta. The latter new insights are the topic of this contribution. The network of channels in the delta has multiple bifurcation nodes and forms and changes by successive avulsions. From Middle to Late Holocene times a set of primary bifurcations developed upstream in the delta (apex region), where the undivided Rhine splits in long-lived channel belts of considerable width and functioning multiple millennia. A second set of bifurcations persists in the central delta, also feeding split channel belts of considerable size and prolonged lifespan (~1000 yrs). Further smaller channel belts also exist in the central delta, some of them thought to have functioned 1000 yrs, others much shorter. The present network of Rhine branches did essentially begin 2500 years ago, when the current channels branched off from former routes as partial avulsion creating a new bifurcation. The larger channels seem to have slowly evolved and matured in size. The new insight is that this is architecturally recorded in the bifurcations that abandoned: the time it took new avulsed channels to mature, the losing abandoning bifur kept receiving and storing bed load and fines. Insights in the morphodynamics of water and sediment divisions, from measurements at modern bifurcations and numerical simulations of bifurcation cases, show bifurcation evolution to be slow due to combined bedload transport processes, channel width adaptation, and varying angles of incoming flow due to meander migration towards the bifurcation node (Kleinhans et al. 2011).. As a result the abandoning branch gradually looses discharge in oscillating fashion, temporarily regaining some, but in the end losing >90% of discharge. This is also recognised in the architecture of meandering bifur channel belts in the delta apex region. This stalling sediment influx overprints the architecture of all channel belts in the delta that were abandoned over the course of the Holocene. It explains the width and sinuosity differences qualitatively inferred between residual and original channel. Traditionally, mapping of channel belts had focused on identifying the position of the residual channel fill within the ribbon sand body that constitutes the channel belts. No genetic subdivision was made within the ribbon sand, despite it being the major part of the channel belt. Instead, focus was on differentiating the overbank facies that buries the sands, split in ‘natural levee deposits’, ‘point-bar swale fills’ and ‘residual channel fill fines’, for example. With the new insights we now identify the ‘sanding en silting up’ part of the channel belt from the lateral meandering behaviour prior to the avulsion leading to abandonment (Toonen et al. 2012). The insight also propagates to the dating of periods of activity of major channel belts, for which many dates come from residual channel bases. Apparent activity overlap between precursor en successor channel belts in the network can now be explained as separation anxiety resulting from bifurcation dynamics. The insights apply to the larger channels in the network in the upper and central delta. Contrasts can be made with residual channels of smaller secondary systems in the delta floodbasin (e.g. crevasse channel complexes) and oxbow fills from upstream of the delta apex. Our updated maps show many examples.

References

Kleinhans, M.G., Cohen K.M., Hoekstra J., Ijmker J., 2011. Evolution of a bifurcation in a meandering river with adjustable channel widths, Rhine delta apex. Earth Surface Processes and Landforms 36: 2011-2027

Toonen, W.H.J., Kleinhans M.G., Cohen K.M., 2012. Sedimentary architecture of abandoned channel fills. Earth Surface Processes and Landforms 37: 459-472.

Introduction to the geology and geomorphology of the Moselle River Valley and adjacent areas

Robert Colbach*

* Robert.Colbach@pch.etat.lu
Service Géologique du Luxembourg

Being one of the major rivers of north-eastern France and south western Germany, the Moselle rises within the Vosges Massif (culminating at 1424 m). The massif forms the left shoulder of the Upper Rhine Graben and exposes endogenous rocks from the central Hercynian mountain belt. The main part of the French Moselle course is then developed through the eastern part of the Paris basin, called the Lorraine Plateau, where concentric aureoles of Triassic and Jurassic sedimentary rocks cover the Hercynian basement. The basement outcrops in the Rhenish Massif, framing the basin in the north (Ardennes, Eisleck, Eifel) and the north-east (Hunsrück). Both are high plateau areas (altitudes up to 816 m), build up mainly of Devonian schists, sandstones and quartzites.

Following the peneplanation of the Hercynian belt during the Permian, coarse fluvial (Buntsandstein), and mainly shallow marine to evaporitic sediments (Muschelkalk and Keuper) accumulated during the Triassic, while the area was part of the German basin. From the Jurassic onwards, the Paris Basin opened up and marine deposits predominate until the end of the Jurassic.

The Cretaceous period was probably characterized by wide-spread deposits, but these have been preserved only on the highest summits of the Ardennes-Eifel massifs. However, a cretaceous erosional surface at 400 m can still be identified in some areas today.

During the Cenozoic, the area has undergone moderate tectonic deformations due to the alpine compression and the opening of the Rhine Graben. Structurally, the region is characterized by mainly NE-SW-striking undulations with large radii of curvature and reactivated faults in the Hercynian basement. From south to north, the Moselle and its main tributary the Sarre cross the Sarreguemines syncline, the Lorraine-Saarbrücken anticline, before entering the Luxembourg syncline (Moselle only), and finally flowing on the Hercynian basement of the Rhenish Massif in Germany.

Since the end of the Pliocene, the area has undergone a generalized uplift. This first caused a valley incision of more than 100m for the Moselle and terrace deposition. The uplift also led in the Mesozoic cover to the individualization of resistant units (limestones, sandstones, iron ore) separated by more easily erodible units (marls and mudstones). The slight westward dip of the units brought forth a typical landscape of concentric cuestas with scarps often exceeding 100 meters and predominating north-south directions.

References:

Le Roux J., 2007. Introduction à la géologie de l'Alsace-Lorraine et de ses regions limitrophes, Livret-guide de l'Excursion des 7,8 et 9 juin 2007, AFEQ, 27-34

Harmand D., Le Roux J., 2007. Origin of the hydrographic network in the Eastern Paris Basin and its border massifs, Livret-guide de l'Excursion des 7,8 et 9 juin 2007, AFEQ,5-10

Liedtke H., Deshaies M., Gamez P., Harmand D., Preusser H., 2010. Die Oberflächenformen in der Grenzregion Saarland-Lothringen-Luxemburg, Institut für Landeskunde im Saarland/Deutsche Akademie für Landeskunde, Saarbrücken/Leipzig, 367 p.

Lexa-Chomard A., Pautrot C., 2006. Géologie et Géographie de la Lorraine, Ed. Serpenoise, Metz, 286 p.

The Lower Tejo River sedimentary sequences as evidence for landscape, climatic evolution and records of human occupation during the Pleistocene

Pedro P. Cunha* (1), António A. Martins (2), Thierry Aubry (3), Nelson A.C. Almeida (4), Andrew S. Murray (5), Jan-Pieter Buylaert (5,6), Reza Sohbati (5), Luis Raposo (7) & Martin Stokes (8)

* pcunha@dct.uc.pt
(1) Department of Earth Sciences, IMAR-Marine and Environmental Research Centre, University of Coimbra, Portugal.
(2) Centro de Geofísica, Dep. Geociências, University of Évora, Portugal
(3) Museu do Côa, IGESPAR I.P., Rua do Museu, 5150-610, Vila Nova de Foz Côa, Portugal
(4) IGESPAR I.P. Extensão do Crato, rua 5 de Outubro, 33, 7430-137 Crato, Portugal
(5) Nordic Laboratory for Luminescence Dating, Aarhus University, Risø DTU, Denmark
(6) Radiation Research Division, Risø DTU, Denmark
(7) Museum Nacional de Arqueologia, Lisboa, Portugal
(8) School of Geography, Earth and Environmental Sciences, University of Plymouth, United Kingdom

The Tejo River (Tajo in Spanish and Tagus in Latin) is the longest river (1007 km) of the Iberian Peninsula and flows to the Atlantic Ocean. In the Portuguese sector along the Lower Tejo Cenozoic Basin, six terrace levels (T1-T6) are inset below the culminant (Pliocene) sedimentary unit (Martins et al., 2010a, 2010b; Cunha et al., 2008, 2012).

Luminescence and U-Series dating provided burial ages only for the three lower terraces (e.g. Raposo, 1995a; Cunha et al., 2008; Martins et al., 2009, 2010a, 2010b), due to the high environmental dose rate and the age limitations of the dating techniques used.

The alluvial infill is considered to be <12ka (Vis, 2009), a cover unit of aeolian sands and colluvium were dated 32 – 12 ka (MIS2), the T6 is 62 – 32 ka (MIS3), the T5 is probably 75 – 136 ka (MIS5) and the T4 is ca. 150 – 340 ka (MIS 6-9). By extrapolation, the probable ages of the upper terraces top deposits could be: T3 – ca. 350 ka; T2 – ca. 500 ka; T1 – ca. 1 Ma.

In the Lower Tejo River, Palaeolithic artefacts have been recovered from three lower river terrace levels and the cover unit of aeolian sands. The integration of absolute age datasets with archaeological, geomorphological and sedimentary data indicate that in westernmost Iberia the first appearance of artefacts in river terrace sediments suggests that the earliest marker for human occupation (artefacts found *in situ* at the T4 base deposits) dates from the lower Acheulian (Lower Palaeolithic), probably corresponding to an age of ~300 ka. Data also suggest, for the first time, that Acheulian lithic industries were replaced by Middle Palaeolithic ones (namely the *Levallois* stone knapping technique) by ~160 ka (~ MIS 6).

The cold climate of the last 62 to 12 ka, was marked by very dry conditions from 32 to 12 ka which resulted in low river flow discharges, floodplain exposure and reworking by NW winds (dominant aeolian sediment transport). The beginning of this cold-dry period, that we dated at 32 ka, is coeval with the disappearance of Megafauna and associated Neanderthal communities, and the replacement of the Middle Palaeolithic industries by Upper Palaeolithic ones in this westernmost part of Europe.

References

Cunha P.P., Martins A.A., Huot S., Murray A.S., Raposo L., 2008. Dating the Tejo River lower terraces in the Ródão area (Portugal) to assess the role of tectonics and uplift. Geomorphology, 102, 43-54.

Cunha P. P., Almeida N.A.C., Aubry T., Martins A. A., Murray A.S., Buylaert J.-P., Sohbati R., Raposo L., Rocha L., 2012. Records of human occupation from Pleistocene river terrace and aeolian sediments in the Arneiro depression (Lower Tejo River, central eastern Portugal). Geomorphology, DOI: 10.1016/j.geomorph.2012.02.017

Martins A.A., Cunha P.P., Buylaert J.P., Huot S., Murray A.S., Dinis P., Stokes M., 2010a. K-feldspar IRSL dating of a Pleistocene river terrace sequence of the Lower Tejo River (Portugal, western Iberia). Quaternary Geochronology 5, 176-180.

Martins A.A., Cunha P.P., Rosina P., Oosterbeck L., Cura S., Grimaldi S., Gomes J., Buylaert J.-P., Murray A.S., Matos J., 2010b. Geoarchaeology of Pleistocene open air sites in the Vila Nova da Barquinha - Santa Cita area (Lower Tejo River basin, central Portugal). Proceedings of the Geologists Association, 121, 128-140.

Vis G.-J., 2009. Fluvial and marine sedimentation at a passive continental margin: the Late Quaternary Tagus depositional system. Ph.D. Thesis, VU University Amsterdam, 246 p.

OSL Chronology of Dust Accumulation along the Mississippi Valley

Manfred Frechen* (1), Eric A. Oches (2) & Sumiko Tsukamoto (1)

* Manfred.Frechen@liag-hannover.de
(1) Leibniz Institute for Applied Geophysics (LIAG), Geochronology and Isotope Hydrology, Stilleweg 2, 30655 Hannover, Germany
(2) Department of Natural & Applied Sciences, Bentley University, 175 Forest St. Waltham, MA 02452, U.S.A.

The Mississippi/Missouri River system is the most important source area of Pleistocene aeolian dust in the Great Plains and the Central Lowland of the U.S. Along the Mississippi Valley, the thickness of loess generally decreases away from the river, indicating a flood-plain source of the sediments. Periods of increased dust (loess) accumulation are mainly associated with large meltwater discharges and sediments from the Laurentide Ice Sheet. During the Late Pleistocene, the Mississippi was a braided-river system with extensive floodplains providing abundant sand- and silt-sized sediments for aeolian processes, including deflation and nearby accumulation of fine-grained sediments. Along the course of the Mississippi, the loess is thick adjacent to the major river valleys, which are the sources of dust, and thins out and becomes finer-grained downwind of the sources. Similar observations have been made on European large river systems, such as the Rhine and the Danube (Frechen et al. 2003).
Along the Middle and Lower Mississippi Valley, the Peoria and Roxana Silt (loess) are important archives of fluvial activity as well as climate and environmental change for the time period of the Upper Pleistocene. We sampled loess-palaeosol successions at six localities on an N-S transect along the Mississippi valley. The Keller Farm section is located east of Saint Louis in the Upper Mississippi Valley about 120 km SW of the maximum ice margin of the Laurentide Ice Sheet. A 14 m thick sequence of loess and loess derivatives intercalated by weak soil horizons are exposed and correlate with the Late Wisconsin (Weichselian) episode, as indicated by 11 radiocarbon ages that provide independent age control. At least 20 periods of increased dust accumulation can be distinguished in the Peoria Loess (Wang et al. 2000). The (former) Pleasant Grove School section was located at the eastern bluff of the Mississippi Valley in Madison County, Illinois, and was the key site for the Roxana and Teneriffe Silt. The last glacial loess-palaeosol sequence at Pleasant Grove had a thickness of 12 m. The section at Vicksburg, Mississippi, is located 1.5 km east of the present Mississippi river course. The loess-palaeosol sequence at Vicksburg is about 20 m thick. Two sections at Natchez, Mississippi, are located 3-4 km east of the Mississippi River and have a thickness of about 20 m.
Altogether 86 OSL samples were collected for a luminescence dating study. Polymineral fine silt (4-11 mm) samples were prepared and used for luminescence dating. Equivalent doses from feldspar and quartz minerals are compared by measuring infrared stimulated luminescence (IRSL) and pulsed optically stimulated luminescence (pOSL), respectively. The aim of this luminescence dating study is to determine the timing of dust accumulation periods in the eastern loess bluffs of the Mississippi Valley in relation to the fluvial activity triggered by the advance and retreat of the Laurentide Ice Sheet and the glacial sediments transported by the river. Our OSL dating yielded ages ranging from 14 to 140 ka and giving evidence for high mass (dust) accumulation rates during the Late and Pleniglacial period.

References

Frechen, M., Oches, E.A., Kohfeld, K.E., 2003. Loess in Europe – mass accumulation rates during the Last Glacial Period.- Quaternary Science Reviews, 22, 1835-1857.
Wang, H., Follmer, L.R., Liu, J.C., 2000. Isotope evidence of paleo El Nino-Southern Oscillation cycles in loess-paleosol record in central United States.- Geology, 28, 771-774.

How could environmental archaeology take part in the understanding of global changes? Initiation of an integrated approach on the evolution of Holocene landscapes in the Lower Seine Valley

Millena Frouin* (1) & Philippe Fajon (2)

* millena.frouin@inrap.fr
(1)INRAP Grand Est Nord, 38 rue des Dats, 51520 St Martin sur le Pré France
(2) DRAC Haute-Normandie - 12 rue Ursin Scheid - 76140 Petit Quevilly

During the Quaternary period, base-level changed because of climate changes, sea-level variations and tectonic movements. At the onset of the Holocene period, fluvial valleys of Northwestern Europe were deeply incised and comprised several terraces. Some now lie beneath estuarine prisms in response to the Holocene sea-level rise. Meanwhile, these geosystems have also been progressively affected by human activities.

The Lower Seine Valley is such an example of deeply incised systems and evolution. Several studies have shown its morphologic evolution during the last centuries (Foussard *et al*, 2010) and its sedimentary evolution during the Holocene period (*e.g.* Frouin *et al*, 2010). The Holocene evolution comprises four main phases: (1) a retrogradation of depositional environments before 7.5 ka cal BP; (2) a maximum flooding event around 7.5 ka cal BP; (3) an aggradation of depositional environments from 7.5 to 2.8 ka cal BP; (4) a progradation of depositional environments after 2.8 ka cal BP. This model has highlighted the role of climatic changes, the sea-level rise, the pre-Holocene topography, the tide and the water-table level on depositional environments. But it surely underestimates the Human impact. A few projects, such as *"les Paysages et les hommes en Basse Vallée de la Seine"* (Durand *et al*, 2000), have however tried to look at this impact.

The CaPaVAl (*"Caractérisation des Paysages Anciens de la VALlée de la Seine"*) project aims at gathering archaeological, paleobiological, geomorphological and geological data to develop an integrated approach to describe the Holocene evolution of landscapes (*e.g.* Fajon, 2011a; 2011b). Are we able to collect and compare all data to have a synthetic view? Are we able to understand and describe the relationships between the River, the landscape and Human practises? Will environmental archaeology data help us to understand global to local changes? For instance, how have the flooding of the Lower Valley occurred (short or long-term process) and as a result, how have the Neolithic adapted to this modification of their landscape?

To address these questions, we have built a multidisciplinary team composed of archaeologists, geologists, geographers, archaeozoologists and palaeo-biologists (*e.g.* pollen, diatom, enthomofauna, malacofauna). The team involves people working in preventive archaeology (*e.g.* INRAP, DRAC-SRA Haute-Normandie) and researchers from different universities (*e.g.* Rouen, Caen, Paris I, Rennes and Aix-Marseille). Based on our multi-proxy approach, we have identified a few tasks: (a) to define tools enabling us to compare each set of data together (environmental frame of reference); (b) to apply this approach to archaeological and non-archaeological sites (five are already considered for the first year of the project); (c) to identify any complementary needs arising during the process of the project; (d) to broaden our project by comparing our results to other fluvial systems of Europe (*e.g.* Danube Valley, Boian plateau south of Romania, *etc*.).

References

Frouin M., Sebag D., Durand A., Laignel B., 2010. Palaeoenvironmental evolution of the Seine River estuary during the Holocene. Quaternaire, 21, 71-83.

Durand A., Billard C., Sebag D., 2000. Projet Collectif de Recherche : Les paysages et les hommes en basse vallée de la Seine depuis 10.000 ans, rapport 2000. Service Régional de l'Archéologie de Haute-Normandie (DFS 1609).

Foussard V., Cuvilliez A., Fajon P., Fisson C., Lesueur P., Macur O., 2010. Evolution morphologique d'un estuaire anthropisé de 1800 à nos jours, fascicules Seine-Aval 2.3, Rouen, mars 2010, 48 p.

Fajon P., 2011a. Archéologie(s) environnementale(s) en Haute-Normandie : contexte et propositions pour des disciplines à développer, actes des Journées Archéologiques de Haute-Normandie, Harfleur, 23-25 avril 2010, Presses Universitaires de Rouen et du Havre, 201-207.

Fajon P., 2011b. L'archéologie du paysage : question de méthode ! ou … Pourquoi l'archéologie s'intéresse-t-elle tant au paysage ? *In* Diot M-F. (Ed.): Le Paysage et l'Archéologie – Méthodes et outils pour la reconstitution des paysages. Actes du 135^{e} congrès des sociétés historiques et scientifiques, Neuchatel 2012 (Suisse), Paris, 33-48.

Contributor list (in alphabetical order): Aoustin D., Aubry B., Barbier-Pain D., Bémilli C., Beslagic S., Chaussé C., Copard Y., Coussot C., Dartois V., Debret M., Dietrich A., Dupont J-P., Durand A., Fajon P., Frouin M., Gonnet A., Granai S., Hermier G., Laignel B., Lepert T., Leroyer C., Lesueur P., Marcigny C., Marguerie D., Marinval M-C., Mouralis D., Ponel P., Rasse M., Sebag D., Sechi S., Sorrel P., Tessier B., Todisco D.

A revised reconstruction of the fluvial response to extrinsic forcing in the Moselle catchment (France, Luxembourg, Germany)

D.Harmand* (1), S.Cordier (2,3), M.Frechen (3), P.Voinchet (4), J.J. Bahain (4), S.Tsukamoto (3) & A.Techmer (3)

* dominique.harmand@univ-nancy2.fr
(1) Laboratoire de Géographie, CERPA, Université de Nancy 2, F-54 000 Nancy, France
(2) Département de Géographie et UMR 8591 CNRS- Université Paris 1-Université Paris Est Créteil, 61, avenue du Général de Gaulle F-94010 Créteil Cedex, France
(3) Leibniz Institute for Applied Geophysics (LIAG), Geochronology and Isotope Hydrology, Stilleweg 2, D-30655 Hannover, Germany
(4) Département de Préhistoire, Muséum National d'Histoire Naturelle, UMR 7194 CNRS, 1 rue René Panhard, F-75013 Paris, France

During the last decade, the fluvial terraces of the Moselle River and its main tributaries (especially the Meurthe and the Sarre) have been largely investigated. The multi-proxy research includes morphological mapping, sedimentological analyses, and numerical dating based on the OSL (Optically Stimulated Luminescence) and ESR (Electron Spin Resonance) techniques. This made it possible to distinguish the pre-capture terraces (formed by the Palaeo-Meurthe while the Upper Moselle flowed towards the Meuse) and the post-capture terraces corresponding with the present-day network. This also provides an initial reconstruction of the Middle and Upper Pleistocene valley evolution (Cordier et al., 2006). In contrast with previous research, this reconstruction covers large parts of the valley (from the Vosges Massif to the Rhenish Massif) and takes into account both for the climate and the tectonic forcing on fluvial evolution. New chronological data makes it possible to complement and refine these results:
-the first ESR dating of the main terraces of the Moselle have been performed. Although the results have to be confirmed, they suggest that these terraces (+120 to +180m relative height) are older than 1Ma. This result, which runs counter the previous estimations (that suggested an age of ca 800 ka on the basis of palaeomagnetic data extrapolated from the Lower Rhine area), is in excellent agreement with the reconstruction of Cordier et al. (2006) and confirms that no significant acceleration of uplift took place at the beginning of the Middle Pleistocene.
-The last pre-capture terrace M4 (+30m relative height) is likely to be older than previously assumed (400-500 ka). This result is consistent with the U/Th dating of speleothems found associated to fluvial sediments in the capture site, and with the reconstruction proposed for the Sarre valley (Cordier et al., 2012).
-The OSL dating performed on the first post-capture terrace M3 (+20m) demonstrate that the sedimentary evolution is more complex than shown in the initial reconstruction (which underlined the importance of sedimentation during the Pleistocene cold periods). The results actually show that significant erosion periods took place along the whole Moselle valley, leading to a common preservation of the post-Saalian sediments.
This new data hence confirm the complexity and the variability of the fluvial response to climate and tectonics in the Moselle catchment, enabling improvement of the correlation with the Rhine fluvial system.

References

Cordier S., Harmand D., Frechen M., Beiner M., 2006. Fluvial system response to Middle and Upper Pleistocene climate change in the Meurthe and Moselle valleys (Eastern Paris basin and Rhenish Massif), Quaternary Science Reviews, 25, 1460-1474.
Cordier S., Harmand D., Lauer T., Voinchet P., Bahain J.J., Frechen M., 2012. Geochronological reconstruction of the Pleistocene evolution of the Sarre valley (France and Germany) using OSL and ESR dating techniques. Geomorphology.

Structure and age of the upper Vistula flood plain near Cracow, southern Poland

Tomasz Kalicki*

* tomaszkalicki@ymail.com
Institute of Geography, The Jan Kochanowski University, ul. Świętokrzyska 15, 25-406 Kielce Poland

The aim of the study is to assess the influence of climatic changes and human impact on the Lateglacial and Holocene evolution of the Vistula valley near Cracow. The interdisciplinary research was done using palaeogeographical methods as sedimentology, geomorphological mapping, palaeobotanic (pollen diagrams, macrofossils), palaeozoology, palaeohydrology, cartographic, archaeological and historical sources, dendrochronology, radiocarbon dating...The studied section is located in the most western part of the Sandomierz Basin, in the front of the Carpathians Mountains. It is long of 50km, between the confluence with the Raba river (tributary coming from the Carpathians) and downstream of Cracow. The Vistula valley, up to 8 km wide, was cut in Miocene clay. On the left bank the higher alluvial fans of the tributaries Prądnik and Dłubnia are preserved, as well as loess-covered terraces, 10-25 m high. The flat Vistula floodplain is 4-5 m high and 2-7 km wide and shows numerous abandoned channels (Kalicki 1991, 2006). The thickness of the sediments rangęs between 4 and 15 m. Within the valley floor, in a N-S cross profile, several morphological zones of different ages may be distinguished. Immediately below the higher terrace edge, the remains of a braided alluvial plain are older than 13 000 BP and correspond with large Alleröd and smaller Early Atlantic abandoned channels, preserved in shape of semicircular recesses in the edge. The second zone corresponds with small Atlantic palaeomeanders. Along both sides of the present river, the third zone associate the Subboreal and Subatlantic meanders, and the large meanders hat were active during the last centuries. The fourth zone finally corresponds with small meanders of Boreal age. In the South, a wide zone located 1 m lower is free of meanders. This zone exhibits Pleniglacial and Lateglacial deposits associated with a braided river, partly buried by Late Atlantic alluvial fans. The dissection of the higher terrace started just after the last glacial maximum and occurred very quickly, since the Vistula river already flew in its present floodplain before 13 000 years ago. At the beginning of the Alleröd, the Vistula channel pattern changed from a braiding river to a meandering one with large meanders. The Younger Dryas cooling led to visible aggradation, again related to a braiding river. At the beginning of the Preboreal, small meanders typical to the Holocene developed. These meanders were cut off during the cool and humid periods. From the beginning of the Preboreal until the end of the Atlantic, slow aggradation and anabranching predominates, associated with channel avulsions, typical of this type of rivers. The beginning of the Subboreal corresponds with a new incision period, probably caused by two local avulsions that occured downstream of Niepołomice at the Atlantic and Subboreal limit. The erosion process culminated at about 2000 - 1500 BP, when the river channel lie almost at the Alleröd level. From the Late-Roman period to the end of Middle Age, a new aggradation period took place, related to human activity. Finally, gradual incision was observed during the last centuries. In the surroundings of Cracow, the changes of parameters of the palaeomeanders have been observed. Evidences for Holocene flood periods are shown both in the morphology and the sediments: cut-offs, avulsions, sediment changes in the floodplain (deposition of overbank muds covering organic sediments or cultural layers, beginning of peat growth, deposition of tree trunks). In the area of Cracow, several periods of floods can be distinguished: Younger Dryas, 9800-9600, 8800-8000, 6700-6000, 5500-5000, 4500-4000, 3500-3000, 2700-2600, 2350-1800 BP, 5-6th, 10-11th, 13-14th, 16-19th centuries (Kalicki 1991, 2006). These periods are in agreement with the humid climatic phases in the Carpathians and in whole Central Europe (Kalicki 2006). Overbank deposits are differentiated with respect to the grain size composition that corresponds to climatic-vegetation changes at the Lateglacial-Holocene transition, to anthropogenic deforestation in the Neoholocene, and to the distance from an active channel. During the Lateglacial and the Early Holocene as well as during the Subatlantic, these overbank deposits correspond with silty-sandy muds (Mz=4.50-6.25 φ). In contrast, the Atlantic sediments correspond with clayey silts (Mz = more than 8.5 φ).

References
Kalicki T., 1991. The evolution of the Vistula river valley between Cracow and Niepołomice in late Vistulian and Holocene times, [in:] Evolution of the Vistula river valley during the last 15 000 years, part IV (ed. L. Starkel). Geographical Studies, Special Issue 6, 11-37.
Kalicki T., 2006. Zapis zmian klimatu oraz działalności człowieka i ich rola w holoceńskiej ewolucji dolin środkowoeuropejskich (Reflection of climatic chan ges and human activity and their role In the Holocene evolution of Centraleuropean Valley). Prace Geograficzne 204, p. 348.

Fluvial response to base level changes during the Late Weichselian deglaciation, Ain River, Jura, France

C. Kasse*

* c.kasse@falw.vu.nl
Department of Climate Change and Landscape Dynamics, Faculty of Earth and Life Sciences, VU University Amsterdam, the Netherlands,

The behaviour of fluvial systems is, besides intrinsic mechanisms, controlled by external forcing factors such as climate change, sediment supply and land use, tectonics and base level, which often operate simultaneously and therefore difficult to disentangle. The Ain river in eastern France offers the opportunity to evaluate especially the effects of base-level changes in the last glacial and deglaciation period. During the Last Glacial Maximum the Ain river catchment was partially glaciated and blocked by the Jura ice cap leading to the development of a large proglacial lake (Lac Combe d'Ain) (Campy & Arn, 1991). Major, up to 30 m thick, gravel and sand deposits were formed by sanders and Gilbert-type deltas at the margins of the lake due to local high base level at 520 m. The associated glaciolacustrine varves, that formed in front of the deltas in 20 to 40 m water depth at the final stage, enable to reconstruct the duration of this high base level phase to a geologically short 1000 year period. During deglaciation the ice dam disappeared and the large proglacial lake in the Ain valley drained almost instantaneously, perhaps catastrophically, since no intermediate delta systems were formed. This rapid base-level fall of circa 40 m first resulted in simultaneous dissection of the high-stand deltas and deposition of a widespread, but thin (c. 2 m), gravel sheet over the former lake bottom. The duration of this dissection and depositional 'phase' is assumed to have been short. Secondly, the base-level fall caused further incision by the Ain, forming a 40 m high terrace staircase of up to 7 terraces, in the deltaic and glaciolacustrine high-stand deposits. This major terrace formation spans the late glacial to Holocene periods. Terrace formation can be explained by intrinsic fluvial behaviour with vertical incision and simultaneous lateral migration leaving the active channel-bed sediments as thin gravel deposits (1-2 m thick) on the eroded surface. However, the upper terraces may be correlated to ice-recessional moraine ridges and therefore a climatic control cannot be excluded. This case study enlarges our understanding of rapid and complex fluvial response to base-level change, not only in fluvial catchments, but possibly also in coastal areas and deltas where sea-level changes determine the preservation of high-stand interglacial deposits.

Reference

Campy M., Arn R., 1991. The Jura glaciers: palaeogeography in the Würmian circum-Alpine zone. Boreas, 20, 17-27.

Channel pattern changes in the Czarna Nida valley during the Late Glacial and Holocene, Polish Uplands

Joanna Krupa*

* joannakrupa@ujk.edu.pl
Institute of Geography, The Jan Kochanowski University, ul. Swietokrzyska 15, 25-406 Kielce, Poland

The aim of the study is to assess the influence of climatic changes and human impact on the Lateglacial and Holocene evolution of the Czarna Nida valley as an example of small river valley in low mountains and uplands – morphological zone of central Poland and all Central Europe. The interdisciplinary research was performed using palaeogeographical methods such as sedimentology, geomorphological mapping, palaeobotanic, analyse of archaeological and historical sources, radiocarbon and TL dating...The Czarna Nida river (63.8 km long, catchment area 1224.1 km^2) is a left-bank tributary of the Nida river (upper Vistula drainage basin). It arises from the confluence of the Lubrzanka and Belnianka streams in the Holy Cross Mountains and subsequently flows through the Szydlowskie Foothills, a part of the Mesozoic margin of this mountain. The river slope is 6.5‰ in the upper section and 1.3‰ in the lower section. Mean discharge near Tokarnia is 5.99 m^3/s, with maximum during snowmelt flood in March (rise of water level up to 2.5 m).
The Wide floodplain is typically preserved about 2-5 meters above river level, and present complex structures. In the valley floor, each morphological unit includes alluvial inset fills of different ages formed by various channel patterns: large meanders, small meanders, multichannel.
Abandoned large meanders locally recognized are associated with the Lateglacial development phase of channels typical for rivers of Central Europe. Small meanders and multichannel systems were typical for the Holocene. The oldest palaeochannel cut off (Mala Wies) was dated to 8120±90 BP and peaty fill was cover with overbank deposits at 7680±100 BP. Multichannel systems (anabranching) are preserved at some places of the floodplain. Their morphological position, morphometric characteristics and the structure of the fluvial deposits provide evidence for these channels to have been active during the Holocene.
The study area exposes traces of the major channel pattern changes observed in Central Europe, from the Pleniglacial braided river to the Lateglacial large meanders and the Holocene small meander. However, the Czarna Nida valley shows that this model has to be completed with the Holocene periods of multichannel activity (anastomosing, anabranching), as was also recognized in other river valleys in Poland. The cut off and changes of sedimentation type in the Czarna Nida floodplain actually correlate very well with periods of increasing river activity (for example 8500-8000, 6600-6000 BP) observed in other Central European rivers (Kalicki 2006). In contrast, some of the periods (for example 7680, 2530 BP) have to be connected also with local events recorded in small catchments as that of the Czarna Nida. Finally, an increase of sedimentation rate near the river channel in the last millennium occurred.

Reference

Kalicki, T. (2006). Zapis zmian klimatu oraz działalności człowieka i ich rola w holoceńskiej ewolucji dolin środkowoeuropejskich (Reflection of climatic chan ges and human activity and their role In the Holocene evolution of Centraleuropean Valley). *Prace Geograficzne* 204, p. 348.

Interests and limits of geoelectrical measurements for reconstruction of palaeodynamics of an Alpine river : the Swiss Rhône River

Laetitia Laigre* (1), Gilles Arnaud-Fassetta (2), Emmanuel Reynard (1) & Ludovic Baron (3)

* laetitia.laigre@unil.ch
(1) University of Lausanne – Anthropole – UNIL-Dorigny – CH 1015 Lausanne (Switzerland)
(2) University of Paris-Est Créteil Val de Marne, UMR 8591 CNRS LGP Meudon (France)
(3) University of Lausanne – Amphipole – UNIL-Sorge – CH 1015 Lausanne (Switzerland)

Geophysical measurements are a precious tool for characterising valley's infilling where outcrops are not available. Due to torrential activity of tributaries, main Alpine rivers' valleys infillings present a wide range of grain sizes (from clay < 2 µm to pebble up to 10 cm long). The electrical response (characterised by measurement of resistivity values) depends on the sediment texture that is quite heterogeneous in alpine alluvial fillings. Resistivity contrasts are therefore more apparent on the electrical tomographies, and the identification of palaeochannels is consequently quite evident.
Upstream from the Lake Geneva, several electrical measurements have been carried out along two cross-profiles crossing the entire width of the Rhône River valley near Martigny (Valais Canton). Electrical tomographies have highlighted information at two spatial scales: (i) At a local scale, two generations of palaochannels have been identified. A layer of gravels and pebbles with sandy matrix is located from 1 to 5 m below the surface and is dated from the Little Ice Age. Comparison with historical maps has shown that the first palaeochannel was abandonned since the Rhône River channelisation in 1860. A second palaeochannel, located between 10 and 20 m of depth, was active prior to the Little Ice Age. (ii) At the scale of the valley, electrical measurements have shown that the main palaeohydrography was principally concentrated in the north part of the valley, where the present channelised Rhône River channel is located. In the southern part, resistivity values are lower suggesting dominance of silty layer and typical calm environment. This interpretation has been confirmed by sediment corings.
Some methodological limits of this method have to be known, particularly in valleys where the hydrological regime of the main river is dependant of snow and ice melting. Indeed this seasonal phenomenon modifies the level and the characteristics of ground water. These modify the resistivity values of terrain and finally the spatial repartition of resistivity in the tomography. A temporal comparison of tomographies have been lead in order to evaluate the rate of resistivity change through the time, distinguishing periods of high or low level of the water table.

Chronology of the Lower Middle Terrace in the southern Lower Rhine Embayment – New insights from luminescence dating

Tobias Lauer* (1), Peter Fischer (2), Frank Preusser (3), Manfred Frechen (4), Anja Zander (2), & Alexandra Hilgers (2)

* tobias.lauer@uni-leipzig.de
(1) Leipzig University, Institute of Geography, Johannisallee 19a, 04103 Leipzig, Germany
(2) University of Cologne, Institute of Geography, Albertus-Magnus-Platz, 50923 Cologne, Germany
(3) Department of Physical Geography and Quaternary Geology, Stockholm University, 10691 Stockholm, Sweden
(4) Leibniz Institute for Applied Geophysics, S3: Geochronology and Isotope Hydrology, Stilleweg 2, 30655 Hanover, Germany

Feldspar- and quartz luminescence dating was applied to fluvial sediments sampled from Lower Middle Terrace (LMT) sites in the southern Lower Rhine Embayment to provide a first independent chronological framework apart from existing chronologies mainly based on morphological aspects, petrography, and relative age estimates deduced from the age of cover sediments.
The determined pIRIR and OSL ages show that parts of the LMT are not to be correlated with the penultimate (Saalian) glaciation, as previously assumed. The LMT was most likely formed during the Early Weichselian. LMT-sediments exposed at Brühl (south of Cologne) yield OSL ages between 90 ± 8 and 97 ± 8 ka and pIRIR feldspar ages from the same site confirm deposition during the Early Weichselian.
The hypotheses that the LMT was formed during the Early Weichselian is supported by a quartz OSL age of 81 ± 8 ka from a drill core at Pulheim (NW of Cologne), and quartz OSL ages from an outcrop at Bovert (NW of Düsseldorf) yielding depositional ages between 77 ± 8 ka to 80 ± 10 ka.
Hence, this luminescence based chronology for the LMT is an important contribution towards a better understanding of the depositional pattern of the River Rhine during the Quaternary.

River incision and uplift of the West Eifel volcanic field (Rhenish Massif, Germany): Evidence from $^{40}Ar/^{39}Ar$ dating on Middle Pleistocene lava flows

Werner Löhnertz* (1), Dieter F. Mertz (2,3) & Paul R. Renne (3)

* werner@loehnertz.de
(1) Hermann-Josef-Kolleg, Hermann-Josef-Str.4, 53925 Kall-Steinfeld, Germany
(2) Johannes Gutenberg University, Institute of Geosciences, Becherweg 21, 55099 Mainz, Germany
(3) Berkeley Geochronology Center, 2455 Ridge Road, Berkeley, CA 94709, USA

The West Eifel volcanic field (WEVF; Rhenish Massif, West Germany) has been active since the lower Middle Pleistocene. 118 lava flows are compiled and our detailed field work indicates that 32 of these flows occur directly on valley floors up to an age of lower Middle Pleistocene. On the basis of this specific geological setting, radioisotope dating on the 32 lava flows enables to reconstruct the uplift history of the West Eifel region for the last ca. 600 ka. Here, we provide new $^{40}Ar/^{39}Ar$ results, which are used together with published $^{40}Ar/^{39}Ar$ data in order to identify the onset of river incision and to evaluate uplift dynamics.

Uplift in the Rhenish Massif and cutting of valleys was suggested to have started after the formation of the "Younger main terrace". In between the sediments of this Pleistocene valley floor the Brunhes/Matuyama boundary at 780 ka was found providing an older age limit. However, no numerically calibrated age is available for the actual start of uplift. In the WEVF, several lava flows propagated over valley floors at a time when they were not yet dissected. The occurrence of leucite in the Liley lava flow (south of the city of Daun) enabled to determine a high-precision $^{40}Ar/^{39}Ar$ step-heating age of 550±3 ka (1s, plateau age) on a flow representing this specific setting related to the river Lieser. Although including much larger analytical uncertainties, previously published $^{40}Ar/^{39}Ar$ ages on groundmasses of lava flows with comparable setting yield ages which are consistent with that of the Liley flow: 590±50 ka for Firmerich (near Daun, also related to river Lieser), 540±60 ka for Kalem (north of the village of Birresborn, related to the Main Terrace of Kyll river). Since the Kalem flow spread more than 3 km upstream, we conclude that the valley floor must have had negligible decline at that time, a characteristic feature of the Younger main terrace.

Assuming that uplift, dissection of the valley floor, and river incision, are contemporaneous processes considering geological time scales, the $^{40}Ar/^{39}Ar$ data suggest that uplift in the WEVF has started ≤ ca. 550 ka. Alternatively and more compelling, as a result of backward erosion caused by the incision of the Moselle river, incision could have started in the more upstream parts of small tributaries with considerable delay. This is supported by basanites at the Niveligsberg near Nürburg which yield a conventional K-Ar age of 430±20 ka. These rocks occur in the present valley floor indicating that watersheds and headwater regions are not affected by uplift-related incision until today.

There are several suggestions on maximum uplift rates (mm/year) which are derived from rates of river incision in a range from 0.25 to 0.115 (Cordier et al. 2006). We found rates of 0.109 for the river Lieser post-Liley lava flow, 0.101 for the river Kyll post-Kalem, 0.123 for the river Lieser at the Horngraben flow (close to the city of Manderscheid) and 0.125 for the last ca. 30 ka incision history of the river Kyll, e.g., for the time post-Sarresdorf lava flow at Gerolstein (32±8 ka, $^{40}Ar/^{39}Ar$ plateau age on ground mass), the river Alf near Strohn (30±12 ka) and the river Uess near Bad Bertrich (32±11 ka).

Rates of river incision of the last ca. 100 ka derived from $^{40}Ar/^{39}Ar$ ages correspond well with the uplift rates of Cordier et al (2006) for the Upper Middle Moselle (0.125 mm/year, derived from OSL- Dating in the Meurthe Valley and a Radiocarbon Dating from the Moselle) indicating that the small tributaries of the Moselle have since 100 ka adapted the processes affecting the receiving river. But in the first period post-780 ka uplift and incision were not synchronous, as the incision of the small Eifelian rivers has started with considerable delay and lower rates.

Reference

Cordier S., Harmand D., Frechen M., Beiner M. (2006). New evidence on the Moselle Terrace Stratigraphy between the Meurthe Confluence (Paris Basin) and Koblenz (Rhenish Massif)., Zeitschrift für Geomorphologie, 50, 281-304.

Landscape-Evolution Modelling: Meeting the challenges via High Performance Computing (HPC)

Darrel Maddy* (1), Stephen McGough (2), John Wainwright (3) & Adam Trueman (1)

* Darrel.Maddy@newcastle.ac.uk
(1) School of Geography, Newcastle University, UK
(2) School of Computing Science, Newcastle University, UK
(3) Department of Geography, Durham University, UK

Existing Landscape-Evolution Models (LEMs) have tended to be applied at relatively coarse spatial resolution and over comparatively short timescales (years-centuries). Extending these models to encompass landscape evolution at the scale of, for example, an entire river basin and over important landscape-forming timescales (i.e. tens of thousands of years) is computationally challenging. In order to address this challenge we are currently reformulating and extending an existing LEM, CybErosion, in order to create a new, highly optimized model, called PARALLEM. PARALLEM is being coded for parallel processing in order to exploit parallel architectures such as CUDA (Compute Unified Device Architecture), the GPGPU (graphics card)-based architecture developed by Nvidia.
PARALLEM, a cellular erosion model written in C, implements erosion, sediment transport and deposition processes at individual cell level, with each cell storing the cumulative changes in cell attributes (e.g. height) over the duration of the model run. Using a 5,000 cell DEM, and a simulated annual time step over 800k years, the original CybErosion code has an execution time of approximately 22 hours on an Intel 980X hexacore processor. Sequential code optimization in Newcastle has reduced this to ~4.5 hours but to achieve the modelling of grids comprising millions of cells requires orders of magnitude improvements in performance, an objective unlikely to be reached via advances in conventional CPU architectures within the foreseeable future.
In this paper we will present our initial results for the parallel implementation of a number of key methods including sink filling, flat routing, flow direction (D8, steepest descent) and flow accumulation (kernels that potentially have widespread application in a whole range of Earth System Models), the key bottlenecks in the current generation of LEMs (typically taking >75% of the execution time). Thus far up to two orders of magnitude improvement in execution times have been achieved using comparatively low-end hardware, with the promise that deployment across large HPC clusters will deliver the necessary speedup. These results suggest that the goal of modelling large areas at comparatively high spatial resolution over extended timescales is achievable now.
Producing high performance models based upon process-based formulations represents only part of the challenge. This model will only prove useful if we provide more appropriate model input data and develop new ways to undertake model-data comparison. We will suggest that utilizing HPC can help resolve some of these problems also.

Transient knickpoints and relict profiles in tributaries of the Tejo River (Portugal): Determination of incision through reconstruction of the pre-rejuvenation profiles

António Martins* (1), José Borges (2), Bento Caldeira (2), Martin Stokes (3), Pedro P. Cunha (4) & António Martins (5)

* aam@uevora.pt
(1) Departamento de Geociências da Universidade de Évora, Centro de Geofísica da Universidade de Évora. Rua Romão Ramalho, 59, 7000 – 671 Évora, Portugal.
(2) Departamento de Física, da Universidade de Évora, Centro de Geofísica da Universidade de Évora.
(3) School of Geography, Earth,and Environmental Sciences, University of Plymouth, UK
(4) Department of Earth Sciences, IMAR-Marine and Environmental Research Centre, University of Coimbra, Portugal
(5) Student of Nova School of Business and Economics, Lisbon.

Longitudinal profiles (ranging from 6 to 93 km in length) and knickpoint retreat of fourteen tributaries of the Tejo River were analysed in this study. Eight of these streams show an upstream reach, which has not yet been affected by Late Cenozoic rejuvenation, and a downstream reach, rejuvenated to a new base level. The later over-steepened reach comprises several knickpoints, within a broad zone of disequilibrium (steepening). This contrasts with the upstream graded reach, represented as a straight line in the DS plots (logarithm of a reach slope against the logarithm of the reach's downstream distance; see Goldrick and Bishop, 2006 for details). In some of the tributary streams, the upstream graded reach corresponds to less than 20% of the total length and drains a smooth, undissected watershed area. This relates to a residual landscape topography that existed prior to Late Cenozoic fluvial incision.
The relationship between the tributary drainage area at the junction with the Tejo River and the upstream distance of knickpoint retreat from the tributary-trunk junction indicates that incision wave propagation is a function of discharge. In contrast, the widespread rejuvenated lower profiles indicate a base-level fall driven by regional uplift. The reconstruction of the ancient graded reach until the junction with the trunk stream allows us to estimate the incision at the stream mouth, and, indirectly, the regional uplift. For the tributaries entering directly into the Tejo River, e.g. the Sever, Nisa, Pracana and Canas streams, the values of incision range from 219±3 m, 195±13 m (for the two first streams) and 94±9 m, 94±7 m (for the latter two).The second values are similar to the present vertical separation between the oldest terrace of the Tejo River and the modern river bed.
Some tributaries show in their ancient unrejuvenated profiles two "cycles" of steady state (equilibrium) profiles that we assume to be correlated, respectively with: 1) the last planation episode of the basement, immediately prior to Late Cenozoic incision (the upper reach) and 2) the inland erosion surface of the oldest terrace (T1) of the Tejo River (the lower graded reach). Resistant lithologies, such as quartzites and granites, suppress the headwards transmission of the incision wave, because the relict profiles and the residual landscapes are preserved in these lithologies or upstream them.
Differential uplift due to local tectonics preclude the incision in the tributaries crossing subsiding compartments (e.g.: Tripeiro stream) or has accelerated the headward transmission of incision in tributaries coming from the SE slope of Portuguese Central Range, which are completely rejuvenated.

Reference

Goldrick G., Bishop P., 2006. Regional analysis of bedrock stream long profiles: evaluation of Hack's SL form and formulation and assessment of an alternative (the DS form). Earth Surface Processes and Landforms 32, 649-671.

Towards developing a standardised framework for recording and processing river terrace sequences

Anne Mather* (1), Martin Stokes (1), Liz Whitfield (2) & Greg Whitfield (3)

* amather@plymouth.ac.uk
(1) School of Geography, Earth and Environmental Sciences, Plymouth University, Drake Circus, Plymouth, Devon, PL4 8AA, United Kingdom.
(2) School of Natural Science & Psychology, Liverpool John Moors University, Byrom Street, Liverpool 3, United Kingdom.
(3) Geomorphology Technical Service, Environment Agency, Lutra House, Preston, PR8 7BX, United Kingdom.

Studies of river terraces have been prolific within the published scientific literature with more than 1400 journal articles published since 1970. Of these >60% have been published in the last decade with the greatest majority of these studies taking place within Europe and the USA. Most of these publications focus on the environmental interpretation of the studied terrace sequences, but few, if any, identify the actual morphological parameters used to underpin the fluvial sequences and terrace groupings which are crucial to the palaeoenvironmental interpretations. Thus no attempt has been made to standardise the collection of these data and the traditional field problems associated with morphological terrace mapping still apply (*e.g.* Cotton 1940, Johnson 1944; Frye and Leonard 1954) despite the development of new techniques for example in field surveying and remote terrain interrogation using digital elevation data. Here we examine the most commonly recorded terrace parameters in the vertical plane (*e.g*. terrace base and top elevations above the modern river valley) and longitudinal plane (*e.g.* terrace gradients) and explore how the errors implicit in the variety of approaches can hinder an understanding of terrace stratigraphy. We attempt to identify the most appropriate methods based on the scale of study and nature of the terrain using a selection of studies from bedrock and alluvial rivers (River Dadés of the High Atlas Mountains of Morocco; River Alías of the basin and range of southern Spain and River Bergantes of the Ebro basin of northern Spain) using field survey and GIS approaches.

Influence of modern climate changes on the activity of fluvial processes in the High Arctic area (as example of SW Spitsbergen, Svalbard)

Piotr Owczarek* (1), Adam Nawrot (2,3) & Krzysztof Migała (1)

* piotr.owczarek@uni.wroc.pl
(1) Institute of Geography and Regional Development, University of Wroclaw, Pl. Uniwersytecki 1, 50-137 Wroclaw, Poland.
(2) Institute of Geophysics, Polish Academy of Sciences, Poland
(3) Institute of Geoecology and Geoinformation, Adam Mickiewicz University, Poland

The High Arctic is a region that is particularly sensitive to global climate change. This factor makes this area an important site for studies of modern glacial and fluvioglacial processes as a response on the global warming. Spitsbergen is the biggest island of the Svalbard archipelago, which lies in the High Arctic region in the northern sector of the Atlantic Ocean. O. Nordli (2011) has calculated long term trend of air temperature in the Svalbard which is equal to +0.24^{o}C per decade. The fast retreat of the glaciers, the changes of temperature and precipitation frequency (the role of high rainfall) and the activity of periglacial processes affect the changes of sediment mass balance in the modern river channels (Maizels 1995).The aim of the study was to reconstruct the dynamics of these processes in the last 100 years and identify tendency of the river runoff and geomorphic activity in the future. The research area is located in the SW Spitsbergen in the vicinity of the Polish Polar Station in Hornsund (77°00'N,15°33'E). The research was based on: geomorphological mapping, dendrochronological analysis of tundra dwarf shrubs and sedimentological analysis. Dendrochronological methods were used to determine minimum age of fluvial and fluvioglacial terraces in analyzed valley sections (Owczarek 2010). The chronology was constructed for two species of tundra dwarf shrubs: *Salix reticulata* and *Salix polaris*. The study was carried out in the lower sections of two rivers with partly glaciated catchments: the Arie River and the Brattegg River. The Arie Valley is a small mountain catchment (2.04 km^2) where upper part is occupied by the small cirque Ariebreen glacier. Two levels of fluvioglacial terraces are clearly visible in non-glaciated part of the valley. Above can be seen flattened old moraine deposits remodeled under periglacial conditions. The youngest level is shaped by the sinuous, locally braided Arie River. The Brattegg Valley, located about 8 km on the northwest, is larger (7.5 km^2). In the upper part of the valley is located small residual glacier (the Bratteggbreen). The middle part is occupied by large glacial lakes (Myrktjørna). Morphology of the Brattegg valley and activity of the modern fluvial processes were studied in the lower part of the valley. The modern river channel has braided pattern with narrow sinuous sections. Lower level of the valley floor with well-defined paleochannels is located 2 – 4 m above modern river channel.The glaciers, located in the upper parts of the catchments, are in the high recession, but the rivers are not overloaded with sediment now. This material is deposited in the marginal lakes and within old frontal moraines (sediment traps). The stages of the development of the analyzed valley sections were distinguished: (1) before 1930: aggradation, (2) from the turn of 1930 and 1940: aggradation and fast erosion, (3) from the middle 70s: stabilization (the lower terraces development), (4) last 20 years: erosion. About 100 years ago aggradation was dominated in the non-glaciated parts of the valleys, but the river channels were relatively stable. The oldest samples of the dwarf shrubs (70~90 years old) were found on the highest terraces. The sediment budget in the glacial rivers was changed rapidly in the early 40s last century. Intensified aggradation (fast retreat of the glaciers) was replaced with fast erosion (start of sediment trapping in marginal lakes). The large paleochannels, observed in the Bretegg valley floor, were developed during the early 50s and 60s. Nowadays, after short period of stabilization (increase of sediment input, weak aggradation), tendency to erosion is observed. Our results indicate rapid changes in fluvial and fluvioglacial processes in non-glaciated parts of the High Arctic. These changes depend on water and sediment input to the catchment. The rate of the glaciers retreat is reflected by activity of geomorphic processes on their forefields, but currently, the relevance of glacier melt in the water input to the analyzed basins is not so large (especially for the Brattegg River). The modern fluvial processes in this part of Spitsbergen are mainly shaped by climatic conditions (precipitation, snow cover, temperature).

References

Maizels J.K, 1995 – Sediments and landforms of modern proglacial terrestrial environments. In: Menzies J. (ed.) Modern glacial environments. Oxford, 365-416.
Nordli O., 2010 – The Svalbard Airport temperature series. Bulletin of Geography-Physical Geography Series, 3, 5-25.
Owczarek P., 2010 – Dendrochronological dating of geomorphic processes in the High Arctic. Landform Analysis, 14, 45-56.

Valley floor confinement as a control on Holocene floodplain development in Northland, New Zealand

J.M. Richardson* (1), I.C. Fuller (1), K.A. Holt (1), N.J. Litchfield (2) & M.G. Macklin (3)

* j.m.richardson1@massey.ac.nz
(1) Physical Geography Group, Institute of Natural Resources, Massey University, Private Bag 11 222, Palmerston North, New Zealand
(2) GNS Science, PO Box 30368, Lower Hutt, New Zealand
(3) Centre for Catchment and Coastal Research and the River Basin Dynamics and Hydrology Research Group, Institute of Geography and Earth Sciences, Aberystwyth University, SY23 3DB, UK

In this study valley floor mapping, sedimentology and ^{14}C-dating have been used to reconstruct the Holocene fluvial history at eight floodplain sites spread throughout New Zealand's northernmost region (Northland). The results of this study indicate that valley floor configuration is the primary control on Northland floodplain geomorphology, with variations in sediment flux in response to climatic and anthropogenic perturbation accounting for differences in the fluvial unit assemblages between sites. A regional model of Holocene floodplain valley evolution and fluvial behaviour based on a continuum of valley confinement settings is proposed. An absence of early to mid Holocene valley-fills (before ~6500 cal. yr BP), coinciding with a warmer wetter climate, suggests limited sediment sequestration due to enhanced discharge and reduced sediment loads during this time. Climatically driven region-wide floodplain alluviation through the mid to late Holocene was followed by a period of valley floor entrenchment and floodplain erosion starting after ~2000 cal. yr BP. In unconfined and partly-confined valley settings this was followed by the aggradation of a low Holocene floodplain surface, with rapid rates of vertical accretion, which we attribute to post-settlement (~800 cal. yr BP) catchment disturbance.

Advances in the study of alluvial deposits with cosmogenic depth profiles: Combined surface exposure-burial dating from paired cosmogenic data

Ángel Rodés* (1), Raimon Pallàs (2), María Ortuño (2), Eduardo García-Melendez (3) & Eulàlia Masana (2)

* angelrodes@gmail.com
(1) Scottish Universities Environmental Research Centre, East Kilbride G75 0QF, Scotland (UK)
(2) RISKNAT, Facultat de Geologia, Universitat de Barcelona, Martí Franquès s/n, 08028 Barcelona, Spain
(3) Facultad de Ciencias Ambientales, Universidad de León, Campus de Vegazana s/n, 24071 León, Spain

Cosmonuclide depth-profiles are used to calculate the age of landforms, the rates at which erosion has affected them since their formation and, in case of deposits, the paleo-erosion rate in the source area. However, two difficulties are typically encountered: 1) old deposits, or deposits strongly affected by cosmonuclide inheritance, often appear to be saturated, and 2) a full propagation of uncertainties often yields poorly constrained ages. We show how to combine surface-exposure-dating and burial-dating techniques in the same profile to get more accurate age results and to constrain the extent of pre-depositional burial periods. Paired ^{10}Be and ^{26}Al depth-profiles measured in alluvial deposits of Iberia are presented as natural examples.

Consequences of alternate bars dynamics on sedimentary archives in large sandy disconnected river channels

Stéphane Rodrigues* (1), Jean-Gabriel Bréhéret (1), Nicolas Claude (1), Coraline Wintenberger (1) & P. Jugé (2)

* srodrigues@univ-tours.fr
(1) E.A 6293 GéHCO - GéoHydrosytèmes Continentaux, Faculté des Sciences et Techniques, Université François Rabelais, Parc de Grandmont, F-37200 Tours,
(2) CETU Elmis, 11 quai Danton, 37500 Chinon.

Modern in-channel sediments can be interpreted as low-preservation potential archives in comparison with floodplain sediments. Cross-bedded sediments associated with bars and dunes located in alluvial channels are usually “discontinuous” in the geological record. Their interpretation in terms of reconstruction of past fluvial systems imply large scale controlling factors (*e.g.* subsidence) but can be problematic or erroneous if the fluvial processes involved in the formation of archives are misunderstood. In order to understand the formation and preservation of these archives and to connect them to sediment transport processes occurring specifically during flood events it is necessary to investigate both the morphodynamics of bedforms and their sedimentary products in modern rivers.

Such a study was carried out on the modern sediments of the Loire River located in a 300 m wide sandy disconnected channel (nearly dry at low flows and submerged during flood events) characterized by the presence of single row migrating alternate bars. The approach proposed here combines scour chains, post-flood stratigraphy and frequent bathymetric surveys performed during a flood to connect the dynamics of alternate bars (and superimposed dunes) with their sedimentary products and vice versa.

The results show that the phasing of the migration of bars and their reworking influence the spatial distribution of sediments potentially preserved during a flood. The location of bars in the channel before the flood and their celerity during the flood governs sediments deposition and erosion and their possible burying and preservation. For instance, the deflection of flows exerted by pre-existing bars during the flooding phase is responsible of sediment erosion between two consecutive bars while burying and preservation of previously deposited sediments is observed at the centre of the bar. The data show that the maximum bedload transport rates are located at one-third of the cross-section during high water discharges while they increase at the centre of the cross-section during the falling limb of the hydrograph due to the deflection or redirection of flow. The spatial and temporal variability of bedload transport rate on a single cross-section is explained by preferential axes of migration of secondary (depth limited) dunes and bars; the latter being governed by the direction of banks and their mutual interactions. Fine sediments preserved as one-centimetre thick layers of silts interbedded within bar sediments constitute useful markers of discharge variation, sediment supply and bar tail proximity.

From the results mentioned here it appears relevant to integrate the instantaneous dynamics of bars before interpreting ancient fluvial archives.

Human induced channel changes of the upper Wisłoka River during last 150 years (Polish Carpathian Mts.)

Mateusz Sobucki* (1), Elżbieta Gorczyca (2) & Dorota Giriat (3)

* mateusz.sobucki@uj.edu.pl
(1) Jagiellonian University, Department of Geomorphology, ul. Gronostajowa 7, 30-387 Cracow, Poland,
(2) Jagiellonian University, Department of Geomorphology, ul. Gronostajowa 7, 30-387 Cracow, Poland,
(3) University of Warsaw, Department of Geomorphology, ul. Krakowskie Przedmieście 30; 00-927 Warsaw, Poland

Fluvial processes and channel morphology depends on many variables, such as geology, soils, sediment availability, climate conditions, vegetation and land use. In Holocene and especially during last millennium predominant impact on fluvial systems has human activity.
The upper reach of the Wisłoka River, located in the Beskid Niski Mountains, western part of the Carpathians, provide an excellent example of a natural field laboratory to observe reaction of fluvial processes on land use change.
First settlers entered the Carpathians and the foreland of the Beskid Niski Mts. early, by the end of the 4th or 3rd millennium BC, but an increase of agricultural activity in the upper part of the Wisłoka River catchment began between the 16th and 17th century, and intensified in 19th century. In 1900 only 26% of the contributing area was covered by forest. Development of settlements, farming, forest clearance and heavy grazing resulted in increased denudation rate and channel instability over a period of decades. Between 1944 and1947, Beskid Mts. were depopulated. Large national farm units established in this area by government and existing till the beginning of the 90's of the 20th century, concentrated production mainly on grazing, nevertheless reforestation process that started by the end of 40's continued (42% of land covered by forest in 1954). In 1995 The Magura National Park was founded and introduced forest management procedures caused further expansion of forested area up to 80% in the upper Wisłoka River catchment.
Historical data on land use, channel morphology, flow and sedimentary properties of bedload were collected based on spatial and temporal analysis of topographic maps (since 1860), aerial photographs (2003-2010), field survey, including geomorphological mapping and geodesic measurements (2009-2011) and detailed hydrological data analysis (1967-2011 for gauging station Krempna).
Results from this study indicate at least four periods of channel changes in Beskid Mts. area over the period of 150 years. Increased sediment yield in the 19th century caused development of a braiding channel system. Since the middle of the 20th century the process reversed and the upper part of the Wisłoka River channel has experienced a reduction of sediment supply. Consequently, as a first stage of adapting to new dynamic equilibrium, channel incision occurred. The upper Wisłoka River valley is built with thick coarse-grained alluvium, therefore channel downcutting was limited by the bedrock exposures. The excess kinematic energy of water was compensated by side erosion and an increase of channel sinuosity from 1.06 to 1.14. Due to the natural colonization of riparian vegetation on gravel bars and riversides, banks were stabilized what stopped channel degradation. However at present, on many reaches of the upper Wisłoka River, dissipation of channels (avulsion) can be observed. During the last decade development of bends and expending its curvature is also clearly visible. This process is now one of the most important issues for river management in the area.
Recently, Wisłoka River channel is developing in a manner close to the natural. However, the impact of past human activity is still observed. In perspective, research may indicate the current stage of dynamic equilibrium of upper Wisłoka River channel system and show prospect of a mountain river reaction on land use change.

External controls on formation and preservation of the Segre River terraces staircase in the Southern Pyrenees foreland

Kurt Martin Stange* (1), Ronald van Balen (1), Julien Carcaillet (2) & Jef Vandenberghe (1)

* k.m.stange@vu.nl
(1) Dep. Earth Sciences, Vrije Universiteit Amsterdam, The Netherlands
(2) Insitut des Sciences de la Terre, University Joseph Fourier de Grenoble 1, CNRS, Grenoble, France

The fluvial network of the Southern Pyrenees is an example of transverse drainage systems in young (alpine) mountain belts and it features well preserved fluvial terrace records. Some of the major Southern Pyrenees tributary rivers, like the Cinca and the Gallego, have been studied previously and have some age controls on their fluvial terrace levels. We extend these records to the largest drainage system of the Southern Pyrenees, the Segre river system, presenting new GIS and field data, as well as exposure ages obtained from in situ produced ^{10}Be cosmogenic nuclides. Our research focus is set to unravel the relative impact of external controls (such as climate, base-level and neo-tectonics) on the formation of the Segre terrace staircase in the Ebro Foreland Basin. The Ebro Basin underwent a long period of endoreic drainage before it opened to the Mediterranean Sea, probably between 8 and 13 Ma (Garcia-Castellanos et al. 2003). The endo-exoreic transition led to wide spread erosion throughout the Ebro Basin and caused the lowering of the Catalan Coastal Range, which bordered the Southern Pyrenees foreland basin towards the Mediterranean Sea.
The Pleistocene terrace staircase of the Segre River is built up by seven major terrace levels (cut and fill type terraces; TQ1 being the oldest, TQ7 the youngest and lowest terrace), which range from 112 to 3 meter above the present-day riverbed. The staircase morphology at the Segre River shows distinct analogies with other streams of the Southern Pyrenees indicating regionally consistent controls on the formation of terraces. The gravel deposits at the Segre River terraces have commonly thicknesses of up to 7m over bedrock. However, locally gravel outcrops show evidence for the impact of ongoing tectonics (i.e. gypsum doming, neo-tectonic basins) and reach extensive thicknesses of up to 20 m, featuring faults and folds as primary features. The prominent terraces TQ1, TQ2, TQ3 and TQ4 have been sampled for in situ produced ^{10}Be cosmogenic nuclides. Our results show Middle to Late Pleistocene exposure ages: TQ1: 278 ka (MIS 8), TQ2: 167 ka (MIS 6), TQ3: 109 ka (MIS 5), and TQ4: 66 ka (MIS 4), involving erosion rates of 3 - 6 mm ka^{-1} (TQ1, TQ3, TQ4), and 6 - 11 mm ka^{-1} for TQ2. The obtained exposure ages indicate a causal relationship between terrace formation (aggradation) in the Southern Pyrenees foreland and glacial periods in the Pyrenean headwaters. Sedimentological outcrop observations corroborate a cold-climate based genesis of the terraces and present numerous braided channels, ice rafted boulders and frozen sand clasts. However, our age results for TQ3 (MIS 5) imply that terrace formation has not necessarily to be attributed to major glacial periods (MIS 4, 6, 8) and can also occur during comparably warmer isotope stages with sufficient climate instability. In case of TQ3, the cold climate episodes of MIS 5.2 and MIS 5.4 (best model fit) seem to have been sufficient to induce the formation of a prominent fluvial terrace level.
Our ^{10}Be profile simulations indicate that extensive floodplains (preserved as terraces) are abandoned latest in the course of upcoming interglacial periods, which probably is owed to lacking glacial discharges and sediment supply. Though, the timing of subsequent incision remains difficult to assess, our model statistics suggest that early glacial (or late interglacial) changes in boundary conditions (i.e. wetter climatic conditions in the Pyrenees, base-level falls at the Ebro Basin outlet) might be primarily responsible for enhanced river incision and the excavation of terrace scarps in the Southern Pyrenees foreland. Moreover, we see links between enhanced incision in the Ebro Foreland Basin and the downcutting history of the Catalan Coastal Range. The stepped morphology at the breach shows several topographic levels that might record the downcutting episodes of the Catalan Coastal Range since the Ebro Basin opening. For the Middle Pleistocene, the longitudinal terrace profiles of the Segre River, together with the regional consistent staircase morphologies, point to a Ebro drainage base-level of about 200 m a.s.l. We argue, that the Catalan Coastal Range functioned as a local base-level upstream the sea outlet presumably until the Late Pleistocene and was eventually cut down owed to base-level lowering (Mediterranean Sea) linked to Pleistocene glacial periods.
In summary, the preservation of the Segre terrace staircase at the Southern Central Pyrenees does not seem to implicitly require tectonic uplift (although it cannot be excluded) and can be explained by base-level mechanisms and climate triggered terrace formation in relation to Pleistocene glacial-interglacial-cycles.

Patterns of Quaternary river terrace staircase formation and preservation in the south-central High Atlas Mountains, Morocco

Martin Stokes* (1), Anne Mather (1), Alaeddine Belfoul (2), Sophia Bouzid (2) & Farid Faik (2)

* mstokes@plymouth.ac.uk
(1) School of Geography, Earth and Environmental Sciences, Plymouth University, Drake Circus, Plymouth, Devon, PL4 8AA, United Kingdom.
(2) Laboratoire de Géologie Structurale et de Cartographie Thématique, Geology Department, Faculty of Science, Ibn Zohr University, Po Box: 8106, Agadir 80000, Morocco.

The High Atlas Mountains of Morocco represents a major topographic relief of between 2-4km altitudes in NW Africa. Relief has developed throughout the Cenozoic by combinations of Mesozoic rift basin inversion, development of a fold-thrust belt system and emplacement of a mantle plume. Topographic development is recorded in 1) Mio-Pliocene to Quaternary fluvial sedimentary infills of basins adjacent to the main mountain relief and 2) inset sequences of Quaternary river terrace staircases that throughout the mountain belt and related basin systems. Within this study, we focus upon the river terrace component of landscape development within the south-central High Atlas, a region coincident with some of the highest topographic relief. Here, the River Dadés forms one of the major drainages. It rises at 3.5km altitude and flows WSW through the fold-thrust belt, wedge top (piggy back) basin, thrust front and foreland basin settings before turning SE, cutting a deeply dissected transverse reach across the deformed craton of the Anti-Atlas mountains.
River terraces were mapped in the field using a Trimble GeoXH GPS and TruPulse laser range finder along a 50km length of the proximal River Dadés between the settlements of Msmerir (upstream) and Boumalne Dadés (downstream). Terraces were developed onto Mesozoic and Cenozoic bedrock. A Schmidt hammer was utilised to quantify rock strength and to assess its relationship to terrace preservation / distribution. Terrace sediments typically comprised 2-10m thick aggradations of rounded cobble sized clasts of Mesozoic limestone and sandstone bedrock, with common recycling from Mio-Pliocene basin sediments. Terrace surfaces lacked soil / pavement development and were commonly buried by slope-tributary fan sediments resulting in poor morphological expression.
Throughout the study area altitudes of terrace bases varied from ~140m to ~10m above the modern river, with a lower level at up to 5m used for agriculture. Major terrace level groupings appear to occur at ~90m, ~70m, ~50m, ~30m, 20m and ~10m. Terrace staircases were generally well developed in the fold-thrust belt and thrust front regions of the study area. Here, the bedrock geology was characterised by km-scale fold and thrust structures affecting interbedded sequences of Jurassic marine limestones and mudstones (fold-thrust belt) and Cretaceous-Eocene continental sandstones (thrust front). Terraces were poorly preserved or lacked morphological expression in areas where 1) deeply dissected river gorges had formed in thick Jurassic limestone units of the fold-thrust belt and 2) Late Cenozoic alluvial basin infills occurred (similar sedimentology to terraces).
Relationships of tectonic, climatic and capture controls on fluvial landscape development are currently being established. Direct evidence for terrace faulting is limited but has been observed with ~2m offsets of the 20m level in the thrust front region. However, the preliminary field mapping and survey results reveal that the bedrock strength, together with its stratigraphic and structural configuration appears to exert an important control on whether the fluvial system can produce and preserve a river terrace.

A 400-year discharge record of Lower Rhine floods, based on the sedimentary characteristics of flood deposits

Willem Toonen* (1,2), Tim Winkels (1), Maarten Prins (3), Lennart de Groot (4), Frans Bunnik (5), Hans Middelkoop (1) & Kim Cohen (1,2)

* W.H.J.Toonen@uu.nl
(1) Utrecht University, Dept. Physical Geography, Utrecht, Netherlands.
(2) Deltares, Unit BGS, Dept. Applied Geology and Geophysics, Utrecht, Netherlands.
(3) Vrije Universiteit Amsterdam, Fac. Earth and Life Sciences, Amsterdam, Netherlands.
(4) Utrecht University, Dept. Earth Sciences, Utrecht, Netherlands.
(5) TNO Geological Survey of the Netherlands, Utrecht, Netherlands.

Many abandoned channels and dike-breach scour holes exist in the apex of the Rhine Delta (Germany and the Netherlands). The sedimentary fill of these features accumulates during successive floods, resulting in a layered fluvial archive that is useful for investigations into historical and palaeoflood magnitudes. Information on the magnitude and recurrence times of palaeofloods is valuable input for assessing safety levels in floodplain regions. Current flood protection designs are based on extrapolated rating curves from discharge data spanning only the last century. This is known to poorly resolve the characteristics of extreme events because of a too limited time frame (- yet, this is used in the Netherlands to estimate the magnitude for a design flood with a recurrence interval of 1/1,250 years).
To lengthen the discharge data for rare-frequency high-magnitude discharge events, cores were recovered and analysed from three flood-layered fills in the delta apex. Each site covers the flooding history of the last ~400 years (1595 – 2010 AD), which enables comparison with historical records, discharge measurements of the last century, and historical water levels (going back to ~1770 AD). Laser-diffraction grain size results were used to assess flood magnitudes for individual flood event layers. Continuous sampling of ~2 cm intervals provided a high-resolution record, resolving the sedimentary records at an annual scale. End-member modelling was applied to characterize the coarse particle admixtures to the grain size distribution, which is indicative of higher flow velocities experienced only during floods exceeding critical magnitudes. End-member scores of flood deposits of the last century show a relation with historical events of known discharge. Using regression analysis, discharges are predicted based on grain size, which is useful to estimate magnitudes of floods that occurred prior to modern measurements began.
Historical geographical information, palynological results (introduction of agricultural species), and palaeomagnetic secular variation measurements allowed the construction of initial age-depth models. Traditional radiocarbon dating was not possible as no suitable identifiable organic material was available in the cores. Major floods in the sedimentary record are used to fine-tune the age models by lining them up with most catastrophic events described in historical records and by cross-relating age information from different research sites. This method allows reproduction of flood dates within several years; the dated flooding events are used as age tie-points for further improvement of the initial age-depth model. The refined model is used to date sedimentary layers deposited by floods of a medium magnitude, which are more numerous and thus more difficult to individually relate to a specific historical peak discharge.
This study demonstrates the suitability of sedimentary records for (palaeo)flood characterization. Based on a network of sites, it is possible to provide an accurate (internally cross-validated) flood chronology for the Lower Rhine and delta, and to reconstruct regional differences in the impact of floods (e.g., by ice dams or local dike breaches). Moreover, given the preservation of filled oxbows from all periods along the Lower Rhine, it is theoretically possible to extend flood chronologies and magnitude estimations back to the Early Holocene using sedimentary data.

Implications of dynamic equilibrium for river management: the Maas and Geul rivers (The Netherlands)

Jef Vandenberghe * (1), Gemma Venhuizen, P. Ward & Jos De Moor

* jef.vandenberghe@vu.nl
(1) VU University De Boelelaan 1085, 1081HV Amsterdam.

This contribution discusses the interaction between climate change, land use, water management and internal evolution within the Maas catchment and its main tributary in The Netherlands, the Geul river. Those results were obtained by a combination of proxy reconstructions and by numerical modelling of past, present-day and near-future climate and river evolution. Since external factors like climate change and human impact influence the river system in such a way that they will have severe consequences for society, economy and public health, understanding of the cause-and-effect relations within a river basin appears to be of utmost importance. Therefore, a background framework for accurate water management strategies, based on the impact of intrinsic factors and external driving factors (climate, human impact) on the Maas river network, is developed. Together with the simulations, which give a good overview of the trends in precipitation and discharge between since 4000 BP, as well as an outlook to the 21st century, the proxies help to gain insight in the long-term changes in climate and hydrology in the Maas basin. It appears that the principles of the dynamic equilibrium in a river system provide most useful guidelines for such a background of river activity. From the reconstructed river evolution it is illustrated what kind of effects may be expected from each natural or anthropogenic distortion of that equilibrium for flood risks, changes in river course and morphology and fluvial transport capacity. It is concluded that river management, including compliance with the recent European directives for maintenance of natural heritage of river systems, should find a balance between a dynamic equilibrium, based on its reconstructed historical river behaviour, and necessary measures as directed by practical social and economic needs.

References

De Moor, J.J.W., Kasse, C., van Balen, R., Vandenberghe, J. and Wallinga, J. 2008 Human and climate impact on catchment development during the Holocene- Geul river,the Netherlands. Geomorphology 98, 316-339, doi 10/1016/j.geomorph.2006.12.033.

Stam, M.H., 2002. Effects of land-use and precipitation changes on floodplain sedimentation in the nineteenth and twentieth centuries (Geul River, The Netherlands). Special Publications of the International Association of Sedimentologists 32, 251-267.

Vandenberghe, J. de Moor, J. and Spanjaard, G. 2012 Natural evolution versus human impact in a present-day fluvial catchment: the Geul River, southern Netherlands. Geomorphology, doi: 10.1016/j.geomorph.2011.12.034.

Vandenberghe, J., Venhuizen, G. and De Moor, J. 2012 Concepts of dynamic equilibrium of interest for river management in the Lower Maas catchment. Geographia Polonica 84 (part 2), 141-153.

Ward, P., van Balen, R.T. Verstraeten, G., Renssen, H. and Vandenberghe, J. 2009 The impact of land use and climate change on late Holocene and future suspended sediment yield of the Meuse catchment. Geomorphology 103, 389-400 (doi 10.1016/j.geomorph.2008.07.006).

Ward, P.J., Renssen, H., Aerts, J.C.J.H., Verburg, P.H. (2008b), Sensitivity of discharge and flood frequency to 21st century and late Holocene changes in climate and land use (River Meuse, northwest Europe). *Climate change*, doi:10.1007/s10584-010-9926-2.

Global review of fluvial sequences, vertical crustal motions, and crustal properties

Rob Westaway* (1,2) & David Bridgland (3)

* r.w.c.westaway@open.ac.uk
(1) MCT, The Open University, Abbots Hill, Gateshead NE8 3DF, UK
(2) NIReS, Newcastle University, Newcastle-upon-Tyne NE1 7RU, UK
(3) Department of Geography, Durham University, South Road, Durham DH1 3LE, UK

We shall summarise the results of a decade of work aimed at understanding cause-and-effect relations between fluvial sequences, vertical crustal motions and physical properties of the underlying continental crust. Prior to the start of this programme, it was well-established that an increase in rates of vertical crustal motion occurred in parts of western and central Europe at a time (~0.9 Ma) that was roughly synchronous with the Mid-Pleistocene Revolution (the change to 100 ka climate cycles). A change in rates of vertical crustal motion at this time is now evident worldwide (e.g., Bridgland & Westaway, 2008; Westaway et al., 2009). Earlier increases in rates of vertical crustal motion, typically uplift in continental interior regions, that likewise correlate with times of climate change are also recognised in many regions, for example, around the 'conventional' Pliocene– Pleistocene boundary (~2.0 Ma), at the end of the Mid-Pliocene climatic optimum (~3.1 Ma), and at the start of the Messinian salinity crisis in the Mediterranean region or its Pontian counterpart in the Black Sea region (~6 Ma). However, these phases of vertical crustal motion did not occur within Archaean cratons (Westaway et al., 2003), where a mobile lower-crustal layer is lacking, suggesting that the presence of such a layer is required to mediate the uplift occurring in the other regions. This uplift is thus envisaged as a consequence of the isostatic response to surface processes (such as, climate-induced erosion), mediated by lower-crustal flow (e.g., Westaway, 2002; Westaway et al., 2002). Others have noted the occurrence of the same phases of uplift, but have tried to explain them as consequences of plate motions or mantle plume activity; however, these alternative views provide no natural explanation for why these phases correlate with times of long-timescale climate change that are known independently. This presentation will also touch upon more recent developments in ideas, such as (1) the detailed modelling of patterns of vertical crustal motion to constrain crustal properties at depth, illustrating how the thickness of the mobile lower-crustal layer affects the observed uplift response (e.g., Westaway et al., 2006), (2) the observation that areas where this mobile layer is thin have experienced alternations of uplift and subsidence, and the potential explanation for this (Westaway, 2012), and (3) the role of climate-induced stress-triggering in the development of active faulting in intraplate continental regions (e.g., Westaway, 2006; Abou Romieh et al., 2012).

References

Abou Romieh, M., Westaway, R., Daoud, M., Bridgland, D.R., 2012. First indications of high slip rates on active reverse faults NW of Damascus, Syria, from observations of deformed Quaternary sediments: implications for the partitioning of crustal deformation in the Middle Eastern region. Tectonophysics 538-540, 86-104.
Bridgland, D.R., Westaway, R., 2008. Preservation patterns of Late Cenozoic fluvial deposits and their implications: results from IGCP 449. Quaternary International 189, 5-38.
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.
Westaway, R., 2006. Investigation of coupling between surface processes and induced flow in the lower continental crust as a cause of intraplate seismicity. Earth Surface Processes and Landforms 31, 1480-1509.
Westaway, R. A numerical modelling technique that can account for alternations of uplift and subsidence revealed by Late Cenozoic fluvial sequences. Geomorphology, in press online.
Westaway, R., Bridgland, D.R., Mishra, S., 2003. Rheological differences between Archaean and younger crust can determine rates of Quaternary vertical motions revealed by fluvial geomorphology. Terra Nova 15, 287-298.
Westaway, R., Bridgland, D.R., Sinha, R., Demir, T., 2009. Fluvial sequences as evidence for landscape and climatic evolution in the Late Cenozoic: a synthesis of data from IGCP 518. Global and Planetary Change 68, 237-253.
Westaway, R., Bridgland, D.R., White, M., 2006. The Quaternary uplift history of central southern England: evidence from the terraces of the Solent River system and nearby raised beaches, Quaternary Science Reviews 25, 2212-2250.
Westaway, R., Maddy, D., Bridgland, D.R., 2002. Flow in the lower continental crust as a mechanism for the Quaternary uplift of southeast England: constraints from the Thames terrace record. Quaternary Science Reviews 21, 559-603.

Late Pleistocene and Holocene sedimentation dynamics of selected river systems in Spain – Stratigraphical records and deducible palaeoenvironmental implications

Daniel Wolf* & Dominik Faust

* daniel_wolf@tu-dresden.de
Institute of Geography, Dresden University of Technology.

The aim of this research is to examine Spanish River systems concerning their suitability to serve as archives to reconstruct Late Pleistocene and Holocene environmental conditions in Spain. For that reason more than 30 outcrops were studied in three different river catchments (Rio Jarama, Rio Guadalete and Rio Guadalquivir), complemented by several percussion drillings to unveil Late Quaternary sedimentation patterns and to develop a standard stratigraphy of fluvial sedimentation history for each catchment. Sedimentological and pedogenetic findings were supported by 68 radiocarbon ages. For the Jarama valley we are able to identify stages of floodplain development covering a timeframe of 44 ka before present. Due to a valley width of up to 3 km the potential was given to preserve older sediment sequences in distal floodplain positions. In the Guadalete valley a succession of erosion and sedimentation periods is documented for the last 14 ka. As the Guadalete catchment is situated in the west of the Sierra de Grazalema, an area with the highest values for rainfall in Spain, peak discharges can reach extreme values and the Guadalete River shows extremely high dynamics concerning erosion and sedimentation processes.
One characteristic of all river catchments is that the fluvial architecture is very complex and inconsistent along the specific river courses. It turned out that besides external forcing like tectonic impulses, also inherent structures of the river systems were responsible for such a development.
However, we were able to build up a standard stratigraphy for each river system and to link individual stages of floodplain evolution to certain palaeo-environmental conditions. By comparing sedimentation dynamics of the Jarama and Guadalete Rivers, the attempt has been made to differentiate between regional and supraregional patterns of fluvial dynamics, especially regarding the factors climate and man. In order to specify such a pattern, two outcrops along the Guadalquivir River were studied and the results were added to the comparison. A first assessment shows that during the Pleistocene-Holocene transition all rivers behaved similarly, accumulating sediments on a Late Pleistocene terrace body, which was followed by soil formation during the Bølling/Allerød. In the Younger Dryas or during the early Holocene a strong incision took place. During Early to Mid-Holocene times the rivers underwent a different development. After 5.0 ka cal BP a considerable sedimentation period started in all river catchments. Later, after a pre-Roman stability period, again sedimentation was initiated across regions during the Roman occupation. A last strong signal in the Jarama and Guadalete catchments shows the Little Ice Age impulse.
Beside the importance of climate variations, indications of human influence to river dynamics were identified.

POSTERS

Extreme fluvial erosion at Ricobayo spillway (Esla River, NW Iberia)

L. Antón* (1) & F. Faundez (2)

* lanton@ccia.uned.es
(1) Facultad de Ciencias. Universidad Nacional de Educación a Distancia (UNED). C/ Senda del Rey 9. 28040 Madrid. Spain.
(2) Laboratorio de Hidráulica de Iberdrola. 49167 Salto de Ricobayo. Muelas del Pan. Zamora. Spain

The evolution of channel profiles is commonly posed as a competition between rock uplift and erosion. However without resorting to a tectonic uplift, the effect of base-level fall caused by a river capture or eustatic changes, results in a similar behaviour, enhancing local erosional capacity and knickpoint retreat into a transient incisional wave that propagates upstream through the channel network. Despite this, in relatively quiescent settings, deep bedrock gorges are thought to be cut very slowly over millions of years.
Recently, several authors documented rapid erosion processes and gorges formation by large flood events. One example of extreme erosion processes occurred during the construction of Ricobayo dam (1929-1935) at the Esla River (NW Iberia). Between 1933 and 1939 extreme erosion occurred in the Ricobayo spillway site as a consequence of several floods. During that period the river excavated ~100 m of granite and produced a head ward retreat of ~300 meters bringing about the formation of a huge pot in less than 6 years. Although in the spillway site the granite is intensely faulted and a strong fracture pattern is shown, ~$1.1*10^6$ m^3 of granitic rock were removed in a matter of years.
It seems plausible that erosion of rock by large floods might be extremely rapid. But in the Esla River the floods that occurred from 1933 to 1939 were not exceptionally large; similar or larger floods occurred in 1929, 1930, 1931 and 1932 without relevant erosion. Up to 1933 the Esla flowed through the previously carved riverbed; while from 1933 the floods passed through the dam spillway, ~100 above the present thalweg and the river was forced to excavate a new channel.
The Esla River flows through the western fringe of the Cenozoic Duero Basin. This area configures a present-day high-level plateau where deep bedrock gorges are developed as the result of the capture of the Duero drainage. The Ricobayo example can provide some clues to understand how exceptional incision rates may occur when the drainage conditions change.

This research was funded by Consolider Ingenio 2006: “Topoiberia” (CSD2006-00041), the Spanish National Research Program: “Topoiberia Foreland” (CGL2006- 13926-C02-01-02).

The confluence between the Seine and the Aube (France): a possible structural control

Pierre Benoît (1) & Bogdan Piwakoswki (2)

(1) Laboratoire d'hydrologie Aquanalyse -10180 Plancy l'Abbaye
(2) Ecole centrale de Lille- 59000 Villeneuve d'Ascq

The role of structural control in the development of watercourses is a long-established fact, yet the underlying assumption is often based on the alignment between fault and hydrographic pattern, without any related information on the seismic, historical or geological record of this possible control.
In our particular case, the Seine River follows the path of the Vittel fault for over ten km upstream of Romilly-sur-Seine. Its northern offset, headed towards the Aube, runs along the extension of the Saint-Martin-de-Bossenay meridian fault zone.
The local seismic record provides no evidence of Holocene-period activity in this fault feature, as evidenced based on seismic reflection data. The only emerging evidence consists in a few rolled and fractured flint pebbles. Other evidence involves flexures with a low curve radius in the Holocene terrace that follow the direction of the faults.
The debate has been reopened with the recent discovery of Quaternary deformations, both at the intersection of the Vittel fault with the northern extension of the Saint-Martin-de-Bossenay fault, and within a 15 km radius.
The observed deformations, both ductile and brittle, differ from periglacial deformations, and have been shown to be seismites.
These deformations are regularly found in the upper Würmian alluvia, and are also found sporadically affecting Holocene strata. Moreover, the recurrent nature of the deformations has already been described 15 km to the NE, at the edge of the Aube, in the Charny-le-Bachot chalk pit, and at Gelannes, on the Saint-Martin-de-Bossenay fault.
They can only have been initiated by seismic shaking on a magnitude greater than 6.
The geological fault features intersecting in the area are therefore active, lending credibility to our initial assumption, in which case it should also be possible to observe the vertical component of these deformations in the morphology.
A study is currently underway to tackle this aspect of the problem.

References

Ancient seismites, special paper 369, 2002, The Geological Society of America.

Banque des données du sous-sol Reims

Baize S., Coulon M., Hibsch C., Cushing M., Lemeille F., Hamard E., 2007.: Non-tectonic deformations of Pleistocene sediments in the eastern Paris basin, France, Bull.Soc.Geol.Fr. 178: 367-381.

Benoit P., Grisoni J.M., Piwakowski B., Argant J., 2011. La craie fracturée de Charny-le-Bachot, témoin enisageable du rejeu quaternaire des accidents de socle au sud est du bassin de Paris, bulletin info. Geol.Bass.Paris, 48:5-16.

Demoulin A., 1996. Clastic dykes in east Belgium: evidence for upper Pleistocene strong earthquakes west of the Lower Rhine rift segment, *Journal of the Geological Society*, London, Vol. 153 1996 65 803 -810.

Van Vliet-LaNoé B.,Magyari A.,Meilliez F., 2004. Distinguishing between tectonic and periglacial deformations of quaternary continental deposits in Europe, *Global and Planetary Change*, 103-127.

Fluvial response to tectonically induced gradient changes in the Roer Valley Rift System, The Netherlands, Belgium and Germany.

Marlies Janssens*, Ronald van Balen & Kees Kasse

* m.m.janssens@vu.nl
Vrije Universiteit Amsterdam, de Boelelaan 1085, 1081 HV Amsterdam.

Meandering rivers can respond to vertical tectonic motion in several different ways; incision, aggradation, combing, avulsions or channel pattern change. An important mechanism in these responses is the adaptation to a tectonically disturbed channel gradient. Meandering rivers can compensate for a disturbed gradient directly by adapting channel bed elevation via incision and aggradation (vertical response) and indirectly by adaptation of channel length via lateral migration or meander cut-off, leading to a sinuosity change (horizontal response). Because meander migration and cutt-offs also occur as autogenic river behaviour, a sinuosity change will only be temporal and will be followed by a vertical response until fluvial morphology and flow reach equilibrium conditions (transient response).

Sinuosity analyses on Lateglacial and Holocene courses of the river Meuse (The Netherlands/ Belgium) show indications for a sinuosity response to active faulting along the faults and fault zones of the Roer Valley Rift System (RVRS). Several remnants of high-sinuosity channels of different generations are present around the Feldbiss fault zone where the Maas enters the Roer Valley Graben. Around the Peel Boundary fault zone, where the Meuse leaves the graben, several anomalously large meander bends are present. In other cases, no sinuosity response is observed around active faults, suggesting that either tectonic deformation rates are too small to induce a fluvial response or that the river adapted purely by a vertical response.

The occurrence of sinuosity responses as observed in the Meuse cannot fully be explained by the conceptual model as described above. The divergent response can possibly be attributed to differences in tectonic deformation rates as well as local boundary conditions, such as substratum and bank lithology, bank cohesion, sediment availability, accommodation space, slope and discharge.

The mechanisms behind the sinuosity response of meandering rivers to vertical tectonic motion and the contribution of boundary conditions are not yet fully understood and have not yet been quantified. Therefore, the existing meander simulation models do not account for the effect of vertical tectonic movement. This recently started project will study and quantify the effect of tectonically induced gradient changes in meandering rivers, as well as the contribution of boundary conditions. In this study several approaches will be combined; palaeogeographic reconstruction in a variety of river valleys within the Lower Rhine Embayment/ Roer Valley Rift System (e.g. Meuse, Rhine and tributaries (The Netherlands, Belgium and Germany) and smaller rivers over the Campine Block (The Netherlands and Belgium)); flume experiments and numerical modelling. An existing meander simulation model will be modified so it can incorporate the effect of tectonically induced gradient changes. This modified model will be applied to the Rhine-Meuse delta and compared with existing fluvial and tectonic datasets.

Contemporary transformations of a braided gravel-bed river (Svalbard)

Waldemar Kociuba* & Grzegorz Janicki

* waldemar.kociuba@umcs.pl
Faculty of Earth Sciences and Spatial Management, Maria Curie-Skłodowska University in Lublin, Poland;

The analysis of contemporary changes in the morphology of the valley bed and channel development of a braided gravel-bed river was conducted in the melt seasons 2010 and 2011 in the post-glacial Scott River catchment (NW part of the Wedel Jarlsberg Land, SW Spitsbergen). Half of the Scott River catchment with an area of 10 km^2 is occupied by a valley glacier, currently in the phase of strong recession. The diversified conditions of the development of the glacier-free valley floor are determined by a number of factors:
1) long-term factors such as: geological structure, glaciotectonics, or the morphogenesis of the terminoglacial zone; 2) medium-term factors, including climatic changes, and changes in the extent of the glacial terminus and hydrological regime, 3) short-term factors such as: weather or flood-flows. Geological factors determined the development of two valley narrowings with a gorge character, and a clear division of the valley bed into 3 varied sedimentation zones. The gorge in the terminal moraine rampart distinguishes the upper wide (of up to 700 m) section of the valley bed with dominating outwash deposits, with a character of a fan-like sandur. The valley gorge dissecting the elevated marine terrace separates the middle section of the alluvial valley from the mouth section (alluvial fan). At this section, the Scott River develops an extensive braided system fed by small tributaries.
Due to the dominance of the glacial alimentation regime (approx. 90%), changes in the discharge rate and bedload transport regime are influenced by the glacial ablation rate, determining the variability of the channel morphology and the contemporary development of the valley bed. The complex proglacial Scott River deposition system also affects the varied pattern of the development of the Scott River threshold channel. The upper, proximal section of the valley is dominated by a braided channel system fed by sub- and supraglacial waters. The channels model the contemporary marginal zone of the glacier, and flow into a stagnant water body. In the middle distal section, the development pattern changes from one-channel meandering one, through a multi-channel "wandering" system, to (locally) classic braided system. In the river's mouth section, it returns to the one-channel meandering pattern, through the multi-channel "wandering" system modelling the southern part of the alluvial fan, to a straight channel. The river below the crevasse in the storm bank develops a subaqual prodelta.
Studies on fluvial transport rate, conducted in the Scott River catchment in the period 2009-2011, also document the mixed type of the river's load with relatively low contribution of bedload material. The currently developed alluvial valley is almost entirely occupied by a flood plain and braided river bed. Changes in the channel system are only related to the period of melting of the snow cover. After the retreat of the snow cover, the channels are distinguished by high stability, and their spatial system is usually transformed during several days of ablation or ablation-precipitation flood-flows.

An example of preserved debris flow in the quaternary deposits of the Moroccan high atlas

Abderrazzak Nahid* (1) & Jérôme Juilleret (2)

* nahid@ucam.ac.ma
(1) GeoHyd Laboratory, Department of Geology, Semlalia Faculty of Sciences, Cadi-Ayyad University, B.P. 2390, 40000 Marrakesh (Morocco).
(2) 35 rue Albert Einstein, L-4445 Belvaux (Grand-Duché de Luxembourg).

The processes of deposition of debris flow trigerred by high intensity storm events are the main hydrogeomorphologic processes which build alluvial fans in the actual humid mountainous such as the Alps (Marchi et al., 2010) as well as the arid zone (Stanistreet and McCarthy, 1993). The development of alluvial fan involves too main sedimentary processes (Blair and McPherson, 1994 a, b). The first one (sediment supply) allows to build typical geomorphic features as alluvial levees and frontal talus. It is followed by a reworking processes phase which tends to erase the frontal talus. Hence, frontal talus has a short life time according to geological time scale. In the northern flank of the High Atlas, alluvial fans are frequent and several level of fan-terrace developed during Pliocene and Quaternary ages were identified (Nahid, 1990 and 2004). These alluvial fans constitute a major quaternary fluvial archive and their study permit to understand both climatic and tectonic history of the High Atlas Mountains (Nahid and Benzakour, 2002). Among all the alluvial fans studied by Nahid (1990 and 2004), only one present an atypical block accumulation capping a Pleistocene alluvial fan. We present here this block accumulation which is morphologically recognized as a fossil frontal lobe elaborated by a palaeodebris flow. Study of quaternary alluvial fans and fossil debris flow processes should be enhance in Morocco to better assess how landscapes may respond to future climatic and tectonic changes of the High Atlas Mountains.

References

Blair T.C., McPherson J.G., 1994a - Geomorphology of Desert Environments. Chapman & Hall, London, 354-402.
Blair T.C.. McPherson J.G., 1994 b - Journal of Sedimentary Research, A64, 450-489.
Marchi L., Cavalli M., and Agostino V., 2010 - Nat. Hazards Earth Syst. Sci., 10, 547-558.
Nahid A., 1990 - Thèse 3ème cycle, Université Cadi-Ayyad, FSSM, 413 pages.
Nahid A., 2004 - Thèse d'Etat, Université Cadi-Ayyad, FSSM, 366 pages.
Nahid A., Benzakour M., 2002 - Estudios Geológicos, Vol 58, No 5-6,145-158.
Stanistreet J.G., Mc-Carthy T.S., 1993 - Sedimentary Geology, 85, 115-133.

Alluvial changes of the Southern Upper Rhine River during the "Late Little Ice Age" deciphered from ancient maps (1689-1767)

Vincent Ollive* (1), Christophe Petit (2) & Michel Reddé (3)

* vincent.ollive@gmail.com
(1) CERPA EA 1135, Université de Nancy 2, France
(2) Équipe "Archéologies environnementales", UMR 7041 ARSCAN "Archéologie et sciences de l'Antiquité", Université de Paris 1 Panthéon-Sorbonne, France
(3) Ecole Pratique des Hautes Etudes, Paris,France

Alluvial changes of the Southern Upper Rhine River near Breisach (Germany) were reconstructed from ancient maps (1689-1767) which were edited before 19^{th} century rectification works. The investigated period is starting with the abandonment of the "Ville de Paille" settlement in 1689 and it lasts until the destruction of the village of Kunheim by major Rhine floods during the years 1765-1767.
The study area provided the opportunity to investigate an original alluvial landscape where coexisted simultaneously braided, anabranching and meandering channels. The high quality of vegetation mapping allowed the definition of six landscape units such as water, non-vegetated bars, humid meadows, forested islands, cultivated areas and anthropogenic settlements. Spatial analysis highlights the close relationship between vegetation cover and the stability of alluvial forms (channels, bars and islands). Moreover, it informs us about the duration of alluvial processes such as bars amalgamation, island formation/destruction and transformation from one alluvial pattern to another one. These alluvial changes (planform changes, evolution of vegetation cover) are discussed within the framework of regional climate dynamics and documentary flood records.

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.

J. Peeters * (1,2), F.S. Busschers (2), J.H.A. Bosch (2), M.W. van den Berg (2), J. Schokker (2) & E. Stouthamer (1)

* j.peeters1@uu.nl
(1) Department of Physical Geography, Faculty of Geosciences, Utrecht University, Heidelberglaan 2, 3584 CS, The Netherlands.
(2) Geological Survey of The Netherlands – TNO, Princetonlaan 6, 3584 CB, Utrecht, The Netherlands

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. 130-115 kyr BP) that are influenced by both coastal and fluvial processes, with the use of multiple cross-sections (Peeters *et al.* 2012, *in prep*).

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, J. Stafleu, D. Maljers, J. Schokker and J. Peeters, 2012. In preparation.
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.
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.

Post-settlement fluvial response in Northland, New Zealand

J.M. Richardson* (1), I.C. Fuller (1), K.A. Holt (1), N.J. Litchfield (2) and M.G. Macklin (3)

* j.m.richardson1@massey.ac.nz
(1) Physical Geography Group, Institute of Natural Resources, Massey University, Private Bag 11 222, Palmerston North, New Zealand
(2) GNS Science, PO Box 30368, Lower Hutt, New Zealand
(3) Centre for Catchment and Coastal Research and the River Basin Dynamics and Hydrology Research Group, Institute of Geography and Earth Sciences, Aberystwyth University, SY23 3DB, UK

Following Polynesian settlement after ca. 800 years BP and European colonisation within the last 200 years, many New Zealand river systems have experienced rapid sedimentation rates in response to post-settlement catchment disturbance (mainly forest clearance). This research uses LiDAR data, sedimentology, ^{14}C chronology, XRF analysis and GPR to examine post-settlement alluviation of the Kaeo River, located in far northern New Zealand. In this area rapid rates of post-settlement floodplain aggradation, equating to over 4 m of interbedded sand and silt alluvium in a more confined valley setting, have created considerable contemporary flooding issues. Radiocarbon dates indicate that sea level stabilised around 7570-7675 cal. yr BP and was immediately followed by low terrestrial sedimentation rates (<1 $mmyr^{-1}$). Under conditions of limited accommodation space the Holocene floodplain has accumulated at a faster rate (~3.7 $mmyr^{-1}$) in the last several hundred years in response to anthropogenic catchment disturbance. These results will be used, along with projections of future climate change, to inform flood mitigation and land use planning decisions.

Age of the Krasówka river valley filling in the light of ^{14}C dating, Szczerców field, Bełchatów Outcrop, Central Poland

Lucyna Wachecka-Kotkowska* (1), Dariusz Krzyszkowski (2) & Kamilla Klaczak (2)

* kotkow@geo.uni.lodz.pl
(1) University of Lodz, Faculty of Geography, Narutowicza 88, 90-139 Lodz, Poland.
(2) University of Wrocław, Institute of Geological Sciences, Cybulskiego 30, 52-205 Wrocław

Investigations of the fluvial sediments of the Widawka river system at the Bełchatów outcrop are prominent in the literature (i.e. Krzyszkowski 1990, 1991, 1992, 1998, Manikowska 1996, Goździk, Zieliński, 1996, Kasse et al. 1998). The opening of the new 'Szczerców field' within the quarry has allowed the extension of geological research west of the Dębina salt diapir, which separates lignite basin-fill deposits. Research on the Quaternary sediments of the Szczerców field, including sediments in the Krasówka river valley, a left-bank tributary of Widawka, began in August 2010. Alluvial deposits were exposed in the SE corner of the lignite mine, on the first exploitation level. The geological position and character of those deposits, with reference to similar situations in the Bełchatów field, permitted the assumption that the described sediments originated in the Middle Pleni-Weichselian and represent the Piaski Formation (segments: e, c/b) according to Krzyszkowski (1990, 1991) and Allen & Krzyszkowski (2008).
Samples were collected for palynological studies, radiocarbon age indication and also for the textural, expecially grain-size analysis. Along the axis of the Krasówka river valley, the thickness of the fluvial series discussed is 10-11 m. A sequence of alluvium begins with grey silt, 80 cm thick and with an admixture of organic material. This passes into sandy-muddy sediments of 5-10 m thickness, which constitute the bulk of the valley filling. Clastic and organic fine-grained sands complete the cycle of valley filling. At the base of the series, just above the bedrock erosion surface, at a depth of 14.9 m, in the silts with organic admixture (PARCH1), a date of >45000 BP was obtained (GdC-476). At the top of the muddy-organic series (PARCH2), at a depth of 14.2 m, the sediments were dated to 47500 ± 3500 BP (GdS-1127). In the series above, although 12 palynological samples were collected, none was suitable for such analysis.
At the top of the series, at a depth of 5 m beneath the surface in very fine-grained sands (PARCH3), the organic component was dated to 43500 ± 2000 BP (GdS-1128; calibrated age (95,4%), 42813 calBC). A single pollen spectrum was obtained from this series, which indicates a relatively high proportion of trees, indicative of a fairly warm climate.
Based on the ^{14}C results and the single palynological assemblage one can say with caution that the filling of the Krasówka river valley in the Szczerców field is older than the similar valleys in the nearby Bełchatów field. The results presented seem to exclude the complete accumulation of the sandy and the muddy series (the filling of the valley) before the Vistula ice-sheet overran the area (28 000–21 000 BP, the b/c segment of the Piaski Formation). This is contradicted by thermophilous vegetation in the pollen diagram, which might represent the Eem interglacial and could have been reworked into the Middle Pleni-Weichselian alluvium.

References

Allen, P., Krzyszkowski, D., 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.
Goździk J., Zieliński T., 1996. Sedymentologia vistuliańskich osadów małych dolin środkowej Polski - przykłady z kopalni Bełchatów. Biuletyn Państwowego Instytutu Geologicznego, 373, 67-77.
Kasse, C., Huijzer, A. S., Krzyszkowski, D., Bohncke, S.J.P. and Coope, G. R., 1998. Weichselian Late Pleniglacial and Late-glacial depositional environments, Coleoptera and periglacial climatic records from central Poland (Bełchatów), Journal of Quaternary Science, 13, 455-469.
Krzyszkowski, D., 1990. Middle and Late Weichselian stratigraphy and palaeoenvitonments in central Poland, Boreas, Vol. 19, 333-350.
Krzyszkowski D., 1991. Vistulian Fluviatile Sedimentation near Bełchatów, Central Poland, Bulletin of the Polish Academy of Sciences, Earth Sciences, Vol. 39, No. 3, 311-329.
Krzyszkowski D., 1992. Czwartorzęd Rowu Kleszczowa: litostratygrafia i tektonika. Zarys problematyki na podstawie obserwacji w odkrywce KWB „Bełchatów", Acta Universitatis Wratislaviensis, 1252, Studia Geograficzne, 54, 1-158.
Krzyszkowski D., 1998. Stratigraphy and sedimentology of Weichselian deposits at Folwark, Bełchatów Outcrop, Central Poland, Quaternary Studies in Poland, 15, 3-25.

Rio Jarama Valley (Central Spain) – Stratigraphical Records and Palaeoenvironmental Implications

Daniel Wolf* & Dominik Faust

* daniel_wolf@tu-dresden.de
Institute of Geography, Dresden University of Technology.

The catchment of the Jarama River (11.500 km²) is situated in central Spain, where the river develops a wide valley floor within its lower reach. The so called Vega contains Late Pleistocene and Holocene sediments with coarse gravels, representing the beginning of the sequences. Within the channel belt in the proximity of the recent river, a multiple remobilization of sediments took place due to the migration of the meandering river course. Mainly Latest Holocene sediments were found in these positions. In more distal areas several sediment sequences were preserved, covering a number of time slices.
The stratigraphical findings show that these sedimentary sequences can be divided into different layers with intercalated soil formations. Generally, such soil formations indicate periods of stabilization and most probably moderate climatic conditions. At the same time, a sediment layer without pedogenetic indications basically points to unstable conditions accompanied by flood activity and sediment mobilization in the catchment. These patterns are controlled and modified by climatic variations, tectonic impulses, human influences and other inherent parameters.
On the basis of our stratigraphical findings and a vast number of radiocarbon dates a standard profile has been developed for the Jarama River system. This standard profile refers to geomorphic stabilization periods during the Isotope Stage 3 (around 31 ka BP), the Bølling/Allerød, the Early to Mid-Holocene between 7 ka and 5 ka BP, a short period around 3 ka BP and a pre-Roman period between 2.7 ka and 2.1 ka BP. Phases of high activity of the fluvial system existed until the Oldest Dryas, during the Younger Dryas, between 5 ka and 3 ka, during a short period around 2.8 ka BP and in the Roman period as well as the Little Ice Age.
A comparison with other terrestrial archives enabled us to reconstruct late Pleistocene and Holocene palaeoenvironmental conditions on a regional scale, and furthermore to link specific stages of floodplain development to prevalent influencing variables.