Fachtagung
und Diskussionsforum

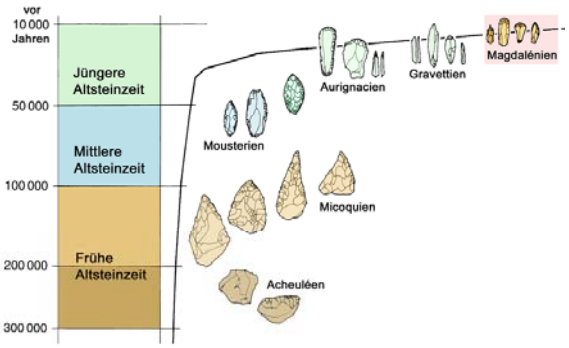
27. Oktober 2007 – Universität Bern

Schweizerische Kommission für Quartärforschung – SKQ
Commission suisse pour la recherche sur le Quaternaire – CSQ
Commissione svizzera per la ricerca del Quaternario – CSQ

SKQ/CSQ

sc | nat
A Commission of
the Swiss Academy of Sciences

Mensch – Umwelt – Klima
Perspektiven der Quartärforschung in der Schweiz



Homme – Environnement – Climat
Perspectives de recherche sur le Quaternaire en Suisse

Colloque
et forum de discussion

Le 27 octobre 2007 à l'Université de Berne

- **Programm** und **Abstracts**
- **programme** et **abstracts**

Fachtagung
und Diskussionsforum

27. Oktober 2007 – Universität Bern

Schweizerische Kommission für Quartärforschung – SKQ
Commission suisse pour la recherche sur le Quaternaire – CSQ
Commissione svizzera per la ricerca del Quaternario – CSQ

SKQ/CSQ

sc | nat
A Commission of
the Swiss Academy of Sciences

Mensch – Umwelt – Klima
Perspektiven der Quartärforschung in der Schweiz

Programm – programme

08.00	**• Registrierung, Kaffee – accueil, café**	
08.25	**Begrüssung – bienvenue**	*Frank Preusser*
08.30	**Pleistocene Glaciations of the Alps**	*Markus Fiebig*
09.00	**Quaternary Climate Change – evidence from high resolution polar ice cores**	*Markus Leuenberger*
09.30	**Die neue Schweizer LGM-Karte: State of the Knowledge – State of the Art**	*Markus Felber*
10.00	**• Kaffee-Pause – pause-café**	
10.30	**Human settlement during the Lateglacial and the Early Holocene in the Central Alps**	*Pierre Crotti*
11.00	**Biotic response to early rapid warming during Termination I**	*Brigitta Ammann*
11.30	**Swiss Holocene and Limnogeology: How far have we come?**	*Daniel Ariztegui*
12.00	**The Neolithic in Switzerland: from the first farmers to the development of the lake-dwelling settlements (5000 – 2500 BC)**	*Matthieu Honegger*
12.30	**• Lunch und Posterpräsentation – lunch et présentation des posters**	
14.00	**Quaternary soils: a study approach to unravel the environmental change and the human impact they witness**	*Judit Becze-Dea'k*
14.20	**Recent developments in Quaternary dating methods**	*Irka Hajdas et al.*
14.40	**Tracking Pleistocene fluviatile episodes in dry valleys of the tabular Jura of Ajoie (northwestern Switzerland)**	*Luc Braillard*
15.00	**• Kaffee-Pause – pause-café**	
15.30	**The role of botanical data from archaeological layer in reconstructing the history of the flora and the human impact on the landscape since the Neolithic**	*Stefanie Jacomet*
15.50	**Veränderungen der Umweltbedingungen und Lebensweise im Spätglazial anhand von zwei Freilandfundstellen am Neuenburgersee**	*Werner Müller*
16.10	**Frühe Schwankungen des Seespiegels und die Siedlung Zürich**	*Dölf Wild*
16.30	**Gründung der Schweizerischen Gesellschaft für Quartärforschung Fondation de la Société suisse de recherche sur le Quaternaire**	
17.00	**Tagungszusammenfassung – résumé et bilan du colloque**	
	• Apéro	

CH-Quat

Mankind – Environment – Climate

Perspectives for Quaternary Research in Switzerland

Abstracts

Scientific committee

Executive board of Swiss Commission on Quaternary Reserach

Abstract volume compiled and edited by

Frank Preusser

Layout of titel and program

Max Maisch

Sponsors

Swiss Commission on Quaternary Research (Platform Geosciences of ScNAT)

swisstopo, Swiss Geological Survey

Universität Bern

sc nat
Swiss Academy of Sciences
Akademie der Naturwissenschaften
Accademia di scienze naturali
Académie des sciences naturelles

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Bundesamt für Landestopografie swisstopo
Office fédéral de topographie swisstopo
Federal Office of Topography swisstopo

Swiss Geological Survey

UNIVERSITÄT BERN

Poster presentations

M. Blant: Fréquence comparée de quelques chiroptères durant l'Holocène

L. Braillard & M. Mauvilly: Morphogenesis of the Sarine canyon (Plateau Molasse, Switzerland): a simple story?

I.M. Braun: Eiszeitliche Kleinkunst in der Schweiz

S. Coray *et al.*: Glazialsedimentologische Untersuchungen an Flutes im Vorfeld des Findelengletschers

E. Eckmeier *et al.*: Der Wandel von Natur- zu Kulturlandschaft im Rheinland (NW-Deutschland): ein Ergebnis anthropogener Brandwirtschaftsweisen

C. Geitner & D. Schäfer: The Mesolithic project Ullafelsen in Tyrol – Man and environment in the early Holocene

A. Gilli *et al.*: Strontium isotopes in the Maya Lowlands (Yucatan/Mexico) – A geochemical tool to trace ancient migration and trade?

A.A. Graf *et al.*: Surface exposure dating confirms multiple extensions of Rhone glacier over the Jura Mountains

A. Heer *et al.*: Late Pleistocene Dunes on the Swiss Plateau: a new contribution from OSL and (palaeo)pedology towards the understanding of Late Pleistocene landscape evolution

D. Jordan: Mixed approaches to archaeology and the environment

P. Jordan *et al.*: Eine Schweiz ohne Quartär: ein digitales Höhenmodell der Felsoberfläche

D. Kauf *et al.*: Bodenkundliche Untersuchungen im Rahmen einer archäologischen Ausgrabung in der Valle Leventina (Tessin)

A. Leroux *et al.*: Analyse multiparamètres à haute résolution de la séquence tardiglaciaire-holocène du Lac Saint Point (Massif du Jura, France)

M. Magny *et al.*: Palaeohydrological changes and human impact history over the last millennium recorded at Lake Joux in the Jura Mountains (Switzerland)

J.H. May *et al.*: Piedmont stratigraphy at Riacho Seco (Salta) and its implications for the Late Quaternary environmental evolution of NW Argentina

C. Recasens *et al.*: Diaton response to Late Holocene environmental changes in Lago Fagnano, Tierra del Fuego

Ph. Rentzel *et al.*: Cover sediments and palaeosols on the High Terrace at Sierentz, France, and implications for the chronology of terrace formation in the Southern Upper Rhine Graben

N. Waldmann *et al.*: Glacial and tectonic dynamics in Southernmost Patagonia since the LGM: The Lago Fagnano record

C. Zahno *et al.*: Surface exposure dating of Late Pleistocene moraines in western Anatolia

P. Zwahlen: Entwurf einer Quartärkarte im Prättigau GR – Konsequenzen für die Quartärstratigraphie, Geochronologie und Klimageschichte im Einzugsgebiet Landquart – Rhein im Spätpleistozän – Frühholozän

Pleistocene glaciations of the Alps

Markus Fiebig (1) & Frank Preusser (2)

(1) Institut für Angewandte Geologie, Universität für Bodenkultur, Peter Jordan Str. 70, 1190 Wien, Austria

(2) Geologisches Institut, Universität Bern, Baltzerstrasse 1+3, 3012 Bern, Switzerland

In classical Alpine Quaternary stratigraphy five huge “gravel production phases”, interrupted by strong erosion and down cutting, have been recognized in the circum-Alpine region. Generations of researcher inferred that these gravel deposits are melt-water sediments that have become available through glacial erosion, transport and termination of glaciers in the lowlands. As a consequence, almost any gravel deposit in the lowlands has been interpreted to represent a glaciation of the Alpine Foreland. The complex interplay between tectonic fragmentation, uplift and erosion of the Alpine body as well as climate change during the Pleistocene was, however, investigated rather poorly, even though a clear fluvioglacial origin of gravel deposits is proofed at a very few sites only.

The oldest gravel unit called “Donau” has been attributed to a Plio-/Lower Pleistocene age based on biostratigraphic markers. First results of burial age dating using cosmogenic nuclides imply a similar age (2.3 +1.0 /-0.8 Ma) for fluvial sediments attributed to the "Günz gravel unit". The next-younger unit “Mindel” was found by burial age dating to be only 0.6 +/- 0.2 Ma old (Häuselmann *et al.*, 2007). This Middle Pleistocene age is in accordance with the amount of local tectonic displacements but it is still controversially discussed. The Meikirch drilling site in the Aare Valley, Switzerland is another locality where Middle Pleistocene deposits have been dated. The so-called Meikirch complex has recently been correlated with Marine Isotope Stage 7 (MIS) (Preusser *et al.*, 2005). Loess deposits of similar age (MIS 7) seem to cover „Günz gravels” in Upper Austria (Wels site) (Preusser & Fiebig, submitted). However, deposits of MIS 7 have been identified in the Alpine area only recently and there may be many other sites with deposits of similar are. The Penultimate Glacial Maximum (classical attributed to the “Riss gravel unit”) is part of the Most Extensive Glaciations (MEG) moraine system. Dating provides several possibilities for the age of Rissian deposits, e.g. 60 to 90 ka or 140 to 200 ka (Fiebig & Preusser, 2003). The ice advance during the Last Glacial Maximum (LGM) in the Northern Alpine foreland is pined by radiocarbon, cosmogenic nuclide, OSL and U/Th ages between 28 and 20 ka (Preusser, 2004). There are numerous open questions about the glacier extension and ice thickness, human occurrence, cave bear behaviour and climatic situation during the last glacial cycle (classical “Würm unit”).

Finally, until today no generally accepted correlation between the three Scandinavian glacial periods (Elster, Saale and Weichsel) and the classical four Alpine units (Günz, Mindel, Riss and Würm) is available. Thus, we have to consider that the knowledge about Pleistocene glaciations of the Alps is still very far from being complete.

References

Fiebig, M. & Preusser, F. (2003). Das Alter fluvialer Ablagerungen aus der Region Ingolstadt (Bayern) und ihre Bedeutung für die Eiszeitenchronologie des Alpenvorlandes. Zeitschrift für Geomorphologie - Neue Folge 47, 449-467.

Häuselmann, P., Fiebig, M., Kubik, P.W. & Adrian, H. (2007). A first attempt to date the original "Deckenschotter" of Penck and Brüchner in Bavaria. Quaternary International 164-165, 33-42.

Preusser, F. (2004). Towards a chronology of the Late Pleistocene in the northern Alpine Foreland. Boreas 33, 195-210.

Preusser, F., Drescher-Schneider, R., Fiebig, M. & Schlüchter, Ch. (2005). Re-interpretation of the Meikirch pollen record, Swiss Alpine Foreland, and implications for Middle Pleistocene chronostratigraphy. Journal of Quaternary Science 20, 607-620.

Preusser, F. & Fiebig, M. (submitted): Middle Pleistocene chronostratigraphy: Evidence from the Wels loess/palaeosol site, Austria. Quaternary International.

Quaternary Climate Change - evidence from high resolution polar ice cores

Markus Leuenberger

Climate and Environmental Physics, Physics Institute, University of Bern

Dave Keeling has started continuous carbon dioxide measurements in the early fifties of the last century at Mauna Loa, Hawaii. His early work has influenced many scientists and lead for instance to pioneering excursions of Langway, Oeschger and others to Polar sites, where they wanted to look for the possibility to extend Keeling's record back in time by using ice cores. A first deep drilling was undertaken in 1961 at Camp Century. Since that time, nearly fifty years have passed during which a wealth of information from ice cores from several Artic and Antarctic sites was retrieved. Ice cores are among the best archives for paleoclimate reconstruction. This is due to their direct recordings of climate change in the different phases of ice (ice matrix, air bubbles, contaminants) through e.g. greenhouse gases (CO_2, CH_4, N_2O), temperature proxies (δ^{18}Oice, $\delta\ ^{15}N$, $\delta\ ^{36}Ar$), chemical proxies (CO_3^{--}, Na^+, etc.), volcanic eruption proxies (electrical conductivity, sulphur) and many more. We know from detailed analyses of different ice cores from Greenland and Antarctica that there have been significant changes in the greenhouse gas concentrations in former times. They are often linked to temperature changes as observed for CO_2 and CH_4. Particularly, CH_4 documents a very close relationship with temperature, even over millennial scale variations. These results are important to improve our good, yet limited, knowledge of climate change and the processes responsible for it.

Die neue Schweizer LGM-Karte: State of the Knowledge – State of the Art

Markus Felber

Schweizerische Kommission für Quartärforschung (SKQ), Bern/Morbio Inferiore

mit Beiträgen von Christian Schlüchter (Bern) und Philippe Schoeneich (Grenoble/Lausanne)

Die neue Schweizer LGM-Karte, die voraussichtlich Ende 2008 erscheinen wird, ist das Produkt einer Kollektivarbeit, an der mehrere Spezialisten aus dem Bereich Quartärforschung beteiligt sind. Diess sind in erster Linie die *Datenlieferanten* (A. Bini, J.-F. Buoncristiani, M. Campy, S. Coutterand, D. Ellwanger, M. Felber, D. Florineth, H.R. Graf, O. Keller, M. Kelly und C. Schlüchter) und ein Redaktionsteam der Quartärgruppe der Universität Bern geleitet von C. Schlüchter unter Mitarbeit von F. Stadelmann und C. Zahno. Die Koordination der Arbeit erfolgt durch die SKQ; Herausgeber wird die Landesgeologie der swisstopo sein.

Ziel der neuen Karte ist, die Berbreitung der letzten Vereisung der Alpen auf den aktuellen Stand der Forschiugn zu bringen. Eine ähnliche, fühere Karte wurde von Jäckli (1962) erstellt und als Blatt 6 des Atlas der Schweiz (1965-1978) publiziert. Das neue Werk setzt sich auch mit dem Problem der Definition von LGM auseinander, die zum Teil auf unterschiedlicher Weise von den verschiedenen Autoren in den untersucthen Regionen angenommen wurde.

Die bedeutendesten Elemente der neuen LGM-Karte werden zum ersten Mal dank der Reportarbeit von C. Schlüchter und seiner Gruppe zusammengefasst und mit der vorherigen "Jäckli"-Karte verglichen. Neben der revidieren Ausdehnung der letzten Vereisung, zum Teil gibt es grössere Abweichungen, wird die Position von proglazialen Seen, Lokalvergletscherungen, Eisdomen im inneralpinen Bereich, sowie die Fliessrichtung des Eises angegeben.

Human settlement during the Lateglacial and the Early Holocene in the Central Alps

Pierre Crotti

Musée cantonal d'archéologie et d'histoire, Place de la Riponne 6, 1005 Lausanne

The history of human settlement in the alpine area is obviously closely related to the glaciations. Thus, in Switzerland, the remains of Palaeolithic occupations before the Last Pleniglacial have been completely obliterated, with a very few exceptions. The first evidence of human presence after the glacial retreat dates to the Oldest Dryas, around 16000 cal yr BC: an Early Magdalenian level was excavated in the years 1950 in a Jura cave near Solothurn. During the Late Magdalenian, from 13'500 cal yr BC, the sites are relatively numerous, established for the majority in caves or rock-shelters in the Jura, but also in the open air on the Plateau. With the Bölling climatic warming, the subsistence economy of the Magdalenian groups, based essentially on open landscapes species, in particular the reindeer and the horse, is replaced by the exploitation of forest resources and a broader territorial occupation. Thus, during the Azilian, from 12300 cal yr BC, the open air sites on the Plateau are the most numerous and new biotopes are colonized in the mountain zones.

During the Younger Dryas, the archaeological evidence is scarce. The settlement seems to be limited to the Plateau.

In the Early Holocene, during the Mesolithic, between 9500 and 5500 cal yr BC, the economy of the hunter-gatherers groups is based on a broad range of resources and all the biotopes are exploited, with a seasonal utilisation of the mountain and sub alpine zones.

Biotic responses to early rapid warming during termination I

Brigitta Ammann (1), Ueli Eicher (2), Jakob Schwander (2), Uli von Grafenstein (3), Katka Mikolasova (4), Stephen Brooks (5), Jacqueline van Leeuwen (1), Lucia Wick (6) & Pim van der Knaap (1)

(1) Institut für Pflanzenwissenschaften, Universität Bern, Altenbergrain 21, 3013 Bern

(2) Physics Institute, University of Berne, Sidlerstrasse 5, 3012 Bern

(3) LSCE, CNRS-CEA, Orme des Merisiers, 91191 Gif-sur-Yvette, France

(4) University of South Bohemia, Department of Botany, Branišovská 31, 370 05 České Budějovice, Czech Republic

(5) Department of Entomology , The Natural History Museum,Cromwell Road, London SW7 5BD, UK

(6) Institute for Prehistory and Archaeological Science IPAS, Basel University, Spalenring 145, 4055 Basel

The various ways how organisms can respond to rapid climatic changes (CC) fall into the following three groups: (1) adaptation (by evolution, including physiology and morphology), (2) migration and population dynamics (incl. biogeographical changes) and (3) extinction. Here we concentrate on examples of the second group.

Organisms – whether algae, trees, or animals – find their niches in a multi-dimensional space of gradients such as temperatures (winter, summer, means or extremes), humidity (soil or air), pH, various nutrients, light etc. Presence or absence of taxa (species, genera, families) are related to such gradients. With training sets based on today's gradients, taxa can be related to environmental changes of the past (e.g. reconstruction of summer mean temperatures or of pH).

The relationships between the occurrence of taxa and environmental variables can also be used to examine the biotic response to CC, provided that a line of evidence for CC independent of the biostratigraphy is available. We present examples where summer temperatures have been inferred from oxygen-isotope ratios in carbonates and organic matter in lake sediments. As groups of organisms we studied plants (pollen), insects (chironomids), and other aquatic invertebrates.

The two periods of very high rates of change in the temperature estimates are the transition from the Oldest Dryas to the Bölling (from GS-2 to GI-1 in the Late Glacial, ca 14'670 cal yr BP) and the transition from the Younger Dryas to the Holocene (11'500 cal yr BP).

The "classical" hypothesis was that trees (represented in pollen diagrams) respond more slowly to climatic change than invertebrates (aquatic or terrestrial) because of differences in life cycles. But we found that terrestrial (vegetation) and aquatic (invertebrate) ecosystems respond synchronously.

Three major biological processes are involved in the responses to climatic change:

- Migration – can be slow if e.g. a long-living tree was migrating back from a southern refugium,
- Build-up of populations– intermediate rates, needs time according to life cycles,
- Productivity - can change fast, within a year or a few years (e.g. pollen productivity, tree rings)

The assessment of rates of biotic responses to past CC is important to estimate possible biological processes under future environmental changes.

Swiss Holocene and Limnogeology: How far have we come?

Daniel Ariztegui
Section of Earth Sciences, Rue des Maraichers 13, 1205 Geneva

Lacustrine basins are ideal sites to study a wide variety of geological processes and their sediments can be used as excellent archives of past environmental change. Hence, modern lakes and their sediments have always fascinated earth scientists and naturalists in general. This is particularly true in Switzerland, a land of lakes without oceans. In 1705 AD, an Italian naturalist, Count Marsili, in his wandering with his Swiss colleague J. J. Scheuchzer described some Swiss lakes as "small seas" with all attributes of their larger counterparts such as the Mediterranean Sea (Kelts, 1987). At the end of the 19th century F.-A. Forel was the first to recognize the enormous erosional power of the turbidity currents generated by the turbid Rhône River into Lake Geneva and set up the basis of the new field of limnology (Forel, 1896). A. Heim in 1888 pondered mechanisms responsible for the formation of large subaqueous slumps while strongly argued against a glacial origin for the main Swiss lakes (Collet, 1922). At the starting of the 20th century, F. Niplow discovered the biogenic varves of Lake Zürich which soon became a model for the Green River formation. But it was in the 70's that many concepts and tools used in marine studies where modified and applied to modern and ancient lacustrine sediments. Scientists from several Swiss research institutions, cantonal agencies and/or geotechnical consulting offices developed lake-based studies most often concentrated in the Quaternary.

Limnogeology, as visioned by Kerry Kelts in the early 1980's, refers to a broad approach to study lake systems driven by the progress in ocean research in the context of *marine geology*. Thus, it includes the study of complex systems and their interactions and it is interdisciplinary by nature (Kelts, 1987). This line of research is now quite well developed in Switzerland and embraces studies using the following broad approaches: geology of lakes and lake deposits; the use of lakes as geological laboratories; and lakes as archives of natural and human-induced environmental changes throughout time. Ongoing Swiss limnogeological research in the Holocene deals – among others - with the development of strategies to recognize sedimentary imprints of former earthquake activity; quantitative climate reconstructions from laminated Alpine lake sediments for the last ca. 3000 years; geomicrobiological studies in modern large lakes and their environmental significance; and geoarcheological investigations using high resolution geophysical methods.

Today, these lake studies are providing critical pieces of information that together with evidence coming from other fields such as geomorphology will help to disentangle the most recent part of the Swiss Quaternary puzzle. Since it is not possible to obtain a continuous record of glacial conditions within Swiss territory because of the pervasive glaciation, Swiss scientists have organized or joined expeditions to study diverse lacustrine environments in a variety of foreign areas. Their implication in recent and future deep drilling projects sponsored by the International Continental Scientific Drilling Program (ICDP) is bringing new light into the processes that dominated the Quaternary and particularly the Holocene at different geographical scales and with various time resolution. These results may in turn help to better constraint the Swiss Holocene paleoenvironmental history.

References

Collet, L. W. (1922). Alpine Lakes. The Scottish Geographical Magazine, vol. xxxviii, 73-101.

Forel, F. A. (1892). Le Léman: Monographie limnologique. F. Rouge, Lausanne (re-edited by Slatkine, Genève 1969).

Kelts, K. (1987). Limnogeological Research in Switzerland. Annual Bulletin of the Swiss Commision of Oceanography and Limnology, Swiss Academy of Sciences, 1-6.

The Neolithic in Switzerland: from the first farmers to the development of the lake-dwelling settlements (5000-2500 BC)

Matthieu Honegger

Institut de Préhistoire et des sciences de l'Antiquité, Université de Neuchâtel, Laténium, Espace Paul Vouga, 2068 Hauterive

S'il est possible aujourd'hui d'avoir une bonne idée d'ensemble de l'origine et du développement du Néolithique suisse, celui-ci demeure marqué par la période lacustre qui voit se multiplier les établissements littoraux entre 4000 et 2500 av. J.-C. La documentation qui émane de ces sites permet d'exploiter la précision des datations dendrochronologiques et de disposer de vestiges d'une conservation exceptionnelle, situés dans des stratigraphies particulièrement dilatées. Au delà des interprétations factuelles, les études actuelles cherchent à mieux cerner les fonctionnements économiques et sociaux des populations de l'époque, en croisant les données archéologiques avec celles de l'environnement, du climat, ou encore de la démographie. Après avoir brossé un tableau général du Néolithique, on présentera quelques exemples précis illustrant les possibilités de reconstituer les rapports entre homme et milieu naturel.

If it is possible today to have a good idea of the origin and development of the Swiss Neolithic, this one remains marked by the lakeside period which sees multiplying the littoral establishments between 4000 and 2500 yr BC. The documentation which emanates from these sites allows to exploit the precision of the dendrochronological dates and to have vestiges of an exceptional preservation, situated in particularly dilated stratigraphies. Beyond the factual interpretations, the current studies try to encircle better the economic and social organisations of the neolithic populations, by crossing the archaeological data with those of the environment, the climate, or still the demography. Having brushed a general picture of the Neolithic, we shall present some precise examples illustrating the possibilities of reconstructing connections between man and natural environment.

Quaternary soils: a study approach to unravel the environmental change and the human impact they witness

Judit Becze-Deák (1), Elena Havlicek (1) & Roger Langohr (2)

(1) Office et Musée d'Archéologie Neuchâtel

(2) Lab. Soil Science, Ghent University, Belgium

Soils are precious recorders of the environmental conditions prevailing throughout their evolution. This is based on the fact that the various environmental parameters are determining the nature and the pathway of soil forming processes, which on turn create the soil characteristics. The study of the latter, at various observation scales and with the support of the laboratory analyses, allows the detection of many parameters of past pedogenesis. Consequently, providing good preservation conditions, we can observe and interpret the effects of decarbonatation or bioturbation, traces left by frost, drought or water saturation or anthropic land use etc. This allows formulating hypotheses about past environmental evolutions. This idyllic image of the reconstruction protocol has to be corrected due to the fact that the understanding of soil characteristics is not an easy task even in conditions of restricted erosion. This is partially caused by the complex nature of the processes involved and the importance of the length of their action. Moreover, with time soils, situated either at the surface or buried, often are subject to changing environmental conditions. In these circumstances sets of soil characteristics become superposed and more recent ones may erase the former. Soil scientists have to deal with a particular type of palimpsest. To overcome these challenges our team uses an object-oriented prospection and recording method. In this approach the observation of large, vertical and horizontal sections and the interpretation of vertical and lateral variability of individual soil characteristics, are the key elements. The examples presented here are stemming form natural outcrops and selected archaeological sites of the European loess belt. Last but not least, some results of interdisciplinary collaborations performed in the region of the Bevaix Plateau at the occasion of highway construction are also shown. To conclude, the study of past environmental changes as recorded by soils is a valuable complement in the catalogue of research perspectives of the Quaternary in Switzerland. Our practice suggests that favourable enquiry conditions are potentially encountered at the occasion of archaeological prospections and excavations. In this context the spatial variability of soil characteristics can often be studied with high precision. Moreover this research framework is a meeting point of an interdisciplinary reflection that allows, for example, to situate the events in a more precise time framework.

Recent developments in Quaternary dating methods

Irka Hajdas (1), Susan Ivy-Ochs (1,2) & Frank Preusser (3)

(1) Ion Beam Physics, Paul Scherrer Institute and ETH Zürich

(2) Department of Geography, University of Zürich

(3) Institut für Geologie, Universität Bern

Nearly sixty years after first radiocarbon ages were published *radiocarbon* dating is a dynamic field with a wide range of applications mainly in geochronology but also environmental and biomedical studies. Recent advances in sample preparation and measurements techniques allow new application and much higher through put of samples measured. These developments lead to higher resolution chronologies of records, provide option for dating various fractions of carbon in studied material, which allows better understanding of old known problems (for example contamination of bones). The need for a reliable calibration curve covering the last 50,000 years cannot be overestimated. Numerous studies of paleoarchives focus on the extension of the radiocarbon calibration curve (INTCAL working group). The present curve based on the tree ring chronology is constantly pushed back in time beyond the Holocene in to the Late Glacial. Further extension requires close collaboration between radiocarbon and paleoresearch communities. The present state of the calibration curve will be presented.

Since their introduction into the Alpine realm more than 15 years ago, in situ produced *cosmogenic nuclides* (^{10}Be, ^{21}Ne, ^{26}Al, ^{36}Cl) have attained an indispensable role in Quaternary studies. Boulders and bedrock surfaces newly created during a geologic event are directly dated themselves, obviating questions of context. Difficulties such as rock surface down-wearing, post-depositional boulder instability or pre-exposure must, never-the-less, always be kept in mind. Rock surfaces ranging from those formed during historical events (such as landslide or glacier advance) to those exposed for hundreds of thousands of years can be dated. The latter limit is given by the rate of rock surface weathering, which is several mm/ka in the Alps. In addition to the crucial determination of exposure ages of boulders on moraines and landslide deposits, innovative ongoing and future studies include the dating of terraces using depth profiling, elucidation of differential rates of bedrock erosion under glaciers and dating of deeply buried sediments with multiple cosmogenic nuclides.

Luminescence dating is used to date quartz and feldspar minerals. Events being dated are i) mineralization, ii) last heating to ca. 450°C, iii) last daylight exposure of the mineral grains. This offers the possible to use luminescence for dating in the context of archaeological (ceramics,

heated stones) as well as geoscientific research (sediments, volcanic xenoliths). The performance of luminescence dating has recently been improved by new measurement techniques (single-grain laser-stimulation) as well as improvements in measurement protocols (single-aliquot regenerative-dose). Recent work is focusing to further improve both the accuracy as well as the reproducibility of luminescence dating, exploring the possibility to date difficult material (e.g. proglacial sediments) and the potential to extend the dating range down to several hundred-thousand years.

Tracking Pleistocene fluviatile episodes in dry valleys of the tabular Jura of Ajoie (northwestern Switzerland)

Luc Braillard

Department of Geosciences, geology and paleontology, University of Fribourg - ch. du Musée 6, 1700 Fribourg

The tabular Jura of Ajoie is characterized by numerous dry valleys. In order to precise their morphogenesis, a multidisciplinary study, including geomorphology, stratigraphy, micromorphology archaeology, tectonics and karstology, has been conducted in relation with the construction of the highway A16 (Braillard 2006). This study led to the conclusion that most of the dry valleys of Ajoie can be considered as tectono-karstic furrows resulting from a primary tectonic embrittlement, exploited and subsequently increased during Late Miocene to Pliocene by karstic dissolution (main process) and fluviatile erosion (accessory process).

The dry valley located at low geomorphological position, i.e. close to the water table, present a U-shape transversal section suggesting the presence of Quaternary deposits under their flat bottom. Early during archaeological prospecting works, a two to ten meter thick filling, containing fluviatile gravels at the base, was indeed revealed.

The detailed stratigraphic study of this filling has allowed to establish a chronostratigraphic subdivision of the deposits in ten units (E1-E10, Fig. 1). Reworked Eemien argillic horizon or older alterite (E10) are locally preserved on the karstified bedrock. Fluviatile gravels (E9, E5) constitute the most important part of the filling. They testify to a fossil drainage system, active probably during the Weichselian Early Glacial (E9), and certainly during the Late Pleniglacial (E5). Solifluction deposits (E8), partly incorporating older alterite (E10), are locally present on footslopes. OSL-dated Middle Pleniglacial loess (E6/7) are intercalated between the two gravel bodies E9 and E5. Part of these loess were reworked and weathered during Late Glacial to Early Holocene (E4). Finally, five fluviatile episodes have been found in the Holocene sedimentary record (E3, E2). All of them correlate with known periods of Holocene high lake levels in the Jura (Magny 2004), and suggest that a climatic control (increase in precipitations) was responsible for the temporary reactivations of the superficial drainage.

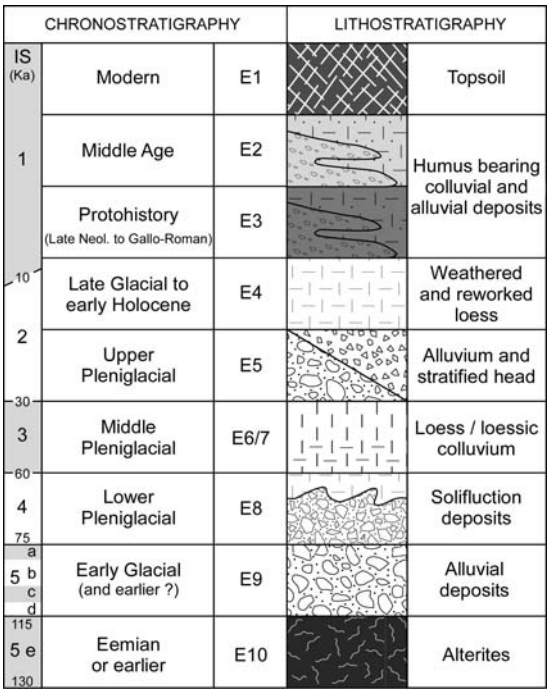


Fig. 1 Stratigraphy of the Quaternary fillings of dry valleys in Ajoie.

References

Braillard. L. (2006). Morphogenèse des vallées sèches du Jura tabulaire d'Ajoie (Suisse): rôle de la fracturation et étude des remplissages quaternaires. Geofocus 14, thèse de doctorat, Université de Fribourg (Suisse), 224 p.

Magny, M. (2004). Holocene climate variability as reflected by mid-European lake-level fluctuations and its probable impact on prehistoric human settlements. Quaternary International 113, 65-79.

The role of botanical data from archaeological layers ('on-site' data) in reconstructing the history of the flora and the human impact on the landscape since the Neolithic

Stefanie Jacomet

Institute for Prehistory and Archaeological Science, Basel University, Spalenring 145, 4055 Basel

Archaeobotany in its narrower sense deals with the analysis of mainly macroremains (seeds, wood) from archaeological layers (for a short introduction see Jacomet 2007). These remains are ecofacts and became incorporated in the layers through human intervention. Therefore, their study is part of the archaeological sciences (environmental archaeology) rather than botany or palaeoecology. The reason for this is that archaeobotanists are mainly interested in the activities carried out by past populations, of which the most important one is, by far, subsistence; in other words, what kind of food people used to eat, how they obtained it, and how and where they stored and processed it, once it had been collected. Archaeobotanists also look at trade, construction materials and aspects of rituals. In addition, archaeobotany provides very valuable (if not the most valuable, because very detailed) information about past environments, especially anthropogenic ones, like fields or grassland. The study of weed seeds for example can provide, not only detailed information about cultivation techniques, but it also sheds light on environmental factors such as, soil types, drainage, climate, as well as the specific cultivation practices employed by the farmer e.g. manuring, tillage, sowing times and weeding. As a result, we have a proxy for determining where past crops were grown (as examples for the Neolithic see Hosch und Jacomet 2004 or Bogaard 2004). However, taphonomical circumstances, such as the stage of crop cleaning, have to be taken into consideration when interpreting weed taxa. The analysis of plant remains from animal dung allows a thorough reconstruction of the foddering processes as well as the landscape, where the animals were sent to graze (as an example for the Neolithic see Kühn and Hadorn 2004 and the ongoing project of the SNF No. 105312-110406/1). In addition, archaeobotanical investigations of fodder (hay) in particular, have shown that the first traces of grassland started to occur in Northern Europe, in the Bronze Age, becoming more and more widespread from the Iron Age onwards.

This presentation shows how archaeobotany can contribute to the study of the history of the anthropogenic landscape. It will also try to demonstrate possible links between palaeoecology ('off-site' data) and archaeobotany – a collaboration whose potential has not, as yet, been taken into account.

References

Bogaard, A. (2004). Neolithic Farming in Central Europe. An archaeobotanical study of crop husbandry practices. London.

Hosch, S. & Jacomet, S. (2004). Ackerbau und Sammelwirtschaft. Ergebnisse der Untersuchung von Samen und Früchten. In: Jacomet, S., Schibler, J. und Leuzinger, U. (Hrsg.) Die neolithische Seeufersiedlung Arbon Bleiche 3: Wirtschaft und Umwelt. Archäologie im Thurgau 12. Frauenfeld, 112-157.

Jacomet, S. (2007). Plant Macrofossil Methods and Studies. Use in Environmental Archaeology. In: (Hrsg.) Encyclopedia of Quaternary Science. Encyclopedia of Quaternary Science 3. Oxford, 2384-2412.

Kühn, M. & Hadorn, P. (2004). Pflanzliche Makro- und Mikroreste aus Dung von Wiederkäuern. In: Jacomet, S., Leuzinger, U. & Schibler, J. (Hrsg.) Die jungsteinzeitliche Seeufersiedlung Arbon Bleiche 3. Umwelt und Wirtschaft. Archäologie im Thurgau 12. Frauenfeld, 327-350.

Veränderungen der Umweltbedingungen und Lebensweise im Spätglazial anhand von zwei Freilandfundstellen am Neuenburgersee

Werner Müller & Denise Leesch

Service cantonal d'archéologie, Laboratoire d'archéozoologie, Chemin de Maujobia 8, 2000 Neuchâtel

Das Spätglazial ist die Zeit der letzten starken Klimaschwankungen vor dem Holozän. In Anpassung an die jeweiligen Bedingungen veränderten sich die Pflanzen- und Tiergesellschaften. In welcher Weise sich die damaligen Menschengruppen an diese sich wandelnden Umweltbedingungen angepasst haben wird an zwei bedeutenden Fundstellen gezeigt, die mehrmals während dieses Zeitabschnitts aufgesucht wurden. Dank guter Erhaltung der organischen Reste, speziell der Tierknochen, können Aussagen über die Säsonalität der verschiedenen Begehungen, sowie über die unterschiedliche Nutzung der einzelnen Tierarten gemacht werden. Jagd- und Transportstrategien werden vorgestellt und in ein Siedlungsmodell eingebunden, das sowohl ökologische als auch technologische und kulturelle Aspekte berücksichtigt.

Frühe Schwankungen des Seespiegels und die Siedlung Zürich

Dölf Wild
Amt für Städtebau, Stadt Zürich, Lindenhofstrasse 19, Postfach, 8021 Zürich

Die geologischen Verhältnisse im Raum der Stadt Zürich sind seit mindestens dem 19. Jahrhundert immer wieder Thema geologischer und historischer Forschung gewesen. In jüngerer Zeit sind besonders die Arbeiten von Conrad Schindler zu nennen. Anlässlich der archäologischen Ausgrabungen auf dem Zürcher Münsterhof in den Jahren 1977/78 kam es zu einer Kontaktnahme zwischen Conrad Schindler und den damals federführenden Archäologen der Stadtarchäologie Jürg E. Schneider und Daniel Gutscher. Ein Beitrag Schindlers in der Grabungspublikation zum Münsterhof war für Jahre prägend (Schneider *et al.* 1982).

Gemäss traditioneller Sicht der Geologen und besonders Schindlers steht die Zürcher City im Raum Paradeplatz und Thalacker auf einem grossen Sihldelta, das in prähistorischer Zeit aufgeschüttet und noch vor den neolithischen und bronzezeitlichen Seeufersiedlungen zur Ruhe gekommen sei. Schindler und die Archäologen konstatierten nun aber auf dem Münsterhof sowohl einen "wilden Arm der Sihl" in römischer Zeit, wie auch eine starke Schwankung des Seespiegels zwischen Bronzezeit und Frühmittelalter. Hervorgerufen wurde letzteres durch die Aufschüttung von Geschieb der Sihl in der Limmat im Bereich des Hauptbahnhofs. Heute liegt der mittlere Wasserstand des regulierten (gestauten) Zürichsees auf 405.95 Meter ü. M. Schindler spricht von einem Höchststand von bis zu 408 m ü. M. und dazwischen liegendem Tiefstand von bis zu 403.50 m ü. M. Es handelte sich also um Schwankungen von gegen 4,5 Meter Höhe.

Für die Archäologie war dieser Befund in der Folge kein Anlass für weitergehende Fragestellungen. Man ging implizit davon aus, dass es sich dabei um kurzfristige Vorgänge im Umfeld von Hochwasserspitzen handelte, welche die topographischen Verhältnisse der Siedlung nicht gross beeinflusst haben. Intuitiv ging man von einem mehr oder weniger heutigen See- und Limmatspiegel aus und verbannte diese Schwankungen in das "unwirtliche Gebiet" jenseits der Siedlung. Jüngste Ausgrabungen haben nun aber dieses Bild nachhaltig verändert. Der Seehochstand von gegen 408 m scheint über lange Zeit und bis ins frühe 1. Jahrhundert n. Chr. angedauert zu haben. Dies hat zur Folge, dass der Lindenhofhügel mit der vor ein paar Jahren entdeckten spätkeltischen Siedlung als grosse Halbinsel in den See hinaus geragt haben muss. - Ein völlig neues Bild dieser frühen Siedlungsphase Zürichs!

Das Absinken des Sees um etwa 4,5 m erfolgte in römischer Zeit in mindestens zwei Etappen. Ein bereits von Schindler konstatierter neuer Seespiegelhochstand im Frühmittelalter brachte

feine Sedimente auf die römischen Schichten im Gebiet des Münsterhofes und auf die Deltaplatte unter der City. Auf diese bis zu einen Meter dicke Sedimentschicht ist dann im 9. Jahrhundert das Fraumünster als bedeutendes königliches Eigenkloster gebaut worden. Der Seespiegel muss dann also wieder dauerhaft tiefer gelegen haben. Seither sind diese langen und anhaltenden Schwankungen des Seespiegels in Zürich kein Thema mehr - nur die durchaus bedrohlichen Hochwasserspitzen von Sihl und See beschäftigten die Stadt bis ins 20. Jahrhundert. Die zeitliche Abfolge dieses Geschehens und eine Anzahl von Detailbeobachtungen lassen vermuten, dass hier die Römer und später dann die karolingischen Klostergründer regulierend ins Abflussgeschehen von Sihl und Zürichsee eingegriffen haben. Diese Beobachtungen sollen an der Tagung vorgestellt und diskutiert werden.

References

Schneider *et al.* (1982). Der Münsterhof in Zürich. Schweizer Beiträge zur Kulturgeschichte und Archäologie des Mittelalters 9, 51-55.

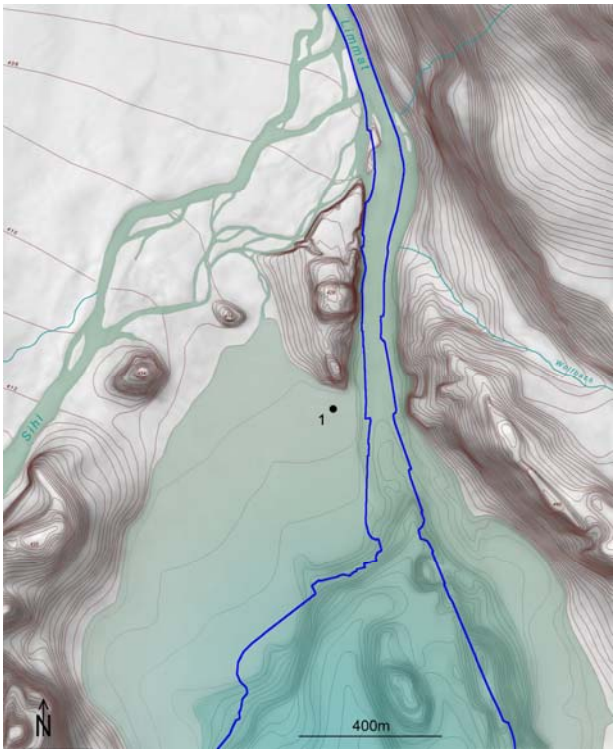


Abb. 1. Der Raum Zürich zur Zeit der keltischen Besiedlung im 1. Jahrhundert vor Christus. Der hohe Seespiegel lässt den Lindenhofhügel als Halbinsel in den See vorstehen. Dunkel markiert die heutige Uferline, (1) Lage des Münsterhofs (Rekonstruktion Urs Jäggin, Stadtarchäologie)

Fréquence comparée de quelques chiroptères durant l'Holocène

Michel Blant

Institut suisse de spéléologie et de karstologie, cp 818, 2300 La Chaux-de-Fonds

Des datations de crânes de chauves-souris ont été effectuées sur des collectes provenant de différentes grottes du Sud et du Nord des Alpes suisses. Le but de ce projet était de rechercher les époques d'apparition après le Tardiglaciaire de quelques espèces forestières thermophiles ou non, considérées comme traceurs des périodes chaudes ou froides. Leur présence est ensuite mise en relation avec les successions forestières végétales de l'Holocène.

Les données issues de notre échantillonnage montrent tantôt une représentation durant un large intervalle de temps inscrit dans la période de l'Holocène (p. ex. Myotis brandti de -6500 à +500, Myotis nattereri de -7300 à +800), tantôt un intervalle plus restreint (p. ex. Myotis blythi de -8500 à -8300). Au Nord des Alpes, les espèces apparaissent plus tardivement, après l'épisode frais de la première moitié de l'Atlantique. La présence plus limitée de certaines espèces à certaines périodes peut être expliquée au moins en partie par les successions végétales. Ainsi, blythi a sans doute profité au début de l'Holocène d'un boisement diffus conservant de larges zones steppiques. Ses populations diminuent ensuite avec la densification des massifs boisés. Elle est aujourd'hui rare en Suisse et moins abondante que par le passé au Tessin (Moretti & al. 2003).

References

Moretti M., Roesli M., Gamboni A.-S. & Maddalena T. (2003). I pipistrelli del Cantone Ticino. Memorie della Società Ticinese di Scienze Naturali 6, 91 pp.

Morphogenesis of the Sarine canyon (Plateau Molasse, Switzerland): a simple story?

Luc Braillard (1) & Michel Mauvilly (2)

(1) Department of Geosciences, geology and paleontology, University of Fribourg - ch. du Musée 6, 1700 Fribourg

(2) Service archéologique du canton de Fribourg, Planche supérieure 13, 1700 Fribourg

The 50 to 100 m deep canyon of the Sarine River, that develops at the north of the prealpine front in the Molasse Plateau, is classically attributed to postglacial erosion, that dug epigenetic meandering gorges on the relatively smooth surface left bare by the retreat of the Rhône and Sarine glaciers. Based on this hypothesis, a fluviatile erosion rate of approximately 0.7 cm/year can be calculated. Although very high, this result is still reasonable taking into account the isostatic rebound of the lithosphere and subsequent uplift after deglaciation.

However, the recent discovery of a Mesolithic archaeological site, located at the bottom of the gorge five meters higher than the river bed, has evident implications for the canyon morphogenesis. Indeed, artefacts as well as radiocarbon dating delivered an age of 8'500 years cal. BP for the oldest anthropic layer found in the stratified rockshelter filling. This new chronological datum involves that most of the canyon was already dug 8'500 years ago, and that only five meters of molasse were eroded since that time. If the Sarine canyon is still considered as a postglacial feature, this implies a dramatically high erosion rate during Tardiglacial to early Holocene times (approximately 1.5 cm/year) and a consequently very low erosion rate since the Atlantic period (approximately 0.06 cm/year). Another solution is to consider an older age for the formation of the canyon.

The confrontation of these archaeological and geological data offers exciting perspectives for Quaternary research. First, the age of the actual canyon should be reconsidered by the means of absolute dating (OSL, ^{14}C, U/Th) of sediments that are cut by the canyon (tills, fluvioglacial and glaciolacustrine deposits) or that postdate its formation (calcareous tufa). Secondly, if the strong erosion following the retreat of the glaciers is confirmed, it should be discussed with respect to the following factors that might have controlled the rates of river incision into bedrock: 1) isostatic rebound of the lithosphere, 2) influence of the recently dated (~18'000 to 9'000 cal yr BP) palaeo-lake of Gruyère situated upstream, 3) role of grain size and sediment supply, 4) role of vegetation and 5) possible neotectonic activity.

Eiszeitliche Kleinkunst in der Schweiz

Ingmar M. Braun

Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt, Landesmuseum für Vorgeschichte, Richard-Wagner-Str. 9, 06114 Halle (Saale), Deutschland

Das Jungpaläolithikum (Jüngere Altsteinzeit) ist in Europa durch das Auftreten des modernen Menschen, *Homo sapiens sapiens*, geprägt. Es dauerte ca. von 35'000 bis 12'000 BP bis zum Ende des Eiszeitalters. Aus dieser Zeit sind in Europa zahlreiche Zeugnisse des künstlerischen Schaffens bekannt, wie z.B. die spektakuläre Höhlenkunst in Frankreich und Spanien. In vielen Teilen Europas wurden auch mobile Kunstwerke, sogenannte Kleinkunstobjekte, gefunden. Aufgrund der starken Vergletscherungen ist in der Schweiz bis jetzt nur die letzte Kultur des Jungpaläolithikums bekannt, das Magdalénien, welche in das Spätglazial fällt und ca. von 18'000 – 12'000 BP dauerte. In der Schweiz sind bis heute rund 50 magdalénienzeitliche Fundstellen bekannt. Die häufigsten Fundstellen liegen auf beiden Seiten der Jurakette zwischen Genf und dem Bodensee und im Mittelland, von denen die meisten vor der zweiten Hälfte des 20. Jahrhunderts ausgegraben wurden. Bislang wurden sieben Fundstellen mit Kleinkunstobjekten in der Schweiz entdeckt. Eine besondere Stellung nimmt dabei das Kesslerloch im Kanton Schaffhausen ein, von dem die meisten und hochwertigsten Fundobjekte stammen. Es wurde jedoch, wie viele andere Fundstellen, schon sehr früh ausgegraben und daher leider ohne ausreichende Dokumentation der Fundumstände. Die magdalénienzeitliche Kleinkunst der Schweiz kann in zwei grosse Gruppen unterteilt werden: die Gravierungen und die figuralen Plastiken. Bei den Gravierungen überwiegen die Tierdarstellungen, die häufig auf Gebrauchsgegenständen angebracht wurden. Als Materialien wurde vor allem Rentiergeweih, aber auch Knochen, Gagat und Stein verwendet. Zahlreiche der eiszeitlichen Kleinkunstobjekte haben ihre Parallelen in den grossen Kunstzentren Westeuropas, aus denen auch Höhlenkunst bekannt ist. Aufgrund dieser Ähnlichkeiten kann angenommen werden, dass es auch in der Schweiz jungpaläolithische Höhlenkunst gegeben haben muss. Diese wurde aber noch nicht entdeckt oder konnte sich aufgrund der klimatischen Verhältnisse nicht erhalten haben.

Glazialsedimentologische Untersuchungen an Flutes im Vorfeld des Findelengletschers

Sandro Coray, Andreas Graf, Sven Lukas & Christian Schlüchter
Institut für Geologie, Universität Bern, Baltzerstrasse 1+3, 3012 Bern

Sedimentologische und geotechnische Untersuchungen im Vorfeld des Findelengletschers erbrachten neue Erkenntnisse über die Bildung von Flutes. Flutes sind in Fliessrichtung orientierte, glazialmorphologische Sedimentkörper in Vorfeldern von Gletschern. In mehreren Aufschlussgräben zegiten sich anhand von Formen und sedimentologische Eigenschaften zwei Fazien in den Flutes; eine untere, diamiktisch ausgeprägte, konsolidierte und eine obere, locker gelagerte, meist sandig bis kiesige Fazies. Durch Geschiebeeinregelungsmessungen (*fabric*) kann eine gute Orientierung der Klasten in den diamiktischen Einheiten gezeigt werden, was auf subglaziale Einregelung hindeutet. Gleiche Messungen in den oberen Einheiten zeigen ebenfalls eine bevorzugte Orientierung. Kornformmessungen (*clast shape*) bestätigen zusätzlich die Zweiteilung in eine untere und obere Fazies. Die Klasten der unteren Einheiten zeigen einen klaren subglazialen Transport an; die der oberen Einheiten zeigen dagegen ein primär fluviales, leicht subglazial aufgearbeitetes Sediment an. Aus letzterem wird interpretiert, dass diese Klasten beim Vorstoss des Findelengletschers von 1979 durch subglaziale Scherflächen an der Gletscherfront hochgescherte, alte Sandersedimente sind, welche in der Ablationsphase nach 1986 aus den Scherflächen ausgeschmolzen wurden, wie aus Luftbildanalysen interpretiert werden kann. Die während des Vorstosses gebildeten sedimentbedeckten Eispyramiden an der Gletscherfront schmolzen nach 1986 bis 2002 langsam herunter. Durch das langsame Herunterschmelzen der Eispyramiden konnte eine inglaziale Einregelung der Geschiebe erhalten bleiben. Die diamiktischen Einheiten werden als proglaziale Eisrandsedimente interpretiert, die beim Vorstoss überfahren wurden. Diese Arbeit ergänzt bestehende Modelle, nach denen Flutes meist hinter einem grösseren Initialblock, in dessen Druckschatten durch longitudinale und transversale, subglaziale Druckgradienten und dem daraus resultierenden Einpressen und Hochfalten von subglazialem Sediment geformt werden.

Der Wandel von Natur- zu Kulturlandschaft im Rheinland (NW-Deutschland): ein Ergebnis anthropogener Brand-wirtschaftsweisen

Eileen Eckmeier (1), Guido L.B. Wiesenberg (2), Jan O. Skjemstad (3), Michael W.I. Schmidt (1) & Renate Gerlach (4)

(1) Geographisches Institut, Bodenkunde & Biogeog., Universität Zürich, Winterthurerstrasse 190, CH-8006 Zürich

(2) Universität Bayreuth, Lehrstuhl für Agrarökosystemforschung, D-95440 Bayreuth

(3) CSIRO Land and Water, PMB 2, Glen Osmond, SA 5064

(4) Rheinisches Amt für Bodendenkmalpflege, Endenicher Str. 133, D-53115 Bonn

Der Wandel von einer natürlichen zur Kulturlandschaft wird in den terrestrischen Archiven der Niederrheinischen Bucht während des Spätneolithikums (3500-2200 v.Chr.) deutlich. Die Vegetation wandelt sich von einer flächendeckenden Bewaldung (Linden, Ulmen) zu einer offenen Parklandschaft, dominiert durch Eichen und Hasel. Zur selben Zeit veränderte sich die landwirtschaftliche Praxis: statt der pfluglosen Ackerwirtschaft dominiert eine extensive Viehwirtschaft. Wir untersuchten fossile dunkle Bodenhorizonte entlang eines Gasleitungsgrabens (33 km) und auf 16 archäologischen Ausgrabungen (0.5-5 ha). Die Bodenhorizonte waren immer an anthropogene Gruben angebunden, und viele dieser Grubenfüllungen enthielten Holzkohlepartikel. Wurden diese dunklen Böden durch anthropogene Brände beeinflusst? Der Anteil verkohlter organischer Substanz an der gesamten organischen Substanz wurde durch die Isolierung und Identifizierung des stabileren pyrogenen Kohlenstoffes mittels UV-Photooxidation und ^{13}C NMR ermittelt. Die verkohlte organische Substanz wurde anschliessend mit ^{14}C AMS datiert. Ein hoher Anteil der organischen Substanz der dunklen Böden ist verkohlte Materie (19-46%). Die ^{14}C-Alter weisen auf Brände zwischen 7530 – 7200 cal yr BC (Mesolithikum) und 675 – 780 cal yr AD (Mittelalter). Zusätzliche Untersuchungen zum Einfluss prähistorischer Brände auf den Boden im Rahmen eines Brandexperimentes (Forchtenberg) zeigten, dass bereits ein Brand ausreicht, um die Farbe des Bodens zu beeinflussen, und dass insbesondere kleinere Holzkohlepartikel in den Boden eingearbeitet wurden. Wildfeuer in den Laubwäldern der mittleren Breiten sind sehr selten. Daher müssen anthropogene Brände die Quelle für die verkohlte organische Substanz in den dunklen Böden sein. Wir schliessen daraus, dass die untersuchten Bodenhorizonte Relikte und Zeugen einer (prä)historischen Brandwirtschaftsweise sind, die sehr wahrscheinlich zur Oeffnung der neolithischen Wälder und Förderung der Viehwirtschaft eingesetzt wurde.

The Mesolithic project Ullafelsen in Tyrol – Man and environment in the Early Holocene

C. Geitner & D. Schäfer

Hochgebirgsarchäologie, Institut für Geologie, Universität Innsbruck, Innrain 52, 6020 Innsbruck, Austira

Meaningful investigations of the occurrence of humans in the Alps can only be carried out transdisciplinary (in the sense of Mittelstraß 2003). The founding of a corresponding alpine archeology was motivated by the recovery of the "ice man" at the Tisenjoch, South Tyrol, in 1991. Since then investigations of the Prehistory of the Early Holocene have been intensified in Tyrol and, in particular, deal with the conditions in the vicinity of the timberline. Numerous sites meanwhile document the here prevailing favourable conditions concerning bio mass, possibilities for hunting groups as well as the use (utilization) of regional and transalpine transport paths.

Our work focuses on the Ullafelsen site (1869m a.s.l., Sellrain), which is situated in the Fotscher Valley, Northern Stubai Alps. The investigations in various disciplines are partly completed, partly ongoing and aim at a better understanding of the natural conditions for the prehistoric land use. This includes several aspects of geology, geomorphology, meteorology, the glaciation history of the late Weichselian and early Holocene, regional climate, and development and change of the timberline zone during the mesolithic settlement of the site. Whereas the time fort his settlement can be derived from ^{14}C-dated charcoals (Preboreal/Boreal) of the mesolithic fireplaces, recent mapping of plant societies in the valley yield information about usage as pastures also in more recent time periods, for which we also have numerous historical and archeological evidence.

Most of the stone artefacts found at Ullafelsen are made of radiolarites and hornstones, which originate from Jurassic hornstones of the Frankish Jurassic (Kelheim Basin, Bavaria) and from Scaglia rossa/S. variegata silex types of the Nons Valley, Upper Italy. Whereas the first group means subsistence-based excursions of more than 200km, the Italian silices yield the oldest holocene proof of the most likely regular crossing of the main Alpine crest, which supports the hypothesis of a transalpine cultural transfer between the mesolithic societies of the Northern and the Southern Alps, respectively. The complexity of the findings seems to increase with the progress of the soil science investigations of the site and its vicinity: The mesolithic fireplaces and other artefacts at Ullafelsen are found directly above a grey, distinctly silty/fine-sandy layer (LL = Light Layer), which originally had been identified as eluvial horizon of podzoles. Podzolisation of varying intensity is often found in the timberline zone of the Fotscher Valley.

However, more exact investigations of the soil science working group, based on various field and labour analyses, rather hint at an aeolian origin of the LL. The archeological results date this sedimentation at the late glacial/early Holocene. Some profiles also show that aeolic sedimentation plays a certain role until today, which could also be shown in the Northern Limestone Alps (Kalkalpen). Under these assumptions, humus horizons under the LL can be explained as relict upper soils from the late glacial, which are still being transformed soil-genetically until today. The LL thus acts as an important diagnostic horizon for landscape history. From the complex interaction between sedimentation and soil genesis more open questions arise, e.g. reconstruction of the Aeolian process, sedimentation and vegetation conditions and secondary sediment transfer.

References

Mittelstraß, J. (2003). Transdisziplinarität - wissenschaftliche Zukunft und institutionelle Wirklichkeit. Konstanzer Universitätsreden 214.

Strontium isotopes in the Maya Lowlands (Yucatan/Mexico) – A geochemical tool to trace ancient migration and trade?

Adrian Gilli (1, 2), David A. Hodell (1), George D. Kamenov (1) & Mark Brenner (1)

(1) Department of Geological Sciences, 241 Williamson Hall, University of Florida, Gainesville, FL 32611, USA

(2) present address: Geological Institute, ETHZ, Universitätstrasse 16, 8092 Zürich, Switzerland

Strontium isotopes ($^{87}Sr/^{86}Sr$) are increasingly being applied in archaeological studies as provenance indicator to solve problems related to ancient migration and trade. Strontium isotope ratios in tooth enamel and bones of humans and animals have been used to infer whether an individual had migrated in his/her lifetime between childhood and adulthood. Strontium is ingested by consumption of food and water, and substitutes for calcium in the teeth and bones without any isotopic fractionation and, therefore, the strontium isotopic ratio of these mineralized tissues should reflect the geological substrate of the place of residence during their formation (assuming no post-mortem alteration). Strontium isotope ratios are also used to trace the source of food, building materials (e.g. timber) or lithic artifacts. A prerequisite for a successful application of strontium isotopes in archaeological studies is an accurate base map documenting the spatial variability of $^{87}Sr/^{86}Sr$ throughout the region of interest. In the Maya realm, Hodell *et al.* (2004) evaluated the potential of the strontium isotope method and identified five sub-regions with distinct strontium isotope signatures. However, the spatial resolution of this strontium isotope map is still too low to reconstruct migration and trade between specific archaeological sites of the Yucatan Peninsula.

For this study, over 200 samples of water, rock, soil, and plants were collected from the Northern Lowlands of Yucatan with a special emphasis to cover major archaeological sites like Chichen Itza, Mayapan and Uxmal. A very uniform $^{87}Sr/^{86}Sr$ signature was observed for the terrain within the Ring of Cenotes, a tectonic structure associated with the Chicxulub impact crater. Therefore, the majority of the bedrock samples from the northwestern part of the Yucatan Peninsula revealed a near identical strontium isotope ratio of 0.70905. The Postclassic archaeological site of Mayapan lies just at the southern end of this uniform terrain and has therefore a well-constrained strontium isotope signature. This makes the archaeological site of Mayapan a promising target for further provenance studies using the strontium isotope method. The outcropping geology is more complex outside the Cenote ring, which is reflected in a higher spatial variability of the strontium isotope values. Samples from the archeological site of Chichen Itza revealed $^{87}Sr/^{86}Sr$ values of 0.7080 to 0.7085, whereas for the site of Uxmal an $^{87}Sr/^{86}Sr$ value of around 0.7088 was

determined. This new strontium isotope base map will be an important tool for archaeologists to evaluate the feasibility of this isotopic tracer for provenance studies in the Northern Lowlands of the Yucatan Peninsula.

References

Hodell, D.A., Brenner, M., Kamenov, G. & Quinn, R.L. (2004). Spatial variation of strontium isotopes ($^{87}Sr/^{86}Sr$) in the Maya Region: A tool for tracking ancient human migration. Journal of Archaeological Science 31, 585-601.

Surface exposure dating confirms multiple extensions of Rhone glacier over the Jura Mountains

Angela A. Graf (1), Stefan Strasky (2), Naki Akçar (1), Susan Ivy-Ochs (3), Peter W. Kubik (4), Marcus Christl (4), Martin Burkhard † (5) & Christian Schlüchter (1)

(1) Institute of Geological Sciences, University of Berne, Baltzerstrasse 1-3, 3012 Bern

(2) Institute of Isotope Geochemistry and Mineral Resources ETH Zurich, Clausiusstrasse 25, 8092 Zürich

(3) Institut für Teilchenphysik, ETHZ, 8093 Zürich & Geograph. Institut, Universtiät Zürich, 8057 Zürich

(4) Paul Scherrer Institute, c/o Institut für Teilchenphysik, ETH Zürich, 8093 Zürich

(5) Institut de Géologie et d'Hydrologie, Rue Emile-Argand 11, 2009 Neuchâtel

A large number of scientists described Alpine erratic boulder situated beyond the known extent of the Last Glacial Maximum (LGM) of Rhone glacier (e.g. Nussbaum & Gygax, 1935; Aubert 1965; Buoncristiani & Campy 2004). However, these authors could only speculate about age of this large alpine ice extension reaching over the Jura Mountain, and, according to the classic stratigraphy of Penck & Brückner (1909), it was attributed to the Rissian.

In the last two decades, considerable effort has been spent to improve dating methods, which allow direct age determination of glacial sediments, i.e. surface exposure dating for erratic boulders or polished bedrock. We successfully tested series of pre-LGM erratic boulders on the Montoz (Graf *et al.*, 2007). The perfect agreement of ages obtained with both radionuclides (^{10}Be, ^{26}Al) and noble gases (^{21}Ne) motivated us to extend our study area. Therefore we determined two transects, the first from Neuchâtel to La Chaux-de-Fonds and the second from Orbes to St.-Croix. The position of both transects was given by the following factors: (1) preservation (not all mapped erratic boulders were found), (2) the need of a quartz-rich lithology (3) exclusion of post-depositional movements (4) similarity of boulder distribution in both profiles. Both start with a prominent boulder situated within the extension of the Last Glacial Maximum (LGM). Further samples were taken from boulders located at higher elevation, but still mapped as LGM. Finally, "pre-LGM" boulders have been sampled beyond the mapped extension of LGM Rhone ice. Therefore we expect our results to cluster into two or three groups, as function of their proximity and altitude.

The age obtained from the highest and remotest samples indicate an extensive glaciation of the Jura Mountains during the early part of Marine Isotope Stage 6 (MIS-6). Notably, the highest erratic in the Jura Mountains, on Mt. d'Amin (MDA-1 at 1398m a.s.l.), is as old as the Montoz test samples. However, other "pre-LGM" boulders (e.g. COR-1 or GRI-1) are far to young, and seem to have been moved or reworked after deposition. The more freshly looking boulders

attributed to the last glaciation (MIS-2) are found at different altitudes, so that we may obtain a chronological constrain of the successive down melting of the Rhone Glacier. Further age constrain is given by the maximum extend of Rhone Glacier during the LGM near Wangen a. d. Aare. The multiple nuclide dating of the Steinhof erratic gives an age of 21 ka (Ivy-Ochs *et al.* 2004).

References

Aubert, D. (1965). Calotte glaciaire et morphologie jurassiennes. Eclogae geologicae Helvetiae 58, 555-578.

Buoncristiani, J.F. & Campy, M. (2004). Expansion and retreat of the Jura ice sheet (France) during the last glacial maximum. Sedimentary Geology 165, 253-264.

Graf, A.A., Strasky, S., Ivy-Ochs, S., Akcar, N., Kubik, P.W., Burkhard, M. & Schlüchter, C. (2007). First results of cosmogenic dated pre-last glaciation erratics from the Montoz area, Jura Mountains, Switzerland. Quaternary International 164-65, 43-52.

Ivy-Ochs, S., Schäfer, J., Kubik, P.W., Synal, H.A. & Schluchter, C. (2004). Timing of deglaciation on the northern Alpine foreland (Switzerland). Eclogae Geologicae Helvetiae 97, 47-55.

Nussbaum, F. & Gygax, F. (1935). Zur Ausdehnung des risseiszeitlichen Rhonegletschers im französischen Jura. Eclogae Geologicae Helvetiae 28, 659-665.

Penck, A. & Brückner, E. (1909). Die Alpen im Eiszeitalter, 3: Leipzig, Tauchnitz, C.H., 1199 p.

Late Pleistocene dunes on the Swiss Plateau: a new contribution from OSL & (palaeo)pedology towards the understanding of Late Pleistocene landscape evolution

Aleksandra Heer (1), Sally Lowick (2), Frank Preusser (2) & Heinz Veit (1)

(1) Institute of Geography, Universität Bern, Hallerstrasse 12, 3012 Bern

(2) Institute of Geological Sciences, Universität Bern, Baltzerstrasse 1+3, 3012 Bern

Dunes are known from different areas in the river plains of the NW Alpine foreland: Rhine Valley, Swiss Plateau, Lower Vallais Valley and south of Lake Geneva. Following the last deglaciation 17'500 cal yr BP (Ivy-Ochs *et al.* 2004), the appropriate geoecological conditions for dune development could be expected during the Oldest Dryas, 17'050 cal yr BP, prior to reafforestation in the Bolling, 14'500 cal yr BP, and again during the Younger Dryas, 12'500 cal yr BP. Due to the lack of numerical datings and before the advent of OSL, different ages and models existed to explain the dune genesis (e.g. Meyer-Wohlfahrt 1986, van der Meer 1982). New investigations, including soil mapping, geochemistry, sedimentology and OSL dating of dunes have been carried out on the Swiss Plateau dunefield in an area called Grosses Moos. This dunefield includes four main sandy dunes divided by flat plains mainly covered by peat and Aare River deposits. The changing level of Lake Neuchâtel has an important influence on dune development, as their shape along the NE edge of the lake suggests.

Based on soil studies, the best developed soils (Luvisols) occur on the north eastern dune (Islerendüne) while less developed Cambisols and Arenosols are widespread. Following the assumption that the Luvisols mark the oldest, undisturbed part of the dune, these new investigations have focused on that area. The Luvisols are decalcified down to 80-90 cm, containing a visible clay enrichment horizon (Bt-horizon) of up to 20 cm thickness. Horizons over- and underlying the Bt-horizon both show hydromorph overprinting (precipitation/groundwater). The geochemical and mineralogical data (main and trace elements, pH, lime content, organic matter, Fe-O & Fe-D and clay minerals), together with the weathering indices, indicate an advanced stage of soil formation. Following this observation, a previous assumption was that the dunes were of pre-Allerod age, 14'500 cal yr BP (van der Meer 1982). The grain distribution curves, constructed for each horizon separately, indicate homogeneous aeolian source sand fining upwards towards the soil profiles, and correspond to weathering and soil formation.

OSL, using the single-aliquot regenerative-dose protocol, was conducted on the quartz and feldspar fractions (150-200 μm) of the aeolian sand. Both fractions are in good agreement to a depth of 70-85 cm where no influence of groundwater fluctuation has been identified. Ages for quartz and feldspar differ below this depth (where groundwater has oscillated) and their interpretation is still under discussion.

OSL-ages suggest deposition of the upper part of the Islerendüne during the Younger Dryas and the Boreal, and consequently the overlying Luvisol is of Holocene age, when conditions would have been appropriate for soil formation. Work continues on identifying the beginning of dune formation.

Refereneces

Ivy-Ochs *et al.* (2004). Timing of deglaciation on the northern Alpine foreland (Switzerland). Eclogae geologicae Helvetiae 97, 47-55.

Meyer-Wohlfahrt, B. (1987). Das jüngere Quartär im Westschweizer Seeland. Revue de Paléobiol. 6/1, 55-80

van der Meer, J.J.M. (1982). The Fribourg area, Switzerland. A study in quaternary geology and soil development. Diss. Univ. Amsterdam. Publ. Fys. Geogr. Bodemk. Lab. Univ. Amsterdam, 32, 203 pp.

Mixed approaches to archaeology and the environment

David Jordan
Institut für Archäologie, Universität Bern, Länggass-Strasse 10, 3012 Bern

Archaeological and environmental research are deeply connected and share key elements of their evidence base. Throughout the development of mankind, and through the Holocene in particular, the intertwined relationships of man and the wider environment is crucial to our understanding of both. There is an abundance of evidence for the effect of past environments, and environmental change, on past societies – both enabling and circumscribing economies and cultures. There is, however, the significant risk of misattributing social change to environmental causes and some significant revisions of archaeological understanding have been required by a more subtle appreciation of archaeological evidence.

There remain, also, many unanswered questions about the influence of man on the wider environment. Some such influences may have been considerable, even many thousands of years ago – what did the vast anthropogenic denudation of Mediterranean soils through late prehistory and Classical times do to regional environments through the changes it may have brought about in the chemistry of sediment-laden coastal waters, the albedo of exposed rocky landscapes or the altered nature of soil gas exchange and surface transpiration over many millions of denuded hectares?

It is a particular strength of archaeological and environmental research that they can share methods of data recovery and, subsequently, the multi-proxy evidence itself gained from the deeply-sediment laden landscapes which provide some of our richest and most complex sources of evidence. The most efficient approach to this, however, requires close coordination of research – both objectives and methods – so that resources are well used and results comparable. This poster will review the combined use of geophysical and geotechnical methods in recovering the combined evidence of past environments and human activity in both urban and rural archaeological sites. It will consider how the further development of such “Mixed Method” research may give us a better picture of the relationship between man and environment as it developed through the Holocene.

Eine Schweiz ohne Quartär: ein digitales Höhenmodell der Felsoberfläche

Peter Jordan, Thomas Schule & Marco Schwab
Böhringer AG, Mühlegasse 10, 4104 Oberwill

Seit drei Jahren wird sukzessive ein digitales Höhenmodell der Felsoberfläche (DHM Basis Quartär) erarbeitet. Das Modellgebiet reicht heute vom Neuenburger zum Bodensee und vom Hochrhein bis zum Zugersee. Das Modell basiert auf publizierten und unpublizierten Berichten, lokalen und regionalen Studien und Kompilationen der Felsoberfläche sowie auf Informationen aus rund 15'000 Bohrungen. Eine weitere wichtige Datenbasis waren die in diesem Gebiet publizierten geologischen Karten. Das Modell ist kongruent zum Digitalen Höhenmodell der Swisstopo (DHM 25) in einem Raster von 25 m x 25 m abgelegt. Neben der Möglichkeit, die Felsoberfläche zu visualisieren erlaubt das Modell auch eine Abschätzung der Mächtigkeit der Lockergesteinsbedeckung sowie die Erkennung und Analyse der übertieften Täler etc. Das DHM Basis Quartär ist eine wichtige Grundlage für quartärgeologische und hydrogeologische Studien wie auch zur Ermittlung seismischer Risiken (Mikrozonierung).

Bodenkundliche Untersuchungen im Rahmen einer archäologischen Ausgrabung in der Valle Leventina (Tessin)

Daniela Kauf (1), Eileen Eckmeier (1), Christiane Jacquat (2) & Philippe Della Casa (3)

(1) Universität Zürich, Geographisches Institut, Bodenkunde & Biogeographie, Winterthurerstrasse 190, 8006 Zürich

(2) Universität Zürich, Abt. Ur- und Frühgeschichte und Institut für Pflanzenbiologie, Zollikerstrasse 107, 8008 Zürich

(3) Universität Zürich, Abteilung Ur- und Frühgeschichte des Historischen Seminars, Karl-Schmid-Str. 4, 8006 Zürich

Im Rahmen eines interdisziplinären Projektes werden eine bronze- bis eisenzeitliche Siedlung in der Valle Leventina (Airolo-Madrano) und die begleitenden Prozesse der Siedlungs- und Landschaftsgeschichte des Tales untersucht. Im Rahmen dieses Projektes sollen auch Kenntnisse über die potentiellen Wirtschaftsflächen in der Umgebung der Siedlung gewonnen werden, insbesondere über deren Lage in Bezug zu der Siedlung, deren Ausdehnung und über Anbautechniken, z.B. Anlage von Ackerterrassen. Ergänzend wurden bodenkundliche Untersuchungen durchgeführt, deren Ziel es war, mögliche Nachweise für menschlichen Einfluss oder ackerbauliche Nutzung in der näheren Umgebung der Siedlung zu finden und die Bodengenese zu untersuchen. Beprobt wurden fünf Profile; zwei Profile on-site (aus der Grabungsfläche), zwei Profile off-site, davon eines in terrassiertem Gelände, und ein Profil im mutmasslichen Uebergangsbereich. Analysiert wurden neben Dichte, Wassergehalt, Körnung, pH-Wert, C und N weitere Elemente (P, Ca, K) in verschiedenen Auszügen. Die Phosphatanalyse kann einen erhöhten Eintrag organischer Substanz nachweisen, Ca und K sind Indikatoren für Siedlungsabfälle (z.B. Knochen) oder Herdasche. Aus dem off-site Profil der terrassierten Fläche (Braunerde-Kolluvium) wurden aus dem untersten Bereich Holzkohlen zur ^{14}C-AMS-Datierung entnommen. Erste Resultate zeigen in den Kulturschichten grundsätzlich erhöhte Elementgehalte, im Vergleich zu den off-site-Profilen und den darüber und darunter liegenden Horizonten. Die beiden archäologischen Profile unterscheiden sich bezüglich ihrer Elementgehalte stark. P_{tot}, P_{anorg}, C_{org}, Ca (HNO_3) und Ca (NaP) scheinen gute Indikatoren für menschliche Nutzung zu sein, die Konzentrationen dieser Elemente sind in den Kulturschichten erheblich höher als in den off-site Proben, im Gegensatz zu K und P_{org}. Die ^{14}C-Datierung der Holzkohlen aus dem Kolluvium ergab ein Alter von 911-1012 cal yr AD. Die Terrassierung des Hanges wurde somit wahrscheinlich erst im Mittelalter angelegt oder vorhandene ältere Terrassen wurden überprägt. Bislang liegen aber nicht genug Datierungen für eine abschliessende Bewertung der Situation vor. Zukünftige Untersuchungen beinhalten einen weiträumigeren Survey des Siedlungsumfeldes, sowie ergänzende bodenkundliche Untersuchungen und Datierungen.

Analyse multiparamètres à haute résolution de la séquence tardiglaciaire-holocène du Lac Saint Point (Massif du Jura, France)

A. Leroux (1, 2), V. Bichet (1), M. Magny (2), A-V.Walter-Simonnet (2), H. Richard (2), T. Adatte (3) & J.-P.Simonnet (2)

(1) Université de Franche-Comté, EA 2642 Géosciences, 16 rte de Gray, F-25030 Besançon

(2) Université de Franche-Comté, UMR 6565 Chrono-Ecologie, 16 rte de Gray, F-25030 Besançon

(3) Université de Neuchâtel, Institut de Géologie, Rue Emile-Argand 11, CH-2007 Neuchâtel

Situé dans la haute chaîne du Jura, le lac Saint-Point (850 m d'altitude) présente une surface de 7 km^2 et se divise en 2 bassins séparés par un seuil situé à 21,5m de profondeur. Le bassin amont atteint une profondeur maximale de 41,1m alors que le bassin aval atteint 35,5m au maximum. L'alimentation de la cuvette lacustre est principalement régie par les apports du Doubs. Son bassin versant, constitué de formations carbonatées jurassiques et crétacées couvre une surface de 247 km^2.Trois séquences ont été acquises dans les zones profondes des bassins amont (carotte SP05 de 12,5m de long) et aval (carotte SP07, 12 m de long) du lac ainsi que dans la zone littorale du bassin aval (carotte SP06, 6,5 m de long).

Ces forages font actuellement l'objet d'une étude paléoenvironnementale multi-paramètres dans le cadre d'une thèse de doctorat.

Les séquences profondes présentent différents faciès de silts carbonatés à lamines plus ou moins marquées. Divers paramètres physiques tels que la densité, la vitesse des ondes P et la susceptibilité magnétique ont été acquis par diagraphie continue sur un banc *GEOTEK MSCL*. Ces paramètres ont notamment permis de corréler les différents enregistrements sédimentaires qu'ils soient issus de la zone profonde ou de la zone littorale.

Une analyse complète des fractions minérale (granulométrie, éléments majeurs et éléments en traces, minéralogie) et organique (caractérisation de la matière organique et analyse pollinique) de la séquence SP05 est actuellement en cours. Enfin, un tri et une analyse en ^{18}O et ^{13}C des tests d'ostracodes présents dans la séquence ont été effectués.

La chronologie de cette carotte, établie par 24 datations ^{14}C et la présence du Laacher See Tephra (13 047-13 232 ans calBP), couvre l'intégralité du Tardiglaciaire et de l'Holocène. Le modèle d'âge met en évidence 3 grandes périodes à sédimentation contrastée : l'Holocène avec des taux moyens de sédimentation de l'ordre de 0.5 $mm.a^{-1}$, la moitié supérieure du Tardiglaciaire avec un taux moyen de 0.1 $mm.a^{-1}$ et enfin le Dryas ancien caractérisé par un taux de 0.5 $mm.a^{-1}$. Ces

variations correspondent à des périodes de changements majeurs des conditions climatiques et se traduisent dans la sédimentation par des variations très marquées des faciès. Ainsi, la séquence Tardiglaciaire se compose de deux unités et présente notamment une partie terminale très condensée. L'Holocène se caractérise également par deux faciès majeurs, à savoir un faciès de type craie dans sa partie basale puis un faciès plus organique et argileux à la limite Atlantique récent-Subboréal.

L'analyse des éléments majeurs a permis de mettre en évidence 3 grandes périodes à sédimentation carbonatée contrastées. Ainsi du Pléniglaciaire au Tardiglaciaire la fraction carbonatée oscille entre 30 et 40% puis atteint brusquement une valeur palier de 50% au début de l'Holocène. A la fin de l'Atlantique récent, cette teneur décroît au profit de la fraction silicatée. Néanmoins, au cours des 1000 dernières années, cette tendance s'inverse et la teneur en carbonates atteint un maximum de 45% avant de décroître à nouveau dans les 20 derniers centimètres de la séquence.

Les relations existantes entre les différents éléments majeurs ont permis d'aborder la signature géochimique des différents faciès et de mettre en évidence 3 pôles origine: un pôle de type carbonate authigène, un pôle argileux et enfin un pôle enrichi en silice. Ce dernier intervient du Pléniglaciaire au Tardiglaciaire puis est brutalement remplacé par le pôle argileux au début de l'Holocène.

Palaeohydrological changes and human impact history over the last millennium recorded at Lake Joux in the Jura Mountains (Switzerland)

M. Magny (1), E. Gauthier (1), B. Vannière (1) & O. Peyron (1)

(1) Laboratoire de Chrono-Ecologie, UMR 6565 du CNRS, Faculté des Sciences et Techniques, 16 route de Gray, 25 030 Besançon, France

On the basis of sediment and pollen analyses of a radiocarbon-dated sediment sequence from Lake Joux in the Swiss Jura Mountains (west- central Europe), wer present a high-resolution record of lake-level and vegetation changes for the last millennium. The lake-level record makes it possible to determine that lowstands of the water table dominated at ca AD 1200-1400, and from 1720 onward, with interruptions by short-lived rise events at ca AD 1340 and 1840. Highstands prevailed at ca AD 1100, and around AD 1450, 1550, and 1700. The comparison of the Joux lake-level record with a solar irradiance record based on cosmogenic nuclides supports the hypothesis of a major solar forcing of climate variations in western central Europe over the last millennium. In agreement with other palaeohydrological records established in Western Europe and in the central North Atlantic Ocean, the Joux lake-level record suggests that, at a multi-centennial scale, the period of LIA coincided in the European mid-latitudes with wetter climatic conditions, and probably with an increase in summer precipitation. Variations in the hydrological cycle appear to have been associated with changes in the general atmospheric circulation pattern, probably coupled with variations in oceanic circulation and solar activity. The Joux record also points to changes in water resources expected to result from ongoing global warming. Finally, despite the severe climatic conditions which prevail in the Joux Valley, the human impact history at Lake Joux over the last millennium seems to reflect political choices and economic context more than climatic changes.

Piedmont stratigraphy at Riacho Seco (Salta) and its implications for the Late Quaternary environmental evolution of NW Argentina

J.-H. May (1), A. Schellenberger (1), I. Sabino (2) & H. Veit (1)

(1) Institute of Geography, University of Bern, Hallerstr. 12, 3012 Bern, Switzerland

(2) Universidad Nacional de Salta, CIUNSa, Buenos Aires 177, 4400 Salta, Argentina

NW-Argentina is located at the transition between wet tropical and semi-arid subtropical climate regimes, and can therefore be considered as a highly susceptible region for the detection of past climatic changes. Most paleoenvironmental studies in the region, however, have come from the Eastern Andean Cordillera and the Puna plateau. Only very few archives have been documented and investigated in the Subandean Ranges and the Chaco plains. In order to close this gap, this study aims at reconstructing Late Quaternary landscape evolution along the piedmont in NW Argentina. Specifically, detailed paleopedological and sedimentological analysis paleosol-sediment-sequences at the Riacho Seco site, Salta, form the base for the reconstruction of past environments. The documentation and interpretation of >20 profiles and radiocarbon dating enable the correlation between the individual sites and allow the establishment of a regional piedmont stratigraphy. These results are discussed and interpreted within the larger-scale geomorphic context of the NW Argentinean piedmont.

In summary, the paleosol-sediment-sequences at Riacho Seco consist of fluvial deposits indicating an overall aggrading fluvial system during most of the Late Quaternary. Intercalated paleosols are characterized by varying degrees of soil development, but can generally interpreted to reflect more stable periods with dense vegetation cover. Near the base of the sequences, well-developed paleosols reflect a stable landscape before the Last Glacial Maximum (LGM), probably characterized by dense vegetation cover. Widespread accumulation of sands during the LGM points to drier overall conditions. Aggradation alternated with paleosol formation, likely indicating wetter climatic conditions during the Lateglacial. At the Pleistocene-Holocene transition, a marked black paleosol is interpreted as a widespread stable surface. Aggradation and the formation of a distinct morphological piedmont fan is attributed to rather dry Holocene climatic conditions. As suggested by the radiocarbon dates, incision (and therefore the end of piedmont deposition) started some time after 4 ka BP. This incision event reflects a large-scale climatic signal or can be interpreted as the result of regional geomorphic changes (base-level, neotectonics).

Diaton response to Late Holocene environmental changes in Lago Fagnano, Tierra del Fuego

Cristina Recasens (1), Daniel Ariztegui (1), Nora I. Maidana (2), Nicolas Waldmann (1), Christopher M. Moy (3), Robert Dunbar (3), James A. Austin Jr. (4) & Flavio S. Anselmetti (5)

(1) Section of Earth Sciences, University of Geneva, Geneva, Switzerland

(2) Dept. de Biodiversidad y Biologia Experimental, Universidad de Buenos Aires, Buenos Aires, Argentina

(3) Department of Geological and Environmental Sciences, Stanford University, Stanford, CA, USA

(4) Institute for Geophysics, J.A. and K.G. Jackson School of Geosciences, University of Texas at Austin, TX, USA

(5) EAWAG, Ueberlandstrasse 133, 8600 Duebendorf, Switzerland

Variations in diatom assemblages blended with geophysical, sedimentological and geochemical datasets allowed us to reconstruct former environmental changes in Lago Fagnano. Located at 54°S in Tierra del Fuego (ARG), this lake occupies a tectonic depression along the Magallanes-Fagnano fault system. Climate in this area is highly influenced by the westerly winds, the Southern Ocean circumpolar flow and the South Pacific gyre, which makes of Tierra del Fuego a key site for paleoclimatic and paleoecological reconstructions in the Southern Hemisphere. Water and surface sediment grab samples were collected in the lake in order to constrain the modern limnology. Taxa identification and counting of diatoms from sediment samples of the modern lake bottom show a highly diverse diatom community, though species from the *Discostella* genus are visibly dominant. Combining limnological data obtained from the water column with sedimentological and diatom analyses of surface sediment samples allowed to characterize present lake water conditions and its flora. A multi-proxy study of a 160 cm long sediment core was performed in order to characterize the sedimentary record. Sediment density and magnetic susceptibility profiles show relatively uniform values occasionally interrupted by peaks which we interpret as turbidites. Rock-eval pyrolysis reveals a relatively uniform distribution of organic and inorganic carbon along the core. Ultra-high resolution X-ray fluorescence micro-profiles show fluctuations at mm scale in major and trace elements. Preliminary results reveal a regularly laminated deposit of alternating light and dark laminae, rich in diatoms and amorphous organic matter, occasionally interrupted by turbidites. Samples collected at estimated decadal frequencies along the core were used for the diatom identification and counting. The different diatom assemblages found in the sedimentary record, well calibrated with the modern limnology, provide valuable paleoecological information. A good interpretation of this dataset is important to develop diatom-based transfer functions, a final goal of this study that will be further applied at different temporal scales.

Cover sediments and palaeosols on the High Terrace at Sierentz, France, and implications for the chronology of terrace formation in the Southern Upper Rhine Graben

Philippe Rentzel (1), Frank Preusser (2), Chritine Pümpin (1) & Jean-Jacques Wolf (3)

(1) Institute for Prehistory and Archaeological Science, University of Basel, Spalenring 145, 4055, Basel, Switzerland

(2) Institut für Geologie, Universität Bern, Baltzerstrasse 1+3, 3012 Bern, Switzerland

(3) Pôle d'Archéologie Interdépartemental Rhénan, 67600 Sélestat, France

Pedological investigations in combination with luminescence dating have been used to reconstruct the geneses and chronologically interpret a complex cover sediment succession at Sierentz, France, composed of loess and palaeosols on top of gravel attributed to the High Terrace of River Rhine. According to the dating results, three phases of soil development within the hill-slope deposits occurred during different warm phases of Marine Isotope Stage (MIS) 7 (245-190 ka). Soil development on top of the gravel occurred either during early MIS 7 or during an earlier warm phase, possibly MIS 9. Following these results implies a minimum age of 250 ka for the formation of the High Terrace in this part of the Upper Rhine Graben and is contrary to previous assumptions that correlated it with MIS 6 (ca. 150 ka). In combination with results from other sites, the chronological setting of terrace formation to the north of the Alps is apparently much more complex than previously assumed.

Glacial and tectonic dynamics in Southernmost Patagonia since the LGM: The Lago Fagnano record

Nicolas Waldmann (1), Daniel Ariztegui (1), Flavio S. Anselmetti (2), James A. Austin Jr. (3), Christopher Moy (4), Robert Dunbar (4) & Cristina Recasens (1)

(1) Earth Sciences Section, University of Geneva, Rue des Maraichers 13, 1205 Geneva, Switzerland

(2) EAWAG, Ueberlandstrasse 133, 8600 Duebendorf, Switzerland

(3) Institute for Geophysics, University of Texas at Austin, TX 78759, Texas, USA

(4) Dept. of Geological and Environmental Sciences, Stanford University, CA 94305, California, USA

Lacustrine sediments provide one of the best continental archives to reconstruct climate change. In addition, many lakes are located in tectonically sensitive regions and therefore, their sediments also store regional tectonic events. Located at 55°S in Tierra del Fuego, Lago Fagnano is the biggest (~110 km long), southernmost non-ice covered lake in the world. It occupies the deepest of a chain of tectonic depressions along the Magallanes-Fagnano transform system (MFT). More than 800 km of geophysical data combining simultaneously 3.5 kHz (pinger) single-channel with 1 in^3 airgun multi-channel systems revealed more than 100 m of sediments. A preliminary seismic stratigraphic analysis of the high-resolution 3.5 kHz pinger data allowed the identification of three major seismostratigraphic units defined by different seismic facies. While the lowermost unit is interpreted as subglacial to proglacial sedimentation probably deposited at the end of the late glacial period, the middle and uppermost unit represent an upward gradual change from a proglacial environment into typical lacustrine sediments. The seismic stratigraphic analysis further allow us the recognition of several mass-flows and mega-turbidites events in the seismic record suggesting continuing tectonic impact on sedimentation. The mass-flows architecture however, thickens upward and their morphological semblance varies in the uppermost seismic unit, probably documenting the onset of Holocene pelagic-type slope and basin sedimentation that provided the material for re-deposition. The internal seismic architecture of the uppermost seismic unit coincides well with the petrophysical properties measured in the cores, allowing a precise core-to-seismic correlation. The sedimentary record provides a unique trace of decadal changes in regional climate, which is mainly governed by the westerly winds, the Southern Ocean circumpolar flow, and the South Pacific gyre. Further research of the older sedimentary record and comparison to other marine and continental archives however, will improve our understanding of the forcing mechanisms behind climate change that can additionally validate the outcome of ocean and atmospheric climatic models for the Southern Hemisphere.

Surface exposure dating of Late Pleistocene moraines in western Anatolia

C. Zahno (1), N. Akçar (1), V. Yavuz (2), P.W. Kubik (3) & C. Schlüchter (1)

(1) Institute of Geological Sciences, University of Bern, Switzerland

(2) Faculty of Mines, Istanbul Technical University, Turkey.

(3) PSI, c/o Institute of Particle Physics, ETH Zurich, Switzerland.

The terrestrial geological record of paleoglaciations in Anatolia is one of the key archives used to quantify paleoclimatic changes in the Eastern Mediterranean region. As Anatolia is situated in the area between the North Atlantic cyclonic, the Arabian-Indian Monsoon and the Siberian and subtropical high pressure systems, it is sensitive to changes in precipitation due to variations in intensity and geographical position of these systems. We focus on two sites with distinct terrestrial paleoglacial records in NW (Uludağ) and SW (Dedegöldağ) Turkey. The aim of this study is to contribute to an improved knowledge of the timing and extent of paleoglaciations and paleoclimatic change in Anatolia.

We collected 49 samples for surface exposure dating with ^{10}Be from glacially transported boulders on lateral and terminal moraine ridges (40), ice-moulded surfaces (5) and glacially unaffected bedrock (4). The morphological context in the sampling areas indicates that the moraines were deposited by local valley and cirque glaciers. ^{10}Be ages from glacially transported boulders on moraine ridges in SW Anatolia indicate a pronounced glacier advance phase before c.28 ka resulting in the Last Glacial Maximum extension of local glaciers. The glacier started to retreat from its lowermost position at c.1400 m asl. approximately 20 ka ago. Late Glacial glacier re-advances were observed at both sites and will be dated using the method of surface exposure dating with ^{10}Be. The chronology of environmental change preserved in the lake sediments of the Konya Basin (c.200 km to the east of the Dedegöldağ) seems to be consistent with the ^{10}Be glacier chronology recorded in the morphology of the Dedegöldağ area.

Deduced from palynological investigations in Anatolia, the prevailing climate condition during the period of the Last Glacial Maximum is suggested to be cold and dry. Therefore, the appearance of valley type glaciers on the northern slope of the Taurus range in SW Anatolia and the occurrence of a high lake level stage in the Konya plain, as observed in closed lacustrine basins all through southern Anatolia, point to an increased moisture input from the Mediterranean area to the inner-Anatolian basins during the winter season.

Entwurf einer Quartärkarte im Prättigau GR – Konsequenzen für die Quartärstratigraphie, Geochronologie und Klimageschichte im Einzugsgebiet Landquart – Rhein im Spätpleistozän – Frühholozän

P. Zwahlen

Dr. M. Kobel + Partner AG, Grossfeldstrasse 74, Postfach 78, 7320 Sargans

Seit 2004 liegt bei der Geologische Landesaufnahme ein Entwurf einer Quartärkarte samt Erläuterung der Stratigraphie des Spätpleistozäns (Rückzugsstadien von Hochwürm (ausseralpin) bis Spätwürm (inneralpiner Kollaps)) und des anschliessenden Frühholozäns (Verlandungsböden im Rheintal, randglaziale Moorbildungen, Massenbewegungen im Prättigau).
Seit den achtziger Jahren des 20. Jhd's wurden im Zusammenhang mit Sondierarbeiten zu Strassenprojekten, Tunnelbauten, Grundwassererkundungsbohrungen und Kraftwerkbauten im Rheintal und Prättigau fossile Hölzer gefunden, stratigraphisch korreliert gesammelt und am ^{14}C-Labor des Physikalischen Institutes Bern datiert. Resultate davon und Interpretationen bezüglich Massenbewegungen und Klimaentwicklungen wurden in Dapples *et al.* (2003) publiziert. Unterdessen sind im Rheintal und Prättigau über 30 Proben datiert worden. Wir möchten mit unserem Beitrag die entsprechenden Resultate und vorläufigen Interpretationen dazu vorstellen.

Bekannt sind folgende Alter (^{14}C yr BP):

- Massenbewegungen im Prättigau (Saaserrutsch u. A., Bergstürze): 9000 – 10'300
- Verlandung und Moorbildung im Rheintal (Landquart – Sargans): 10'500 – 12'000
- Grundmoräne bei Saas i.Pr. (Tunnelbau, Lokalmoräne Kar Saaser Calanda): 12'000

Der Saaserrutsch hat eine voll entwickelte Waldvegetation überfahren.
Anhand von Korrelationstabellen aus den Erläuterungen der Quartärkarte und stratigraphischen Querprofilen sollen auf Konflikte mit herkömmlichen Alterszuweisungen aufmerksam gemacht werden:

- Die Eismassen kollabieren von ausseralpinen Stadien (z.B. Hurden Zürichsee) zu inneralpinen Rückzugsstadien (Sargans – Gschnitz – Daun – Egesen) in unwahrscheinlich kurzer Zeit; 15'000 – 12'000 ^{14}C yr BP.

- Verlandungen und Moorbildungen im Rheintal und die Grundmoräne bei Saas fallen in die Warmzeit „Bölling/Alleröd“ zwischen 11‘000 und 12‘000 ^{14}C yr BP.
- Die Massenbewegungen um 10‘000 ^{14}C yr BP fallen in die Kaltzeit „jüngere Dryas“ welche ihrerseits mit dem Penk'schen Egesen-Stadium korreliert wird.
- Die Grundmoräne bei Saas (1020 m ü.M.), mit 12‘000 ^{14}C yr BP datiert als Egesen-Stadium liegt für dieses viel zu tief. Saas entspricht stratigraphisch höchstens einem lokalen Gschnitz-Stadium (älteste Dryas um 15‘000 ^{14}C yr BP)

Die Konflikte der Stratigraphie der ausgehenden Eiszeit im Gebiet Prättigau – Rheintal mit der „offiziellen“ Geochronologie sind offensichtlich. Eine Lösung wird nicht präsentiert, die vorgestellten Resultate sollen zu Diskussionen Anlass geben.

Ausgestellt werden soll:

- Kopie der Quartärkarte 1:12‘500 Blatt Serneus, Quadrant Saas, Legende dazu.
- 2 Korrelationstabellen Quartärstratigraphie – Geochronologie aus den Erläuterungen.
- Längsprofil der Glazialstadien Spätwürm aus den Erläuterungen.
- Kurze Texterläuterung bezüglich offene Fragen und Konflikt Stratigraphie – Chronologie.

References

Dapples *et al.* (2003). New records of Holocene landslide activity in the Western and Eastern Swiss Alps. Eclogae Geol. Helv. 96, 1-9.

List of participants

Abbühl, Luca
Institut für Geologie, Universität Bern
Baltzerstrasse 1+3
3012 Bern
luca@geo.unibe.ch

Akcar, Naki
Institut für Geologie, Universität Bern
Baltzerstrasse 1+3
3012 Bern
akcar@geo.unibe.ch

Amman, Brigitta
Institut für Pflanzenwissenschaften, Universität Bern
Altenbergrain 21
3013 Bern
Brigitta.Ammann@ips.unibe.ch

Anselmetti, Flavio
Swiss Federal Institute of Aquatic Science & Technology
Überlandstrasse 133
8600 Dübendorf
flavio.anselmetti@eawag.ch

Ariztegui, Daniel
Earth Sciences Section, University of Geneva
Rue des Maraichers 13
1205 Geneva
daniel.ariztegui@terre.unige.ch

Becze-Dea'k, Judit
Office et Musée d'archéologie Neuchatel
Av. Du Mail 59
2000 Neuchatel
judit.becze-deak@ne.ch

Benkert, Jean-P.
Dr. Benkert AG
Im Dorf 11
3315 Bätterkingen

Bieberstein, von Christoph
Arch. Dienst Ktn. Bern (ADB)
Brunnenstr. 66
3001 Bern
christoph.vonbieberstein@erz.be.ch

Bissig, Pius
Schleifergasse 5
8032 Zürich
pius.bissig@gmx.ch

Blant, Michel
Institut Suisse de Spèléologie ISSKA
CP 818
2300
La Chaux-de-Fonds
michel.blant@isska.ch

Borello, Maria
Département de géographie, Université de Genève,
Uni Mail
40 bd du Pont-d'Arve
1211 Geneve
borrelloarch@yahoo.fr

Braillard, Luc
Géologie et paléontologie
Chemin du Musée 6
1700 Fribourg
luc.braillard@unifr.ch

Braun, Ingmar
Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt, Landesmuseum für Vorgeschichte
Richard-Wagner-Strasse 9
D-0614 Halle (Saale)
IngmarBraun@gmx.ch

Brönnimann, Cornelia
Matosek, Baumann und Niggli AG
Probusweg 10
8057 Zürich
Conae@gmx.net

Burkhalter, Reto
Bundesamt für Landestopografie swisstopo
Seftigenstrasse 264
3084 Waber
Reto.Burkhalter@swisstopo.ch

Coray, Sandro
Eigerplatz 8
3007 Bern
sandrocoray@bluewin.ch

Crotti, Pierre
Musée cantonal d'archéologie et d'histoire
Place de la Riponne 6
1005 Lausanne
pierre.crotti@unil.ch

Dehnert, Andreas
Institut für Geologie, Universität Bern
Baltzerstrasse 1+3
3012 Bern
dehnert@geo.unibe.ch

Deplazes, Gaudenz
Dr. Heinrich Jäckli AG
Albulastr. 55
8048 Zürich
g.deplazes@gmx.net

Dillier, Oliver
Wehrstrasse 10
6032 Emmen
odillier@students.unibe.ch

Doppler, Thomas
Universität Basel, IPNA
Spatenring 145
4055 Basel
thomas.doppler@unibas.ch

Drescher-Schneider, Ruth
Schillingsdorfer Str. 27
A-8010 Kainback bei Graz
ruthdrescher@hotmail.com

Ebersbach, Renate
Archäologischer Dienst des Kanton Bern
Postfach 5233
3001 Bern
renate.ebersbach@erz.be.ch

Eckmeier, Eileen
Universität Zürich, Geographisches Institut
Winterthurerstrasse 190
8006 Zürich
eckmeier@geo.unizh.ch

Felber, Markus
Via Comacini 31
6834 Morbio inferiore
mfelber@ticino.com

Fiebig, Markus
Institut für Angewandte Geologie
Universität für Bodenkultur
Peter Jordan Str. 70
1190 Wien
markus.fiebig@boku.ac.at

Furrer, Heinz
Universität Zürich, Paläontologisches Institut und Museum
Karl Schmid-Strasse 4
8006 Zürich
hfurrer@pim.unizh.ch

Geitner, Clemens
Forschungsstelle Gebirgsforschung: Mensch und Umwelt der Österreichischen Akademie der Wissenschaften
Technikerstr. 21a
A-6020 Innsbruck
clemens.geitner@uibk.ac.at

Gilli, Adrian
Geologisches Institut, ETH Zürich
Universitätsstrasse 16
8092 Zürich
agilli@ufl.edu

Girardclos, Stéphanie
Geological Institute, ETH Zürich
Universitätsstrasse 16
8092 Zürich
stephanie@erdw.ethz.ch

Graf, Angela
Institut für Geologie, Universität Bern
Baltzerstrasse 1+3
3012 Bern
angela.graf@geo.unibe.ch

Graf, Hansruedi
Dorfstrasse 40
8214 Gächlingen
h.graf@mbn.ch

Guélat, Michel
Creux de la Terre 11
2800 Delémont
mic.guelat@bluewin.ch

Haeberli, Wilfried
Geographisches Institut, Universität Zürich
Winterthurerstrasse 190
8057 Zürich
haeberli@geo.unizh.ch

Hager, Daniela
Spalenberg 55
4051 Basel
daniela.hager@stud.unibas.ch

Hajdas, Irka
AMS Labor, ETH Hönggerberg
HPKZ 27
8093 Zürich
hajdas@phys.ethz.ch

Haldimann, Peter
Dr H. Jäckli AG
Albulastr. 55
8048 Zürich
haldimann@jaeckli.ch

Havlicek, Elena
Office et Musée d'archéologie, Neuchatel
E. Argand 11 CP158
2000 Neuchatel
elena.havlicek@unine.ch

Hecker, Dominique
Rép. et canton du Jura, Office du patrimoine historique
Hôtel des Halles, Case postale 64
2900 Porrentruy
dominique.hecker@jura.ch

Heer, Aleksandra
Geographisches Institut, Universität Bern
Hallerstrasse 12
3012 Bern
heer@giub.unibe.ch

Heitzmann, Peter
Niederriedweg 110
3019 Bern
heitzmann@bluewin.ch

Honegger, Mathieu
Institut de Préhistoire et des sciences de l'Antiquité
Université de Neuchâtel, Laténium
Espace Paul Vouga
2068 Neuchatel
Matthieu.Honegger@ne.ch

Huber, Adrian
Kantonarchäologie
Denzlerstrasse? 36
8004 Zürich
adrian.huber@bd.zh.ch

Hüster Plogmann, Heide
IPNA, Universität Basel
Spatenring 145
4055 Basel
heide.huester-plogmann@unibas.ch

Ilgner, Jana
Geographisches Institut, Universität Bern
Hallerstrasse 12
3012 Bern
ilgner@giub.unibe.ch

Ivy-Ochs, Susan
Teilchenphysik, ETH Hoenggerberg
8093 Zürich
ivy@phys.ethz.ch

Jacomet, Stefanie
Universität Basel, IPNA
Spatenring 145
4055 Basel
stefanie.jacomet@unibas.ch

Jeannin, Piere-Yves
Institut Suisse de Spèléologie ISSKA
CP 818
2300 La Chaux-de-Fonds
pierre-yves.jeannin@isska.ch

Jordan, David
Institute of Archaeology, University of Bern
Längass-Strasse 10
3012 Bern
david.jordan@arch.unibe.ch

Jörin, Ulrich
Tägernstrasse 9
8127 Forch/ZH
ujoerin@bluewin.ch

Jost, Monika
Eidgenössisches Departement für Umwelt, Verkehr, Energie und Kommunikation UVEK, Bundesamt für Energie BFE
Mühlestrasse 4
3063 Ittigen
Monika.Jost@bfe.admin.ch

Leroux, Aurélie
Université de Franche-Comté, Département de Géosciences
16, route de Gray
F-25030 Besancon cedex
aurelie.leroux@univ-fcomte.fr

Leuenberger, Markus
Klima- und Umweltphysik, Universität Bern
Sidlerstrasse 5
3012 Bern
leuenberger@climate.unibe.ch

Lowick, Sally
Institut für Geologie, Universität Bern
Baltzerstrasse 1+3
3012 Bern
lowick@geo.unibe.ch

Mäder, Andreas
Kantonsarchäologie Zürich
Stettenbachstr. 7
8600 Dübendorf
andy.maeder@bd.zh.ch

Magny, Michel
Laboratoire de Chrono-Ecologie
UMR 6565 du CNRS, UFR des Sciences et Techniques
16 route de Gray
F-25030 Besancon
michel.magny@univ-fcomte.fr

Maisch, Max
Geographisches Institut, Universität Zürich
Winterthurerstr. 190
8057 Zürich
maisch@geo.unizh.ch

May, Jan-Hendrik
Geographisches Institut, Universität Bern
Hallerstrasse 12
3012 Bern
may@giub.unibe.ch

Messerli, Bruno
Geographisches Institut, Universität Bern
Hallerstrasse 12
3012 Bern
bmesserli@bluewin.ch

Monbaron, Michel
Departement Geosciences, Uni. Fribourg
4, ch. Du Musée
1700 Fribourg
michel.monbaron@unifr.ch

Müller, Werner
Service cantonal d'archéologie, Laboratoire d'archéozoologie
Chemin de Maujobia 8
2000 Neuchâtel
werner.mueller@ne.ch

Nielsen, Ebbe
Kantonsarchäologie
Libellenrain 15
6002 Luzern
Ebbe.Nielsen@lu.ch

Nyffenegger, Franziska
Berner Fachhochschule, Architektur, Holz und Bau
Pestalozzistrasse 20, Postdach 1058
3401 Burgdorf
Franziska.Nyffenegger@bfh.ch

Preusser, Frank
Institut für Geologie, Universität Bern
Baltzerstrasse 1+3
3012 Bern
preusser@geo.unibe.ch

Pümpin, Christine
IPNA, Universität Basel
Spatenring 145
4055; Basel
chpuempin@intergga.ch

Recasens, Cristina
Section des Sciences de la Terre
Rue des Maraîchers 13
1205 Genève
recasen9@etu.unige.ch

Rentzel, Philippe
IPNA, Universität Basel
Spatenring 145
4055 Basel
Philippe.Rentzel@unibas.ch

Rolli, Marc
Rue Louis Bourguet 5
2000 Neuchâtel
marc.rolli@scnat.ch

Roten, Lorenz
Geographisches Institut, Universität Bern
Hallerstrasse 12
3012 Bern
lorenz.roten@gmail.com

Scapozza, Cristian
Institu de Géographie, Université de Lausanne
Dorigny-Anthropode
1015 Lausanne
cristian.scapozza@unil.ch

Schäfer, Dieter
Hochgebirgsarchäologie am Institut für Geologie
Innrain 52
A-6020 Innsbruck
Dieter.Schaefer@uibk.ac.at

Schibler, Jörg
IPNA, Universität Basel
Spatenring 145
4055 Basel
joerg.schibler@unibas.ch

Serneels, Vincent
Departement Geosciences, Uni. Fribourg
6, ch. du. Musee
1700 Fribourg
vincent.serneels@unifr.ch

Schindelwig, Inga
Institut für Geologie, Universität Bern
Baltzerstrasse 1+3
3012 Bern
inga.schindelwig@geo.unibe.ch

Schlüchter, Christian
Institut für Geologie, Universität Bern
Baltzerstrasse 1+3
3012 Bern
schluech@geo.unibe.ch

Schoeneich, Philippe
Mont-Tendre 16
1007 Lausanne
Philippe.Schoeneich@ujf-grenoble.fr

Schwab, Marco
Böhringer AG
Mühlegasse 10
4104 Oberwill
marco.schwab@boe-ag.ch

Steffen, Damian
Institut für Geologie, Universität Bern
Baltzerstrasse 1+3
3012 Bern
steffen@geo.unibe.ch

Strasky, Stefanie
Institut für Isotopengeologie & Mineralogische Rohstoffe,
ETH Zürich, Clausiusstrasse 25
8092 Zürich
strasky@erdw.ethz.ch

Tinner, Willy
Departement Umweltwiss., ETH Zürich
Universitätsstrasse 16
8092 Zürich
willy.tinner@env.ethz.ch

van der Knaap, Pim
Institut für Pflanzenwissenschaften, Universität Bern
Altenbergrain 21
3013 Bern
knaap@ips.unibe.ch

van Leewen, Jacqueline
Institut für Pflanzenwissenschaften, Universität Bern
Altenbergrain 21
3013 Bern
vanleeuwen@ips.unibe.ch

Vescovi, Elisa
Institute of Plant Sciences, University of Bern
Altenbergrain 21
3013 Bern
elisa.vescovi@ips.unibe.ch

Waldmann, Nicolas
Earth Sciences Section, University of Geneva
Rue des Maraichers 13
1205 Geneva
Nicolas.Waldmann@terre.unige.ch

Walter-Simonnet, Anne-Véronique
Géosciences, Université de Franche-Comté
16 route de Gray
F-25000 Besancon
anne-veronique.walter@univ-fcomte.fr

Walthard, Peter
Bleihollenweg 2
4242 Laufen
Peter.Walthard@stud.unibas.ch

Weidmann-Dutoit, Marc
Sentier du Molard 3
1805 Jongny
weidmann-dutoit@bluewin.ch

Wild, Dölf
Stadt Zürich, Amt für Städtebau, Stadtarchäologie Zürich
Lindenhofstrasse 19
8021 Zürich
doelf.wild@zuerich.ch

Zahno, Conradin
Geologisches Institut, Universität Bern
Baltzerstrasse 1+3
3012 Bern
zahno@geo.unibe.ch

Zech, Roland
Geographisches Institut, Universität Bern
Hallerstrasse 12
3012 Bern
zech@giub.unibe.ch

Zwahlen, Peer
Dr. M. Kobel + Partner AG, Büro für Techn. Geologie
Grossfeldstr. 74
7320 Sargans
peter.zwahlen@btgeo.ch