EUG XI

Theme SS

Special Symposia

EUG XI

Symposium SS01

Correlation and Synchronisation of High Resolution Terrestrial Sediment Profiles (An ELDP-Initiated Symposium)

Convenors

Achim Brauer
Jörg F.W. Negendank

Sunday PM Session

SS01 : SUpm25 : F1
Highly Laminated Sediments of Lac Pavin, A Maar Lake in the Auvergne/France – Results of Sedimentology and Microstratigraphy

Thomas Kulbe (tkulbe@gfz-potsdam.de)[1], **Cathrin Brüchmann** (cat@gfz-potsdam.de)[1], **Martina Stebich** (martina.stebich@fossi.uni-weinar.de)[2] & **Jörg F. W. Negendank** (neg@gfz-potsdam.de)[1]
[1] GeoforschungsZentrum Potsdam, Telegrafenberg Haus C, 14473 Potsdam, Germany
[2] Forschungsinstitut und Naturmuseum Senckenberg, Steubenstr. 19 a, 99423 Weimar, Germany

Lac Pavin located in the volcanic field of Puy de Dome, Auvergne ca. 1200 m a.s.l. has a diameter of ca. 800 m and a maximum water depth of ca. 96 m. A 182 cm long sediment core from the deepest part of the lake is entirely laminated. The uppermost 92 cm of unconsolidated surface sediments (water contents of 85%) were recovered by freeze core technique. The silty sediment shows distinct laminae of diatoms, vivianite, and siderite. Main components of the laminae are different diatom species. Layers consisting mainly of *Aulacoseira spp.* and/or *Asterionella spp.*/*Stephanodiscus spp.* blooms change with layer comprising mostly benthic species like *Epithemia spp.*, *Pinnularia spp.*, *Fragillaria spp.*, *Rhopalodia spp.*, and others as well as siderite, vivianite, and organic particles. According to changes of seasonal diatom blooms these laminations are of annual origin and changes in the diatom assemblage indicate sensitive environmental changes during the last few millennia and their relation to climate variability. The age model is cross checked by radiometric age determinations (^{14}C, ^{137}Cs). AMS Radiocarbon data show an inverse age-sediment depth relation possibly due to volcanic sources (the origin of Lac Pavin is estimated at ca. 6000 years BP in the literature). Besides that, the sediments were sub-sampled every centimetre for a multi-proxy-approach (geochemistry, pollen, diatoms, physical properties).

SS01 : SUpm26 : F1
Weichselian Late Glacial Lake-Level and Stable Isotope Records from the French Jura

Gerard Aalbersberg (aalg@geo.vu.nl)[1] & **Michel Magny** (michel.magny@univ-fcomte.fr)[2]
[1] Faculty of Earth Sciences, Vrije Universiteit Amsterdam, De Boelelaan 1085, Amsterdam, NL-1081 HV, The Netherlands
[2] Laboratoire de Chrono-Ecologie, UFR des Sciences et Techniques, 16 route de Gray, 25 30 Besançon, France

Over the past years, detailed lake-level records for the Younger Dryas and the larger part of the Holocene have been reconstructed from authigenic lake carbonates from lakes in the French Jura. For the Late Glacial Interstadial (GI-1) however, such a record is not yet available. Cores from two infilled lakes (Pré de l'Etang, 701 m a.s.l. and Le Lautrey, 790 m a.s.l.) were investigated using various methods, including stable isotope ($\delta^{18}O$ and $\delta^{13}C$), pollen, chironomid and carbonate facies analyses to provide an as complete as possible picture of Late Glacial palaeohydrology, palaeoclimate and palaeo-ecology of the French Jura.

High resolution stable isotope measurements provide both palaeoclimatological information as well as a chronological framework that allows the other results to be tied in with GRIP ice-core stratigraphy. Preliminary results indicate that lake carbonate accumulation started with the onset of the climatic amelioration of the Bølling (GI-1e). The $\delta^{18}O$ records of both cores show that the well-known climate fluctuations of the Aegelsee and Gerzensee Oscillations (GI-1d and GI-1b, respectively) are registered along with several other, smaller events, although the magnitude of these climatic deteriorations appears to vary from lake to lake. The $\delta^{13}C$ records are predominantly controlled by the influence of the developing vegetation, in particular the Betula-Pinus forest around the lakes.

Pollen analyses confirm the presence of climate variations, but also show that the vegetation reacted differently to stages GI-1d and GI-1b. Stage GI-1d is recorded as a clear decline in *Betula* values, with little to no reaction of *Pinus*, whereas stage GI-1b only registers as a small (5-10%) decrease in *Pinus* pollen. Other climatic events, such as the immediately above the Laacher See Tephra, locally appear to have had a much greater impact on the ecosystem.

Application of stable isotopes and carbonate facies analysis on Late Glacial lake sediments has resulted the first high-resolution lake-level curve for the French Jura for this period. Information gathered from other proxy data helps to improve the palaeoclimatic interpretation of this lake-level record.

SS01 : SUpm27 : F1
Surface Scanning Magnetic Susceptibility and Multiproxy Data for Characterisation of Late Glacial Environmental Changes in the Lautrey Lake (Jura, France)

Boris Vannière (boris.vanniere@univ-fcomte.fr)[1], **Gilles Bossuet** (gilles.bossuet@univ-fcomte.fr), **Gerard Aalbersberg** (aalg@mailhost.geo.vu.nl)[2], **Michel Magny** (michel.magny@univ-fcomte.fr)[3], **Pascale Ruffaldi** (pascale.ruffaldi@univ-fcomte.fr), **Carole Bégeot** & **Anne-Véronique Walter-Simonnet**
[1] Laboratoire de Chrono-Ecologie UMR 6565 CNRS, UFR Sciences, Université de Franche-Comté, 16, rt de Gray 25030 Besançon, France
[2] Faculteit der Aardwetenschappen, Vrije Universiteit Amsterdam, De Boelelaan 1085, 1081 HV Amsterdam, Neederlands
[3] Laboratoire de Chrono-Ecologie UMR 6565 CNRS, UFR Sciences, Université de Franche-Comté, 16, rt de Gray 25030 Besançon, France

The abrupt climatic changes which succeeded one another over a short period from the last glacial maximum to the climatic optimum of Holocene are certainly of crucial interest for our understanding of climate mechanism. The studies about the evolution of the icecap, and in particular the analysis of the oxygen isotopes variations, allowed to establish the principal phases of the Late Glacial on a global scale (GRIP Members, 1993). Contrary to these studies, the ecological modification connected with these climatic evolutions can be recognised only in the regional scale. Then the problem is to link chronologically these two perceptions of the environmental evolutions (Amman and Oldfield, 2000).

Numerous mineral magnetic studies of lake sediments have shown the potential of magnetic method to correlate lakes cores, to identify minerals and sediment sources and to evaluate environmental changes (Verosub and Roberts, 1995). Magnetic susceptibility, which reflects concentration and grain size of ferromagnetic and ferrimagnetic materials in sediments, is one of the classical magnetic parameter. Magnetic susceptibility is commonly used to assess erosion intensity by identifying allochtonous material in lake sediments (Stochkausen and Zolitschka, 1999). However magnetic susceptibility values can also be influenced by numerous other processes like authigenous formation of ferrimagnetic phases in lake, bacterial activity, dilution or diagenesis (Verosub and Roberts, 1995). Therefore most of the authors agree to say that initial magnetic susceptibility is controlled directly or indirectly by climate (Lanci et al., 1999, Williams et al., 1996).

This paper presents surface scanning magnetic susceptibility data obtained from five continuous late glacial sediment sequences in the Lautrey lake (Jura, France). Lautrey lake is a small size basin of 10 ha. The use of surface scanning sensor gives high stratigraphical resolution results which permit to identify the thinner lithological variations as tephra layers. Whole core susceptibility is used to assess correlation of lithological successions from various parts of the basin. Then the magnetic susceptibility record is evaluated in relation to pollen and mineralogy analysis in terms of environmental changes connected with erosion, water level change, and $\delta^{18}O$ - $\delta^{13}C$ variations. A model of sedimentological accumulation process is proposed for the Lautrey lake infillings, with particular attention to the complementary signal obtained from the different cores. These types of investigations allowed to construct a magnetic stratigraphy of the Late Glacial record and to highlight local responses of a geosystem to global climatic changes.

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SS01 : SUpm28 : F1
Comparison of Lake Van and Greenland Ice Core Records: The Late Pleistocene/Holocene Transition

Guenter Landmann (landmann@geowiss.uni-hamburg.de) & **Stephan Kempe**
Geological-Palaeontological Institute, University of Technology Darmstadt, Schnittspahnstr. 9, 64287 Darmstadt, Germany

Sediment core K10 from Lake Van, eastern Turkey, provides a continuous varve record back to 14,570 a BP. Chronological, geochemical and mineralogical details of this record were discussed elsewhere (e.g. Landmann et al., 1996a,b). Its annual sediment deposition rate (SDR), depends mainly on lake level variations (by shifting the distance between the fluvial input source and the position of K10 and by causing increased precipitation of carbonates during evaporative phases) and river input. The lake level curve was reconstructed from this record and was extended back to 20,000 a BP by using laminated lake sediment terraces.

During the LGM, Lake Van stood about 70 m higher than today. Between 18,900 and 15,000 a BP, the lake dried up completely, i.e. its level fell by more than 500 m. The water balance became positive again at >14,570 a BP. This was possibly simultaneous with the onset of an abrupt increase of snow accumulation and $\delta^{18}O$ in the GISP2 ice core (e.g. Cuffey et al., 1997, Dahl-Jensen et al., 1993, Grootes et al, 1993). In the succeeding 2000 years, both parameters decreased in Greenland ice, while Lake Van level continued to rise and attained a maximum when snow accumulation and $\delta^{18}O$ reached a minimum, after a sudden drop, at 12,600 a BP. During the next two millenniums, general trends reversed, i.e. the lake level decreased while snow accumulation and $\delta^{18}O$ increased. A strong peak, beginning at 11,840 a BP and culminating 100 years later, initiated a period of elevated SDR with sediments of high quartz and low aragonite content in Lake Van. An abrupt increase of snow accumulation and $\delta^{18}O$ found in Greenland ice at 11,600 a BP is not reflected in Lake Van SDR. In addition, a sudden rise of SDR at 10,920 a BP (due to a lake level drop), and a strong peak with a maximum at 10,500 a BP - caused by flushing and enhanced precipitation - are observed, while no conspicuous changes are revealed in the Greenland records. This temporary lack of synchronisation might be caused by different response times of the two depositional systems. What is known in Greenland ice cores as the '8.2 ka event' is paralleled in Lake Van by a SDR peak, centered at 8,260 a BP and caused by flushing, following a minor lake level drop.

In conclusion, the onsets of both the Late Pleistocene oscillations and of the Holocene climate plateau at around 10,000 a BP, appear simultaneously in Greenland and Lake Van records, while the fluctuations in between occur asynchronously. Results suggest that the establishment of chronozones may lack significance when climate changes are discussed at a global level.

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SS01 : SUpm29 : F1
Late Pleistocene and Holocene Palaeoclimate Record from the Dead Sea, Israel

Claudia Migowski (migo@gfz-potsdam.de)[1],
Sushma Prasad (sushma@gfz-potsdam.de)[1],
Jörg F. W. Negendank (neg@gfz-potsdam.de)[1] &
Mordechai Stein (motis@vms.huji.ac.il)[2]
[1] GeoForschungsZentrum Potsdam, PB 3.3 Sedimente und Beckenbildung, Telegrafenberg, 14473 Potsdam, Germany
[2] Institute of Earth Sciences, The Hebrew University of Jerusalem, 91904 Jerusalem, Israel

Results of a study to decipher the consequences of shifts in wind regimes and the resulting changes in precipitation in the eastern Mediterranean region during late Quaternary are presented. Samples were collected from outcrops of White Cliff Member of Lisan Formation in Massada, and cores were raised from the western shore of the Dead Sea.

Mineralogy, and counting and measurement of laminae thickness were carried out on thin sections. Radiocarbon dates were obtained from aragonite and organic matter.

The entire White Cliff Member from Massada and parts of the Holocene sequence, consist of alternating laminae of white aragonite and dark detritus. The white laminae are composed of authigenic aragonite, possibly the annual summer precipitate of lake waters. The detrital material consists of clays, fine-grained calcite, dolomite, quartz and unaltered plagioclase resulting from flood inputs into the lake during winter rains.

Laminar gypsum is absent in the White Cliff Member indicating that during this period the density stratification was intact and there was no large scale exchange between the two water masses (Stein et al., 1997). However, gypsum of diagenetic origin, occasionally with inclusions of primary detrital sediment is present. During this period the lake was saline and chemical precipitation was dominant. The deposition of White Cliff Member ceased ~15 ka BP (ref. in Niemi et al., 1997) due to a major drop in lake level.

Laminae counting of White Cliff Member yielded dates significantly younger than that obtained by the radiocarbon dating of aragonite. However, counted parts of Holocene sediments show a good agreement between laminae counting and radiocarbon dates on organic matter.

The highly arid period reflected by the halite base of the Ein Gedi cores during early Holocene is followed by increasing freshwater influx indicating a wetter (and warmer?) period up to 6.5 ka. Slightly drier conditions are represented by the occurrence of gypsum layers between 6.5 and 5 ka. From 5-3.5 ka a higher sedimentation rate and a lower amount of evaporites indicate a shift back to wetter conditions. A sudden increase in aridity from 3.5 ka to recent times is reflected by the presence of gypsum layers and secondary halite cubes at the top of the Ein Gedi cores.

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SS01 : SUpm32 : F1
Linking Mediterranean Terrestrial and Marine Paleorecords using the High-Resolution Tephrochronological Record of the Last 100 ka from Lago Grande di Monticchio (Southern Italy)

Sabine Wulf (wulf@gfz-potsdam.de)[1],
Achim Brauer (brau@gfz-potsdam.de)[1],
Ute Frank (ufrank@gfz-potsdam.de)[1],
Jens Mingram (ojemi@gfz-potsdam.de)[1],
Jörg F. W. Negendank (neg@gfz-potsdam.de)[1] &
Bernd Zolitschka (zoli@uni-bremen.de)[2]
[1] GeoForschungsZentrum Potsdam, PB 3.3 - Sedimente und Beckenbildung, Telegrafenberg, 14473 Potsdam, Germany
[2] Geomorphologie und Polarforschung, Institut für Geographie, Universität Bremen, Celsiusstrasse, 28359 Bremen, Germany

Partly laminated sediments recovered from Lago Grande di Monticchio, a maar lake in the Monte Vulture volcanic massif (southern Italy), provide not only detailed information about the regional climatic and environmental development of at least the past 100 ka but also contain numerous tephra layers (n=344) which have been precisely dated by the independent chronology of Monticchio sediments. This chronology has been established from a combination of varve counts and high resolution sedimentation rate calculations based on microscopic sediment investigation and confirmed by radiocarbon dating of sediments and $^{40}Ar/^{39}Ar$ dating of tephras. Based on chemical, mineralogical and rock magnetic properties most of the tephra deposits have been attributed to high-explosive eruptions of Italian volcanoes, particular to the still active Campanian volcanic district (Southern Italy), which represents an area of high volcanic risk for Naples and its surrounding towns. In the first place, the correlation of tephra layers to specific, age-dated volcanic events has demonstrated that the lacustrine sediment record of Monticchio documents the whole known spectrum of plinian to subplinian activity of the Somma-Vesuvius (< 27 ka BP) and the island of Ischia (< 100 ka BP). In consideration of the completeness of tephra deposition, it was possible to elaborate a new stratigraphic framework for the explosive volcanism of the Phlegrean fields which reaches back to more than 100 ka BP. A small number of tephra layers documented in the Monticchio record has been correlated with widely distributed pyroclastic products of the Roman (Alban Hills, Sabatini Hills), Sicilian (Etna, Pantelleria) and Eolian volcanoes. These, together with marker tephras like the “Avellino Tephra” (Vesuvius, 4 ka BP), the “Neapolitan Yellow Tuff” (Phlegrean Fields, 14 ka BP), the “Biancavilla Ignimbrite” (Etna, 17 ka BP), the “Campanian Ignimbrite” (Phlegrean Fields, 37 ka BP) and the “Monte Epomeo Green Tuff” (Ischia, 56 ka), are key horizons for connecting the Mediterranean terrestrial record with marine sequences from the Adriatic, Tyrrhenian and Ionian Seas. A correlation with other terrestrial European records (e.g. Lac du Bouchet, Lac de Joux) has been established by comparison of geomagnetic palaeosecular variations (Brandt et al., 1999) and palynostratigraphy (Allen and Huntley, 2000).

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SS01 : SUpm33 : F1
Volcanological Features of the Piànico Tephra: A New Stratigraphical Marker of the Early Middle Pleistocene in Italy

Daniele L. Pinti (pinti@geol.u-psud.fr)[1],
Xavier Quidelleur[1],
Sergio Chiesa (cnrbg@uninetcom.it)[2],
Cesare Ravazzi[2] & **Pierre-Yves Gillot**[1]
[1] Laboratoire de Géochronologie, Université Paris SUD, Bat 504, 91405 Orsay Cedex, France
[2] CSGAQ - CNR, Sezione di Bergamo, Piazza Cittadella 4, 24129, Bergamo, Italy

A distal tephra has been recently discovered in the varved lacustrine succession of Piànico-Sèllere, Southern Alps, Italy. The stratigraphical succession of Piànico-Sèllere is one of the best-preserved interglacial sedimentary assemblages, south to the Alps. It has been regarded since the half of the last century as the best site documenting the “Riss-Wurm” interglacial, south to the Alps. The tephra is graded, constantly 1 cm thick all over the exposed lateral extent of the varved unit, and is set into the uppermost part of the light (spring/summer) layer, 0.1 mm to the subsequent dark (winter) layer. This indicates that the pyroclastic fall deposited undisturbed in the deep lacustrine environment of Pianico, and that the eruption took place shortly before the end of the summer. The tephra is composed up to 90% of pumice shards, and 10% of phenocrists. EPMA analysis showed that the phenocristic phase is composed of oligoclase-andesine, orthoclase and biotite. EPMA and ICP-MS analysis of the pumice shards shows that the tephra is of trachytic composition with a strong shoshonitic affinity. Rare earth element analysis is in progress to identify precisely the source, which is located probably in Central or Southern Italy. The K-Ar dating of the juvenile pumiceous phase gave an age of 779±8ka. This age is supported by paleomagnetic measurements in the sedimentary sequence of Piànico-Sèllere. A succession of reverse and normal polarity directions was recorded at the base and the top of the varved sequence of Piànico. This transition can reasonably be identified as the Matuyama-Brunhes with the assigned age of 780 ka. The age of 779±8 ka assigned to the varved unit of Pianico is much older than that of the last interglacial, which was previously suggested. The Piànico tephra represent thus the first stratigraphical marker of an interglacial so far unsettled in the Southern Alps.

SS01 : SUpm34 : F1
High and Low Resolution Geochemical Records of the Kalya Platform and Ridge in Central Lake Tanganyika: Weathering, Biological and Redox Processes

Damien Cardinal (dcardinal@africamuseum.be)[1],
Luc André (landre@africamuseum.be)[1],
Pierre-Denis Plisnier (pierre-denis.plisnier@arcadis.be)[1],
Kiram Lezzar (klezzar@syr.edu)[2],
Andrew Cohen (acohen@geo.arizona.edu)[3],
Meagan Eagle (akeagle@stanford.edu)[4],
Derrick Zilifi[5] & **Valentine Michelo**[5]
[1] Dept. of Geology - Royal Museum for Central Africa, Leuvensesteenweg, 13, B-3080 Tervuren, Belgium
[2] 204 Heroy Geology Laboratory, Department of Earth Sciences - Syracuse University, Syracuse, NY 13244-1070, USA
[3] The Nyanza Project - Dept. of Geosciences, The University of Arizona, Tucson AZ 85721, USA
[4] Geological and Environmental Sciences, Stanford University, Palo Alto CA94305-2115, USA
[5] Department of Geology, University of Zambia, Lusaka, Zambia

East African Rift Lakes have a great interest for paleoreconstructions because of the presence of seasonal laminations in sediments (Pilskan & Johnson, 1991) and the succession of climatically driven water level changes, that have drastically modified the biology and geochemistry of these lakes (Johnson, 1996). Although numerous investigations of paleolimnology have been made (cf. in Johnson & Odada, 1996), few have focussed on trace element geochemistry (e.g., Brown et al., 2000), especially for Tanganyika. In this study we have analysed the trace and major element composition of two cores (1.7 m length) raised during the Nyanza project from Central Lake Tanganyika: LT00-02 from the eastern coastal slope adjacent to Kalya ridge (309 m) and LT00-03 from the northern end of the ridge (608 m). Lithology, lamination counting, statistical calculations and previous studies on similar depositional environment suggest that these cores cover approximately ~1,700yrs and ~17,000yrs respectively (^{14}C dating should be available soon).

LT00-02 records events with a high resolution (annual to decadal) and consequently, the geochemical signals fluctuate highly. Sediments have abnormally low K/Al ratios (< 0.20) compared to average shale values (0.31). Moreover there is a sharp change from very low K/Al (0.16) in diatom-rich laminations from the upper 40 cm to higher K/Al ratios (0.19) in enriched clay laminations from 40 cm to 150 cm. LT00-02 nearshore location allows to record seasonal laminations of short weathering and/or runoff events. This can be seen, for instance, in the Nb/Ta ratios, which oscillate from 15 to 53 between 100 and 140 cm, tracing the sporadic erosion of a lithogenic source characterised by higher Nb/Ta ratios. These Nb/Ta events are also seen, condensed, in the upper 30 cm of LT00-03 and therefore could be used as a tool to correlate these two cores.

In LT00-03, the Al contents are lower in the upper 30 cm and below 110 cm, corresponding very well to the diatom-rich zones. U/Al ratios and C_{org} are higher during these time intervals. Hence, these high biological productivity periods may have induced a more reducing environment, also favouring the preservation of organic carbon. The occurrence of these events might be correlated to a larger river runoff as shown by variable input of the Nb enriched sedimentary source. This runoff could have supplied additional nutrients. In contrast, the period between 60 and 100 cm evidences a more stable depository environment.

These geochemical results are interpreted in term of paleoenvironmental changes. The high-resolution core especially focuses on runoff imprints, whereas LT00-03 also shows redox and biological variations over time scale through the Late Pleistocene and Holocene. Comparison with additional data (e.g., other element contents and limnological results) and previous studies will allow a better understanding of the relationship between catchment area, water-column processes and low latitude continental records of global changes.

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SS01
High Resolution Terrestrial Sediment Profiles

SS01 : SUpm35 : F1
The Huguang Maar Lake (Huguangyan) – A Long, Continuous and High Resolution Archive of Palaeoenvironmental and Palaeoclimatic Changes from the South China Sea Coast

Jens Mingram (ojemi@gfz-potsdam.de)[1], **Georg Schettler**[1], **Norbert Nowaczyk**[1], **Xiangjun Luo**[2], **Huoyuan Lu**[2], **Gergana Yancheva**[1], **Jiaqi Liu** (liujq@igcas.igcas.ac.cn)[2] & **Jörg F. W. Negendank**[1]

[1] GeoForschungsZentrum Potsdam, Telegrafenberg, Haus C, Potsdam, 14473, Germany

[2] Institute of Geology, Chinese Academy of Sciences, PO Box 9825, 100029 Beijing, China

The Huguangyan is a small, 20 m deep maar lake located within an inactive volcanic field on the northern coast of the South China Sea. The longest section from several overlapping drill sites containing more than 45 m of lake sediments, provided a ca. 78,000 - year complete record of local palaeoclimatic and palaeoenvironmental changes. This region experienced variable influences from the SE-Asian summer monsoon, the winter monsoon and changing sea levels. Our interpretations are based on high-resolution dry density and magnetic susceptibility data, pollen investigations, estimations of total organic and inorganic carbon, total nitrogen, biogenic silica and ^{14}C age determinations mainly derived from single leaves. During the Last Glacial Stage sudden shifts of the palaeoenvironmental conditions at the Huguangyan site correspond well with the timing of palaeo-climate change known from marine and ice core records. However, the Huguangyan record sometimes shows an anticyclic behaviour with a relatively warm and humid MIS 4 and a climatic deterioration at the beginning of the MIS 3. In contrast to the millennial-scale fluctuation between stadials and interstadials known from Greenland ice core records, the chronological equivalent of MIS 3 at the Huguangyan site is characterised by a warm and humid interval between 48,000 and 40,000 years BP and a long-lasting, stable cool and dry period between 40,000 years BP and the onset of Termination I. However, at Termination I the Huguang maar record shows striking similarities with high resolution records from the South China Sea and the Greenland ice cores. During the Holocene there are more pronounced amplitude changes, especially in the high-resolution physical data set than during the full glacial stage. The early Holocene monsoon maximum is followed by a dryer period between 7,000 and 5,000 years cal BP. Such a pattern has also been reported from marine records of the South China Sea (Wang et al. 1999). The onset of a perceptible human influence could be inferred at about 4,000 years ago from the increasing sedimentation rates and changes in the pollen spectrum.

Wang L, Sarnthein M, Erlenkeuser H, Grimalt J, Grootes P, Heilig S, Ivanova E, Kienast M, Pelejero C & Pflaumann U, *Marine Geology*, **156**, 245-284, (1999).

SS01 : SUpm36 : F1
The Lake Baikal Drilling Project: A Decade's Effort to Extract the Paleoclimatic and Tectonic History of Asia from the World's Deepest Lake

Douglas Williams (doug.williams@schc.sc.edu)[1], **Michail Kuzmin** (mikuzmin@igc.irk.ru)[2], **Eugene Karabanov** (ekarab@geol.sc.edu)[1], **Alexander Prokopenko** (sasha@geol.sc.edu)[1] & **Galina Khursevich** (khurs@ns.igs.ac.by)[3]

[1] Geology Dept., USC, Columbia, SC, 29208, USA

[2] Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences, Irkutsk, 664033, Russia

[3] Institute of Geological Sciences, National Academy of Sciences of Belarus, Minsk, 220141, Belarus

Lake Baikal, the world's deepest, largest and oldest extant freshwater lake, is a natural laboratory for studying a wide variety of modern and ancient geological, biological-ecological and hydrological-atmospheric processes related to global change. Baikal's thick sedimentary cover, undisturbed by the growth and decay of high latitude continental ice sheets, makes the Baikal sediments ideal for obtaining important records of continental climate change. These records are unparalleled relative to other terrestrial deposits in terms of the combination of both temporal resolution and duration. Not only can these sediments be used to understand the tectonic and structural development of the Baikal Rift Zone, one of the world's most active continental rift zones, but also to determine the relationship between climate change and the biotic evolution of geographically isolated populations. These populations are expressly represented by well-preserved and rich assemblages of diatoms and chrysophytes, phytoplankton which are important members of the dominant primary producers of Lake Baikal's ecosystem.

The scientific goals the Baikal Drilling Project (BDP) were both comprehensive and integrated: a) Understand the responses of Baikal's limno-ecosystem and watershed to forcing from both external and internal dynamics of the Earth's climate system; b) Determine the evolution of the Baikal sedimentary basin in response to rifting, uplift, faulting and changes in weathering rates of the surrounding country rock; c) Determine a high resolution record of the evolution of the abundant diatom flora.

Five drilling campaigns were organized and executed in 1993, 1996, 1997, 1998 and 1999. Highlights of the latest scientific results will be presented.

BDP-93 (Leg I) cores have provided the highest resolution paleoclimatic signals for the last 80,000 years (Prokopenko et al., 1999; Karabanov et al., 2000). Older parts of the cores contain important new information about environmental and tectonic changes during last 760,000 years (BDP members., 1997).

Leg II (BDP-96) drilling made it possible to recover a complete sedimentary record for the last 5 million years. Results demonstrate the impact of external orbital forcing and internal climate system feedbacks (Williams et al., 1997).

Leg III (BDP-97) drilling in the southern basin constitutes the world's first lake drilling in water depths exceeding 1400 m as well as the first sampling of the only known deposits of gas hydrates (Kuzmin et al., 2000).

Leg IV (BDP-98) drilling extended the 5 million year BDP-96 record back to the last 12 million years providing an unparalleled opportunity for both long-term and high resolution paleoclimatic reconstructions in relation to the uplift and development of Asia's major orogenic systems (BDP Members., 2000).

The Leg V (BDP-99) cores contain new information about Lake Baikal watershed evolution and the structural development of the Selenga Delta area of Baikal.

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SS01 : SUpm37 : F1
First Glaciation of Siberia at 2.8-2.5 Ma: Evidence from Lake Baikal Sediments

Eugene Karabanov (ekarab@geol.sc.edu), **Alexander Prokopenko**, **Galina Khursevich**, **Douglas Williams**, **Mikhail Kuzmin**, **Elena Bezrukova**, **Nadia Sochina**, **Svetlana Fedenia** & **Alexander Gvozdkov**

Geology Dept., USC, Columbia, SC, 29208, USA

The continuous sedimentary record from Lake Baikal represents environmental/climatic changes in Central Asia during the last 5 million years. The records of diatom abundance, biogenic silica content, diatom species distributions and lithological composition shows the climatic cooling trend of the Late Cenozoic which started in the Pliocene and are superimposed on the cyclic climatic variations controlled by the Earth's orbital parameters. The Baikal records also reveal the presence of the two cold episodes at the time intervals 2.8-2.5 Ma BP and 1.8-1.5 Ma BP characterized by glaciation at their maximum phases. The glaciation at 2.8-2.5 Ma BP recorded in Lake Baikal is the first account of the earliest alpine glaciation in southeast Siberia.

Three glacial intervals from 2.8 to 2.5 Ma BP represent full glacial conditions, similar to those of the Pleistocene glacials. The sediments of these intervals consist of fine clay with dispersed coarse sand and sandy silt lenses, which we interpret as ice-rafted detritus (IRD). Such lithological composition is typical for glacial periods of the Pleistocene (Karabanov et al., 1998). The clay mineralogy in the diatom-barren clay layers of 2.8-2.5 Ma BP is close to that of late Pleistocene glacial clays in Lake Baikal (Solotchina et al., 2001). Diatom content during this interval is very low and drop to zero in clay layers indicating glacial-type depression of diatom productivity. The interval 2.8-2.5 Ma BP in the Baikal record is also characterized by remarkable changes in terrestrial vegetation (Bezrukova et al., 1999) and diatom assemblages. A major biostratigraphic boundary is marked in the Baikal record by a complete disappearance of two diatom genera at 2.8-2.5 Ma time interval.

This early glacial interval of 2.8-2.5 Ma BP in the Baikal record correlates with the beginning of Northern Hemisphere glaciation registered in other parts of the world. The beginning of loess accumulation in China, interpreted as a beginning of Asian glacial ages, started above the Gauss/Matuyama reversal boundary (Zhongli et al., 1992). The first glacial in the European pollen record is also located above this magnetic boundary (Zagwijn, 1997). However, the first glacial interval in the Lake Baikal record is mostly located below this magnetic boundary, early than in Europe and China. The most pronounced glacial conditions occur in the Lake Baikal record at 2.67 Ma BP, which correlates remarkably with the onset of glacial conditions in the subarctic North Pacific region at 2.67 Ma (Prueher and Rea, 1998). The continental record of Lake Baikal contains the majority of climatic events found in marine records and demonstrates that the continental regions of Asia responded to all major changes in the Earth's climate recorded in other long paleoclimate records.

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SS01 : SUpm38 : F1
Evidence for Sub-Milankovitch Events in Lake Baikal Sediments (Siberia)

Hedi Oberhaensli (oberh@gfz-potsdam.de)[1], **Georg Schettler** (georg@gfz-potsdam.de)[1], **Lena Vorobieva** (postmaster@lin.irk.ru)[2] & **Nathalie Fagel** (nathalie.fagel@ulg.ac.be)[3]

[1] GeoForschungsZentrum, Telegraphenberg, D-14473 Potsdam, Germany

[2] Limnological Insitute, Ulan Batorskaia, Irkutsk, Russia

[3] University Liege, Liege, Belgium

It has been shown recently by several authors that today the North Atlantic weather system is not only controlling climate in the adjacent borderlands but also has its influence far into Siberia and Northern China. Lake Baikal as climate archive with a sedimentary record dating far back in time is an ideal location for tracing the influence of North Atlantic derived climate phenomena into the past. For the last 800 kys the cyclic changes of silty clay and diatom-rich clay layers resemble, when tuned to the marine oxygen isotope curve, glacial-interglacial cycles. This monotonous lithological pattern is interrupted by sporadic intercalation of either coarser detrital material and /or increased detrital input. Though they are mostly confined to clayey intervals, occasionally they are observed in diatom-rich intervals. We suggest that these detrital spikes reflect changes in the atmospheric circulation, which are rooting in variations of the North Atlantic regime. Although the timing of the short events during the last 130 kys is not well controlled we propose that they be related to Heinrich-events.

Sunday PO Session

SS01 : SUpo01 : PO
The High Resolution Multi-Proxy-Parameter Network and Synthetic Timescale in KIHZ (Natural Climate Variations in the Holocene)

Markus J. Schwab (mschwab@gfz-potsdam.de), **Jörg F. W. Negendank** (neg@gfz-potsdam.de) & **KIHZ consortium**
GeoForschungsZentrum Potsdam, Telegrafenberg, D-14473, Germany

The German project KIHZ ("Klima in Historischen Zeiten bis 10.000 Jahre vor heute" - "Natural climate variations from 10,000 years to the present day; http://kihz.gfz-potsdam.de") aims to analyse the dynamics of natural climate variations using high resolution palaeoclimate archives and modelling. The research project incorporates all available palaeocimate data, both prehistoric and historic, from a variety of high-resolution continental and marine archives. These include, for example, European varved lake sediments, N-GRIP ice cores, German dendrochronology, Red Sea and Bermuda coral records, and laminated marine sediments (offshore Pakistan). Of fundamental importance for the combination of data analysis with numerical modelling is the construction of a synthetic time scale on a calendar year basis.

Before, however, developing such a synthetic time scale, it is necessary to be able to access all available information on palaeoclimate archives. Thus, the development of an infomation system which can handle the large amount of scientific data from the various climate archives is a basic requirement. Such a system must guarantee both the consistent longterm storage of the proxy data and also provide easy access for interested parties. The preferred system is called PANGAEA (www.pangaea.de). This databank contains all raw proxy data together with related information and evaluated palaeoclimatic data. In addition, we also use published data from other sources, for example, the World Data Center for Paleoclimatology (Boulder, Colorado).

In order to reconstruct the Holocene climate more precisely and to integrate more regional details with higher temporal resolution, we have used a multi-proxy approach, as outlined above. An initial attempt at the construction of a synthetic annual timescale has been based on the varve chronology from the Eifel region (Central Europe). The Eifel region timescale includes two isochrones - the Ulmener Maar Tephra (UMT) at 11.000 vy.BP (varve year before 1950 AD) and the Laacher See Tephra (LST) at 12.880 vy.BP. Correlation of the Eifel chronology with other palaeoclimate archives, for example, ice cores, dendrochronological records, varved lake sediments, has been initiated. There are, however, significant problems inherent in attempting such a broad-based correlation. It is intended that multi-proxy parameter networks will be established for each palaeoclimate archive type for the Holocene period.

SS01 : SUpo02 : PO
Rapid Climate Oscillations during the Early Holocene Recorded in the Varved Sediments of Lake Holzmaar (Germany)

Uta Brathauer (brath@gfz-potsdam.de)[1], **Jörg F. W. Negendank** (neg@gfz-potsdam.de)[1] & **Bernd Zolitschka** (zoli@uni-bremen.de)[2]
[1] GeoForschungsZentrum Potsdam, Telegrafenberg, D-14473 Potsdam, Germany
[2] Universität Bremen, Celsiusstr. FVG-M, D-28359 Bremen, Germany

In the last ten years there has been a growing interest in high resolution (decadal to annual) paleoclimatic studies. Many parts of the climate system are working on subdecadal time scales, for example the 'North Atlantic Oscillation' (NAO) or the 'El Niño - Southern Oscillation' (ENSO). Therefore, it is necessary to investigate the paleoclimate with annual resolution. A broad range of high resolution paleoclimatic records with annual or subannual resolution (e. g. ice cores, corals, and tree rings) are available for the late Holocene. Further back in time such records are scarce. Here we present a continental paleoclimatic record with seasonal resolution from the early Holocene. The varved sediments of Lake Holzmaar contain several sub-layers as winter-clay-layers, spring-diatom-bloom-layers, summer-clay-layers and fall-diatom-bloom-layers, which allow us to resolve the seasonal structure of climatic changes. The results show, that the early Holocene warming trend was interrupted by two short periods (200 - 300 years) of climatic deteriorations. About 300 years after the beginning of the Holocene a first shift in climate took place, which is known as the Preboreal Oscillation. Drastic changes in varve thickness and varve composition indicate cooler and wetter climatic conditions. 800 years after the Preboreal Oscillation a similar climatic shift can be observed in the sediments of Lake Holzmaar, which we call the Boreal Oscillation. Again a rapid and drastic increase in varve thickness and changes in varve composition indicate cooler and wetter conditions during the winter season. These early Holocene oscillations are probably connected to North-Atlantic cooling events, which caused decreased heat transport to central Europe.

SS01 : SUpo03 : PO
Late Quaternary Diatom Stratigraphy and Palaeolimnology of Lake Holzmaar, Germany

Janina Baier (jbaier@gfz-potsdam.de)[1], **Andreas Lücke** (a.luecke@fz-juelich.de)[2], **J. F. W. Negendank** (neg@gfz-potsdam.de)[1] & **Bernd Zolitschka** (zoli@uni-bremen.de)[3]
[1] GeoForschungsZentrum, Telegrafenberg, 14473 Potsdam, Germany
[2] Forschungszentrum, Jülich, 52425 Jülich, Germany
[3] Institut für Geographie, Universität Bremen, 28359 Bremen, Germany

Holzmaar (W-Eifel, Germany) sediments consist of finely laminated diatomaceous varves. Applying several dating-methods, a varve chronology reaching back 23000 calendar years was obtained. Here, the main objective is to study high resolution diatomological, sedimentological and isotope-geochemical analyses in order to reconstruct changes of the palaeo-ecosystem. Moreover, possible leads and lags among proxy-parameters may reflect interrelations between climatic and anthropogenic forcing.

Palaeolimnological proxies are coherent between 6300 and 5100 varve years BP. Diatom-inferred total phosphorus (TP) suggests that Lake Holzmaar was eutrophic to polytrophic. This agrees well with relatively high diatom flux rates, high accumulation rates for biogenic silica and for total organic carbon (TOC). Additionally, the accumulation rate for minerogenic matter was high. A sufficient supply of internal and external nutrients may be inferred to support high diatom productivity.

Lake Holzmaar turned mesotrophic to eutrophic between 5100 and 3300 varve years BP as reflected by a marked change in diatom composition. Simultaneously, accumulation rates for biogenic silica, TOC and minerogenic matter decreased. A cool dry climate with a short growing season that inhibited microbial decay and thus nutrient cycling may have contributed to this change in trophic state.

Eutrophic to polytrophic diatom taxa again dominate between 3300 and 2600 varve years BP. However, diatom plankton flux rates as well as accumulation rates for TOC, biogenic silica and minerogenic matter do not show any drastic change during this period. Possibly Si-depletion occurred when phosphorus enrichment caused an increased Si-demand for diatom production and thus prevented an increase in diatom productivity. Noteworthy is a continuous rise in non-arboreal pollen percentages after 2800 varve years BP. An increase in total phosphorus concentration, probably resulting from intense upwelling of dissolved nutrients from the hypolimnion into the epilimnion, may reflect climate change. Additionally, Bronze Age anthropogenic activities might also have contributed to changes in the lacustrine system.

A successive decrease in diatom-inferred TP suggests that Lake Holzmaar eventually turned mesotrophic to eutrophic around 2000 varve years BP. However, accumulation rate for minerogenic matter shows an abrupt threefold increase around 2600 varve years BP, resulting from Iron Age activities (Zolitschka, 1998). Approximately 20 varve years later, the accumulation rates for biogenic silica, for TOC and for diatom plankton show a marked increase as well. The antagonistic development between diatom accumulation rates (high) and total phosphorus (low) does not have to be contradictive. This could be attributed to a shift to diatom species more efficient at using low phosphorus. In order to determine the cause of the decrease in nutrient supply, further knowledge of lake internal processes is required.

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SS01 : SUpo04 : PO
200 Years Lake History Recorded in the Laminated Sediments of Lake Woserin, Mecklenburg-Vorpommern, Germany

Cathrin Brüchmann (cat@gfz-potsdam.de)[1], **Stefan Dreibrodt** (dreibrodt@landw.uni-halle.de)[2] & **Jörg F. W. Negendank** (neg@gfz-potsdam.de)[1]
[1] GeoForschungsZentrum Potsdam, Telegrafenberg C, 14482 Potsdam, Germany
[2] Universität Halle, Germany

Lake Woserin, a glacial lake of around 212 ha and a maximum water depth of 37 m is located ca. 150 km north of Berlin. Several short cores were recovered from the deepest part of the lake using a gravity corer. Thin section analysis revealed that the uppermost 38 cm of the analysed short core WOS Ia are annually laminated and document the last 80 years. The chronology of the lowermost sediment sequence is based on two AMS ^{14}C dates obtained from a parallel core. The analysed sediment is a diatomaceous gyttja with interbedded calcareous laminae. Limnological changes are clearly documented in the changing diatom assemblages. Diatom samples were prepared in consecutive 0.5 cm increments. So far the diatom distribution of the studied sediment sequence was analysed qualitative and quantitative by light microscopy every 2 centimetres. More than 120 species representing 30 genera were identified. Dominating planktonic taxa are *Stephanodiscus minutulus*, *St. alpinus*, *Cyclotella comensis*, and *Aulacoseira islandica*. Periphytic taxa are found in rather low frequencies (10-30%) with generally decreasing percentages from 1890 onwards. In order to assess stratigraphic changes in lake water pH the diatom taxa were grouped into pH-categories. The dominance of alkaliphilous and alkalibiontic taxa throughout the sequence is reflecting the influence of the calcareous morainal deposits in the catchment area. The striking occurrence of the acidophilous taxon *Tabellaria quadriseptata* with rather high frequencies until 1995 may be due to redepositional processes. Diatom inferred changes in epilimnic total phosphorus content revealed a distinct anthropogenic influence during the analysed time sequence. For example, the intensification of land-use during the 1950s is clearly marked by a rise in inferred trophic stage indicating eutrophic conditions. Since ca. 1970 the diatom assemblage is mainly dominated by eutrophic and polytrophic taxa showing the adaptation to enhanced nutrient supply. Correlation between regional climatic data (mean annual temperature and precipitation) and varve thickness revealed a slight relationship.

SS01 : SUpo05 : PO
Potential for Studies of Laminated Lake Sediments in Russia

Konstantin Kremenetski (costya@geog.ucla.edu)
In-te of Geography RAS, Staromonetny lane 29, Moscow 109017, Russia

Different types of research have provided a lot of information about laminated lake sediments in former Soviet Union. That research however was a part of routine geological research by Geological survey or by investigation for medical purposes.

After publication by Shostakovich (1934) of counting of annual layers in Saki lake (Crimea), no research on annually laminated sediments was carried out in the USSR. All publications were based upon Shostakotich results. However primary data from that research were not preserved.

Several types of laminated lakes are known in Russia and Ukraine (Crimea) now. The lesser known type is miromectic fresh water deep lakes which occur in some parts of European Russia.

In few cases interglacial Eemian lake sediments are reported as being annually laminated. Eemian section of Cheremoshnik near Rostov provides such type of lamination, limited however by early stages of transition from periglacial environment to the Eemian interglacial.

Most evidence comes from Holocene brakish or saline lakes with annually laminated sediments. These lakes are concentrated in southern part of Russia with semiarid climate. Laminated lakes differ by area and depth. Nature and regularity of lamination is still not well known.

SS01 : SUpo06 : PO

Millennial-Scale Events during the Past 130 ka in Lake Baikal Record Indicate the Long-Range Climatic Teleconnections of Continental Interior Asia

Alexander Prokopenko (sasha@geol.sc.edu), **Eugene Karabanov**, **Douglas Williams**, **Galina Khursevich** & **Mikhail Kuzmin**
Geology Department, USC, Columbia, SC 29208, USA

The paleoclimate records from Lake Baikal for the last climatic cycle are among the best in the Northern Hemisphere in terms of resolution, sensitivity and robust age model (Williams et al., 1997). The content of biogenic silica, organic carbon and diatom abundance in the Baikal records reveal a strong rhythmicity making the intervals equivalent to marine oxygen isotope stages MIS 1-4 and substages MIS 5a-5e readily recognized.

During warm intervals MIS 5e and 5c, analogs of the mid-Eemian cooling around 122 Ka BP (Maslin and Tzedakis, 1996) and the Montaigu cooling episode at 103 Ka BP (Reille et al., 1992) are found in the Baikal records. A similarly pronounced cooling episode is observed during the MIS 5a. The presence of the short-lived 'European' events in the Baikal record indicate strong long-range climatic teleconnections of continental interior Asia. During the MIS 3 interval, regular erosional events are observed reflecting abrupt recurrent changes in the regional precipitation regime in semi-arid steppes of Buryatya and Mongolia. As a result of catchment soil erosion, these events led to the deposition of brownish terrigenous layers with detrital carbonate material (Prokopenko et al., 2000). Stratigraphic and AMS-radiocarbon age models allow to confidently correlate the Baikal erosional carbonate events to the intervals of Heinrich layers in the North Atlantic, thus extending a surprisingly strong climatic teleconnection of the remote mid-continent southeast Siberian location with the Dansgaard-Oeschger events and the Bond cycles in the North Atlantic region.

There is evidence of times when teleconnection is broken due to the rapid onset of glacial conditions in continental Asia in response to the insolation minima. For example, the MIS 5/4 transition in the Baikal is recorded as an abrupt irreversible cooling, whereas in European and North Atlantic records the interval of 74-70 Ka BP is characterized by significant warm/cold oscillations. Another abrupt and irreversible cooling is observed in Lake Baikal record at the end of the last interglacial. The Eemian in Siberia was abruptly terminated by a rapid onset of the regional glaciation during MIS 5d (Karabanov et al., 1998). The Baikal MIS 5e/5d transition appears to lead the post-Eemian cold pulses in Europe and in central North Atlantic by 5 to 8 Ka (Prokopenko et al., 2000). This lead suggests that Siberia experienced a much shorter climatic optima than the western part of Eurasia, which was strongly affected by the maritime influence of the North Atlantic.

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