BELQUA

2008 Annual Scientific Workshop

Brussels, 19 March 2008

Rubens Auditorium, Academy Palace, Brussels

The Royal Academies for Science
and the Arts of Belgium

Programme

09.00 - 09.40 **Key-note lecture** *(contribution to the International Polar Year – IPY)*
The SIBClim Community Members (J.-L. Tison, B. Delille, C. Lancelot, L. Chou, S. Becquevort, J. de Jong, V. Schoemann, A. Borges, D. Lannuzel, I. Dumont & F. Masson)
Sea Ice Biogeochemistry and the Climate: Popping up the Sea Ice Cork!

09.40 - 09.55 **M. Sterken, E. Verleyen, D.A. Hodgson, S.J. Roberts, K. Sabbe & W. Vyverman**
Late Quaternary marine and lacustrine paleoproductivity in relation to ice shelf break-up and ice sheet history in Maritime Antarctica

09.55 - 10.10 **K. Heirman, M. De Batist, F. Charlet, J. Moernaut, E. Chapron, M. Pino, R. Brümmer & R. Urrutia**
Seismic stratigraphy of the glacial infill of Lago Puyehue: implications for the timing of deglaciation in the Chilean Lake District

10.10 - 10.25 **K.J.J. Van Landeghem, A.J. Wheeler & N.C. Mitchell**
Remarkably well-preserved palaeo-glaciated terrain offshore Anglesey, UK: implications for the final deglaciation phase of the Irish Sea.

Coffee break

11.00 - 11.15 **D. Van Rooij, F.J. Hernandéz-Molina, J. Iglesias, G. Ercilla, M. Gomez-Ballesteros, E. Llave, B. De Mol, D. Blamart, I.N. McCave & J.-P. Henriet**
Variability of northern MOW pathway dynamics and influence on deep-water ecosystems

11.15 - 11.30 **T.J. Verleye, K. Mertens, S. Louwye, H.W. Arz**
The Holocene salinity changes in the southwestern Black Sea: A reconstruction based on dinoflagellate cysts

11.30 - 11.45 **D. Braekmans, B. Neyt & P. Degryse**
Identification and Provenancing of Regional Ceramic Fabrics in Pisidia (SW Turkey) during the Iron Age to the Late Roman Period

11.45 - 12.00 **J. Moernaut, M. De Batist, F. Charlet, R. Brümmer, R. Urrutia & M. Pino**
Paleoseismological exploration of South-Central Chilean lake sediments using reflection seismic profiling

Lunch break + BELQUA National Commission Meeting

14.00 - 14.15 **M. Van Daele, F. Audemard, C. Beck, M. De Batist, A. Van Welden, J. Moernaut & the Guaiqueri II 2006 Shipboard Party**
Reconstruction of sea/lake-level changes in an active strike-slip basin (Gulf of Cariaco, NE Venezuela)

14.15 - 14.30 **V.M.A. Heyvaert, C. Baeteman, S. Dawson, R. Gehrels & H. Weerts**
The impact of channel shifting, sea-level change and human action on the Holocene coastal evolution of the Lower Khuzestan plain, Iran, Persian Gulf

14.30 - 14.45 **M. Mathys, C. Baeteman & M. De Batist**
From the Pleistocene incision of a palaeo-valley until the Holocene formation of sandbanks: the Quaternary evolution of a shelf with low accommodation potential (Belgian Continental Shelf, southern North Sea)

14.45 - 15.00 **C. Baeteman**
Sediment variations supported by radiocarbon dates as fingerprints for processes of coastal changes in the late Holocene deposits of a tide-dominated coastal lowland

15.00 - 15.15 **B. Notebaert, G. Verstraeten, T. Rommens, B. Vanmontfort, G. Govers, J. Poesen**
A Holocene sediment budget for the river Dijle

15.15 - 15.30 **C. Derese, D. Vandenberghe, E. Paulissen & P. Van den haute**
Optical dating of the Late Glacial dune complex at Opgrimbie (NE-Belgium)

15.30 - 15.45 **G. Ghysels, I. Heyse, J.-P. Buylaert, A.S. Murray, D. Vandenberghe, F. De Corte & P. Van den haute**
Relicts and pseudomorphs of Pleistocene thermal-contraction-cracking wedges in Low Belgium: relict sand wedges, composite-wedge pseudomorphs and optically stimulated luminescence dating of their infill

Coffee break

16.15 - 16.30 **J. Hus**
Some rock magnetic properties of loess-palaeosol sequences in Belgium

16.30 - 16.45 **G. Le Roux, F. De Vleeschouwer, A. Cheburkin, M. Krachler, W. Shotyk, N. Mattielli, N. Fagel**
Holocene Records of Aerosols in Continental Environments (HoRACE)

16.45 - 17.00 **T. Verfaillie, S. Verheyden, H. Cheng, L. Edwards & E. Keppens**
Late Holocene palaeo-climate reconstruction from stable isotope records of stalagmites from three Belgian caves

17.00 - 17.15 **E. Keppens, M. Van Rampelbergh, P. De Geest, H. Cheng, L. Edwards & S. Verheyden**
A Holocene palaeoenvironmental reconstruction based on geochemical research (isotopes and trace elements) on three speleothems from Soqotra Island (Yemen)

17.15 - 17.30 **K. Fontijn, G.G.J. Ernst, D. Delvaux, D. Williamson, E. Abdallah, A. De Craene, E. Mbede & P. Jacobs**
A review on recent volcanology and volcano-related hazards in the Rungwe Volcanic Province (SW Tanzania)

17.30 - 17.45 **P. Vermeersch** - “Out of Africa 2” and Egypt - an evaluation

Key-Note Presentation

A contribution to the International Polar Year

Sea Ice Biogeochemistry and the Climate: Popping up the Sea Ice Cork !

The SIBClim Community Members
(J.-L. Tison[1], B. Delille, C. Lancelot, L. Chou, S. Becquevort, J. de Jong, V. Schoemann, A. Borges, D. Lannuzel, F. Fripiat, I. Dumont & F. Masson)

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Sea Ice is one of the largest ecosystems on Earth, with surface area ranging between 18 and 28 10^6 km^2 every year. It has now been recognized as a significant contributor to the Climate system for several reasons such as: albedo feedback, driver of the Global Thermohaline Circulation, stratification of the surface ocean layer on melting, obstacle to matter and energy exchange between the Ocean and the Atmosphere. However, it is only during the recent years that studies have focused on the potential biogeochemical role of sea ice in regulating the climate. This has been the main goal of an ARC Belgian program called SIBClim (Sea Ice Biogeochemistry in a Climate Change Perspective) which has integrated the expertise of glaciologists, oceanographers, biologists and ecosystem modellers of the ULB, ULg and UCL between 2002 and 2007. Its is now supported by a dedicated IPY labelled Belgian program entitled BASICS (Biogeochemistry of Antarctic Sea Ice and the Climate System) which has been endorsed by two IPY integrated project: ICED (Integrated analyses of circumpolar Climate interactions and Ecosystem Dynamics in the Southern Ocean) and ASI-IPY (Antarctic Sea Ice in IPY). These Belgian programs are dedicated to the study of the biogeochemical cycles of C, S, Nutrients, Iron in sea ice, and how these interact with the physical and biological properties of sea ice and contribute to the fluxes of climatically significant gases (CO_2, DMS, CH_4,…) between the Ocean and the Atmosphere.

We will show, with results from three Antarctic field process studies (ARISE 2003, ISPOL 2004 and SIMBA 2007) that the common assumption of all global biogeochemical models that sea ice is impermeable to gas fluxes and acts as a “cork” to gas exchanges is invalid for at least several months during autumn and spring. It is also demonstrated that the role of sea ice is not limited to a passive physico-chemical control of the fluxes. For CO_2, the combined effect of brine dilution, calcium carbonate dissolution and algal photosynthetic activity induces profound depletion and strong gradients in the sea ice cover during spring and summer, which results in an additional net sink to the ocean amounting to minimum 10% of the total open water sink south of 50°S. For DMSP (Dimethylsulfoniopropionate - an organic molecule that is produced by ice algae as a cryoprotectant and an osmotic regulator) and its degradation by-product DMS (Dimethyl Sulfur - a gas compounds which is released to the atmosphere and quickly oxydized to sulphate aerosols, which act as cloud condensation nuclei and therefore both directly and indirectly limit the incoming solar radiation), sea ice shows concentration levels up to three orders of magnitude higher than those measured in surface sea water. We will show with our data sets that the degradation process of sea ice on warming both favours the conversion of DMSP to DMS and the release of the latter to both the ocean below and the atmosphere above. Iron too shows enrichment factors of 10 to 100 with regard to sea water, and can therefore be seen as a major contributor to spring algal blooms, both in the sea ice itself and in the water below, when it is made available to the primary producers of this HNLC environment, as the ice warms up, gets more porous and light levels are growing again. Finally, we will illustrate the brand new potentials of Iron and Silicium isotopes studies in sea ice for understanding sea ice algae metabolism and possibly providing new tools for paleo reconstruction of sea ice margins.

Oral Presentations

Sediment variations supported by radiocarbon dates as fingerprints for processes of coastal changes in the late Holocene deposits of a tide-dominated coastal lowland

C. Baeteman

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The late Holocene deposits of the Belgian coastal plain were formed by a renewed expansion of the tidal environment after a period of 2-3 ka years of almost uninterrupted peat growth. The expansion of the tidal environment was associated with the formation of tidal channels which eroded deeply into the mid and early Holocene sediments, and sometimes into the Pleistocene subsoil. In general, the late Holocene deposits comprise a 1-2 m thick, apparently homogeneous tidal-flat mud. Organic horizons or peat beds are no longer present with few exceptions. The overall texture of the infilled channels consists of fine sand for its major part with a thickness that varies between 5 and 25 m. The upper part of the channel infill, here called the final fill, consists of laminated mud and fine sand often strongly burrowed. The final fill reflects the eventual silting-up phase of the channel. In the surroundings of the infilled channels, the post-peat deposits show lateral and vertical sediment variations. These changes in lithology used to be interpreted as a result of transgressions and regressions.

Since the sea-level curves of the Southern North Sea coastal lowlands do not show sea-level fluctuations for the past 2500 years (except in northern Germany), the mechanisms and processes that led to the sediment variations have to be determined. Therefore, the sediment characteristics and chronology of the post-peat deposits have been investigated in detail in shallow outcrops with special attention to the final infill of the tidal channels.

The results show several steps in the formation of the post-peat deposits. The deep vertical incision is followed by sedimentation with high energetic conditions whereby erosion and sedimentation alternate. The large age differences (c. 1000 years) between the peat dates and shell dates from the overlying clastic deposits suggest that areas in the surroundings of the channels became in a subtidal position with minimum sedimentation. At first, all the available sediment was used to fill the deepened channels. The subtidal position was a result of the collapse of the peat due to drainage when the channels cut into the peat bog. It took at least 500 years before the channels were filled and their surroundings became in an intertidal position between about 1400 and 1200 cal BP documented by the ubiquitous presence of *Scrobicularia*. This period is represented by the final fill whereby the channel cross-section, sediment supply, tidal prism, and sea level were in equilibrium. Following this low-energy silting-up phase which lasted until about 1150 cal BP, the high-energy conditions prevailed again. Open marine sediments were brought in, pointing to shoreface erosion and a landward shift of the coastline. In this period the channels started to migrate laterally. This process led to the reworking of the deposits of the salt marshes and mudflats adjacent to the channels and in seaward areas. Also the final fill of the channel itself experienced shallow erosion and reworking, but with minimum transportation. The lateral migration was prompted by a shortage of accommodation space. Sea-level rise was very slow and consequently did not create further accommodation space in the plain which was in an inter- and supratidal position. On the basis of only one radiocarbon date, it is suggested that the eventual and complete silting up of the channels and the plain did not happen before 560 cal BP.

The detailed sedimentological investigation of the late Holocene deposits in shallow outcrops supported by radiocarbon dates from shells highlighted several issues which are of wider methodological interest for the study of tide-dominated coastal lowlands.

- The results show that over short distances sediment successions caused by the same event can vary significantly.
- The sedimentation was discontinuously and the changes happened rapidly.
- The different channel systems experienced the same process, but not necessary at the same time because the channels progressively invaded the peat bog with the enlargement of their tidal prism and the channels also reacted to local situations.

Consequently, the mechanism of coastal change may be identical for the entire plain but the timing is certainly not.

- The repeatedly reworking of the deposits (sometimes without any apparent lithological change) implies that the radiocarbon dates of the shells must be considered carefully. It is essential to integrate the results in a wider stratigraphic context. The same remark applies for microfossil analyses.
- The main controls on the sedimentation of the late Holocene deposits were the slow sea-level rise, the availability of sediment and accommodation space, and the change in size of the tidal prism of the channels.

Identification and Provenancing of Regional Ceramic Fabrics in Pisidia (SW Turkey) during the Iron Age to the Late Roman Period

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The characterization of regional artisanal ceramic production and identification of its clay raw materials is of major importance for the understanding of ancient crafts and socio-economic interaction within a region. Different fabrics of locally produced pottery were recognized both at the excavations of the ancient Hellenistic to Byzantine city of Sagalassos (Pisidia, SW-Turkey) and on surveys within its territory. Preliminary archaeometrical data describe the studied area as a chain of different local and regional production entities during the Iron Age where the continuous use of the same fabrics over a relative large period can be observed, used for the whole functional spectrum of ceramics. These regional economies later developed into one unified centre of production for the mass produced (export) luxury tableware at the city of Sagalassos. In the late Roman period, however, it is clear that cooking pots and storage vessels (e.g. local amphorae) are not as homogenous in raw material as seen in the tableware. The mineral resources vary, and likely there must again have been different production centres active in the territory in which large farms were responsible for the production of their proper ceramic containers. In order to comprehend the regional ceramic production in the territory, an integrated approach of typological, petrographical and geochemical (microscopy, cathodoluminescence, main & trace element analysis, X-ray diffraction) methods is used to define the properties of the raw materials and the origin of the different ceramic fabrics. In this way, different production processes and possible exchange patterns in the studied area are described.

Optical dating of the Late Glacial dune complex at Opgrimbie (NE-Belgium)

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The Late Glacial, which is the transition interval from the Weichselian Late Pleniglacial to the present interglacial (Holocene), is characterised by major climatic oscillations. In the NW European coversand belt, these fluctuations resulted in varying intensities of aeolian activity and vegetation growth and thus in the alternation of phases with widespread sand deposition and periods marked by soil formation. Based on the pollen record and pedostratigraphic evidence, the Late Glacial has been subdivided into the Earliest Dryas, Bølling, Early Dryas, Allerød and Late Dryas periods. However, few places exist within the coversand belt where both Bølling and Allerød organics and soil horizons can be identified and thus where the stadial episodes can be differentiated. The dune complex at Opgrimbie (NE-Belgium) is thought to represent one of these very few localities: this is derived from the study by Paulissen and Munaut (1969), who applied radiocarbon dating and pollen analysis to two peat horizons intercalated within the sandy aeolian sediments. Since then, however, considerable advances in dating technology have been made and new techniques, such as optical (or OSL, optically stimulated luminescence) dating, have become available. In this work, the chronology of the dune complex at Opgrimbie was reinvestigated using quartz-based optical dating.

Nine samples were collected from a profile near the dune crest where, according to Paulissen and Munaut (1969), both the humic Bølling and Allerød layers have passed into bleached horizons. Six samples were taken from the sediment unit between the two soil horizons, and three samples were collected from the sediments below the lowermost bleached horizon. Additionally, the two peat layers at the lee side of the dune were sampled for AMS radiocarbon dating.

An average OSL age of 12.9 ± 0.9 ka (n=6) was obtained for the sediment unit between the two bleached horizons, while the sediments underlying the lowermost bleached horizon yielded an optical age of 13.0 ± 0.8 ka (n=3). The dating results are internally consistent, and extensive performance tests provide solid evidence for the validity of the applied dating procedures. The dose distribution of one sample, collected from the lowermost sediment unit, indicates that the sediments are well-bleached and unaffected by post-depositional mixing.

The optical ages of the sediments are consistent with both the previously (14.0 – 13.6 ka calBP; bulk) and newly (13.9-13.7 ka calBP and 13.2-13.0 ka calBP; charcoal) obtained radiocarbon ages for the uppermost peat horizon, confirming that the uppermost bleached horizon represents the Usselo Soil of Allerød age. The optical ages, as well as the newly obtained AMS radiocarbon ages of uncharred organic matter, for the lowermost sandy peat layer are systematically younger than the ^{14}C age of 15.2 – 14.5 ka calBP obtained by Paulissen and Munaut (1969) for bulk material extracted from this horizon. It is theoretically possible that contamination with recent humates caused a rejuvenation of the AMS data for the uncharred plant remains. However, as the new AMS ages are corroborated by an internally consistent and robust set of optical ages, we conclude that it is more likely that the dune complex at Opgrimbie is younger than previously stated. Further research is warranted to assess the validity of this conclusion.

References

Paulissen, E., Munaut, A.V., 1969. Un horizon blanchâtre d'age Bølling à Opgrimbie. Acta Geographica Lovaniensia 7, 65-91.

Relicts and pseudomorphs of Pleistocene thermal-contraction-cracking wedges in Low Belgium: relict sand wedges, composite-wedge pseudomorphs and optically stimulated luminescence dating of their infill

G. Ghysels[1], I. Heyse[1], J.-P. Buylaert[2], A.S. Murray[2], D. Vandenberghe[3], F. De Corte[4] & P. Van den haute[3]

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Reconstruction of former periglacial environments in Europe heavily relies on the identification of relicts and pseudomorphs of thermal-contraction-cracking wedges in soils. During the past seven years a large number of these wedge-shaped sedimentary structures have been identified in lowland Belgium. Wedge forming processes have been carefully reconstructed, providing new information on Pleistocene palaeoenvironmental and palaeoclimatic conditions of the Flemish sandy lowlands. Investigation methods included field observations, sedimentological analysis and optically stimulated luminescence (OSL) dating. A key observation includes the identification of composite-wedge pseudomorphs and relict sand wedges. These wedge types suggest thermal-contraction-cracking of frozen soils in a former cold periglacial environment. Their windblown infill points to sand transport on a sparsely vegetated ground surface with a limited snow cover during wedge growth. The results point to a greater complexity of wedge forming processes and palaeoenvironments compared to those of previous studies. The latter stressed the dominance of ice-wedge pseudomorphs. Therefore, former reconstructions may have been biased towards conditions suitable for ice-wedge growth. Sparse vegetation and snow covers during wedge growth may also have favoured efficient cooling and contraction of the frozen soil due to the lack of an insulating boundary layer. As a consequence, it cannot be excluded that wedges grew at higher mean annual air temperatures (MAAT ≤ -3 °C) than previously suggested (MAAT ≤ -6 °C). Finally, OSL-dating of the aeolian wedge fillings provides direct age estimates for these cold-climate soil processes. The majority of the results points to extensive thermal contraction cracking during Marine Isotope Stage (MIS) 2 (Late Pleni-Weichselian – Lateglacial), peaking around 15.000 and 20.000 years ago. A few data even suggest the possibility of earlier phases of wedge growth (during MIS 3 or Middle Pleni-Weichselian and MIS 6 or Saalian).

A review on recent volcanology and volcano-related hazards in the Rungwe Volcanic Province (SW Tanzania)

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So far the volcanological aspect of the Rungwe Volcanic Province (RVP) in SW Tanzania has received very little attention. A review of mainly colonial work reveals potential volcano-related hazards in this densely populated area. The RVP volcanic products cover ~3,000 km² in the East African Rift System, between Lakes Malawi and Rukwa. Structural mapping based on observations of lineaments and volcanic constructs on digitized and georeferenced aerial photographs, topographical maps and an SRTM DEM90 reveals a strong control of the local tectonic framework on the location of volcanic centers.

Volcanism is believed to have started ~9 Ma ago, and has given rise to a wide variety of construct morphologies and alkaline products. Three main, active or dormant, eruptive centers (Rungwe, Kiejo and Ngozi) can be recognized to have produced mainly basaltic, phonolitic and trachytic lavas and tuffs since the Mid-Pleistocene (Harkin 1960; Ebinger et al. 1989; Ivanov et al. 1999). Spread around and in between the large centers, scoria cones, domes, tuff rings and maars are abundant.

Next to the actual volcanic/magmatic activity, several related phenomena can be recognized on remote imagery and in the field, e.g. mudflow deposits, debris-avalanche deposits originating from a sector/flank collapse at Rungwe volcano with resulting summit scar, and CO_2-rich springs. In 2004, an increase in spring temperature was reported by Tanzanian scientists and efforts are being made to investigate this further.

The last documented eruption was that of a lava flow exiting from Kiejo volcano only 200 years ago (Harkin 1960). Several post-sector collapse pumice cones and lava flows in the Rungwe crater area have a clearly fresh appearance (e.g. well-defined structures, limited vegetation cover), and may have erupted only a few hundred years ago. The whole area is covered with a superficial blanket of pumice and ash; RVP ash is found up to 600 km away. A ~30 m long sediment core in Lake Masoko (a maar lake) reveals more than 65 – mostly felsic – volcanic ash layers from explosive eruptions during the last 50,000 years, the most recent and significant one (more than 10cm) dated at 1,190 cal yr BP. Widespread pyroclastic flow deposits presumably originate from a caldera-forming eruption at Ngozi (possibly ~10.2 ka BP), whereas an extensive cream-coloured pumice layer is thought to originate from a plinian eruption at Rungwe (possibly ~4.35 ka BP) possibly associated with a –potentially tectonically-triggered– major sector collapse dispersing debris avalanches that traveled over 20 km to the SW.

The extensive pumice fallout layer must correspond to the *Rungwe Pumice* that was described by Harkin (1960). During a recent field mission to the Rungwe area, we could collect essential data to construct a first rough isopach and isopleth (of maximum grain size) map that provides the basis for a physical model for this major eruption. The first data indicate a dispersal axis roughly NW – SE, with tephra dispersion to the SE. On the Rungwe summit, the pumice layer may be several tens of meters thick, with a gradual decrease to the SE (e.g. >4 m at 2,5 km distance; 1 m at 10 km).

All the above suggests RVP volcanoes are dormant/active and will erupt again in the future. A detailed investigation of the eruptive history, of volcanic/tectonic hazards and their interplay are therefore much needed in the region.

References

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Seismic stratigraphy of the glacial infill of Lago Puyehue: implications for the timing of deglaciation in the Chilean Lake District

K. Heirman[1], M. De Batist[1], F. Charlet[1], J. Moernaut[1], E. Chapron[2], M. Pino[3], R. Brümmer[3] & R. Urrutia[4]

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At present, the southern hemisphere - with its very scattered and often disagreeing records – still lacks a general consensus on the existence and timing of several main Quaternary events, such as the exact timing of the last deglaciation. Solid chronologies are needed, but such chronologies, however, are only meaningful if they can be linked to a clear understanding of the climatic and environmental processes active at the study sites. The Chilean Lake District (39°15'S - 43°20'S) has an insolation regime that is out-of-phase with northern mid-latitudes (Moreno et al. 2001), is highly sensitive to variations in the position of the Westerlies (Lamy et al. 2001; 2004), is far from the North Atlantic region with its large ice sheets (Lowell et al. 1995; Bertrand et al. in press) and featured several piedmont glaciers during glacial times. This kind of mid-latitude mountain glaciers should react sensitively to both medium and long-term climate changes (Häberli 1994).

After deglaciation following the LGM a completely altered Chilean landscape was left behind, characterised by the presence of a series of medium- to large-sized deep glacigenic lakes. Lago Puyehue is one of such glacigenic lakes with a very complex deglaciation history. A detailed seismic-stratigraphic study allowing a quasi three-dimensional exploration of its infill indicates a much earlier glacial retreat than the neighbouring Rupanco glacier. Because of their close proximity Rupanco meltwater streams played an important part in the depositional processes of Lago Puyehue. Linking the seismic stratigraphy with a multiproxy study of a core taken on an elevated platform in the lake reveals a major discrepancy between the timing of deglaciation of the Puyehue glacier and other glacial history studies in the area. The new data imply an ice-free lake by 23600 cal yr BP. As the Puyehue glacier probably had a very short response time to climatic amelioration, a short warming event around 28000 cal yr BP could have been sufficient to cause glacier retreat. Calving processes and a large moraine ridge in the centre of the lake probably prevented the glacier from readvancing during the subsequent cold reversal. This cold reversal, on the other hand, did probably cause minor readvances in other lakes in the Chilean Lake District.

The impact of channel shifting, sea-level change and human action on the Holocene coastal evolution of the Lower Khuzestan plain, Iran, Persian Gulf

V.M.A. Heyvaert[1], C. Baeteman[1], S. Dawson[2], R. Gehrels[3] & H. Weerts[4]

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The Lower Khuzestan plain, crossed by the rivers Karun, Karkheh and Jarrahi, is located in southwest Iran and forms the southeastern extension of the Lower Mesopotamian plain. The plain is bordered to the west by a major estuary, the Shatt-el Arab. Because quaternary geological investigations have hardly been carried out in the plain, the ideas about the extension of the Persian Gulf and the position of rivers were inferred from historical sources and geomorphological observations. This made the palaeogeographical reconstructions for the area rather speculative.

For the first time, the Holocene sequence of the Lower Khuzestan plain has been investigated in the context of coastal evolution and relative sea-level change. The facies of the sediment succession in undisturbed hand-operated cores and temporary outcrops are identified on the basis of lithology, sedimentary structures, macro- and microfossils. Radiocarbon dates, historical and archaeological data provide chronological control.

Facies analyses are in agreement with microfaunal analyses (foraminifera and diatoms) in that four main palaeoenvironments of deposition are identified: brackish tidal flat, clastic coastal sabkha, brackish-freshwater marsh and fluvial plain.

A large-scale palaeogeographical reconstruction of the Lower Khuzestan plain and the northern extension of the Persian Gulf is made for different time slices between 8000 and 450 cal BP. During the early and middle Holocene, the Lower Khuzestan plain was a low-energy tidal embayment under estuarine conditions. The rapid RSL rise in the early Holocene forced the coastline to transgress rapidly across the shelf. The drowning of most probably the antecedent valley of the Shatt-el Arab resulted in the development of extended tidal flats. A deceleration of the RSL rise after ca. 5500 cal BP, together with more arid conditions, allowed coastal sabkhas to extend widely and to aggradate while the position of the coastline remained relatively stable. Continued deceleration of the RSL rise initiated the progradation of the coastline from ca. 2500 cal BP. The effect of sediment supply by the rivers became more important than the effect of the RSL rise and a Karun megafan developed. The avulsive shifting on the Karun megafan, mainly initiated by human activities, influenced the changing positions of the Karkheh and Jarrahi river channels. Moreover, the development of the Karun megafan, in conjunction with the Wadi Batin fan in the southwest, initiated the development of the Mesopotamian brackish-freshwater marshes (Ahwar) and controlled to a great extent the late Holocene progradation of the Lower Khuzestan coastline.

Some rock magnetic properties of loess-palaeosol sequences in Belgium

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Palaeomagnetic investigations of worldwide loess-palaeosol sequences proved to be very successful to provide time markers, mainly based on the presence of geomagnetic reversals, for establishing stratigraphical schemes and palaeoclimate reconstructions.

Previous palaeomagnetic investigations of several loess-palaeosol sequences in Belgium demonstrated that they carry a stable remanence of normal polarity, suggesting that they belong to the Brunhes Chron. The search of large directional field deviations during the Late Pleistocene that could point to the presence of short-term reversals or field "excursions" was unsuccessful. This was also the case for a more recent detailed examination of the humerifous horizon of Remicourt and immediately overlying loess deposits in Remicourt, characterised by a magnetisation of normal polarity. Besides alternating field demagnetisation also thermal demagnetisation experiments were carried out for the first time in order to isolate the stable characteristic remanent magnetisation. Thermal demagnetisation and magnetic susceptibility versus temperature diagrams point to magnetite as the main remanence carrier and principal magnetic mineral present in the loess and soil units.

Rock magnetic investigations are not only important to increase the reliability of palaeomagnetic results and magnetostratigraphical schemes but some rock magnetic properties in loess deposits are indicators of formation processes and environmental conditions and in particular climate. Especially the weak field response or weak field magnetic susceptibility is considered as a climate proxy but it also proved to be very useful for differentiating units, for between-site correlation and for tracing volcanic tuff layers

The Eltville Tephra of Upper Weichsel age differentiates remarkably well from the over- and underlying loess by its high magnetic susceptibility and thermomagnetic behaviour. Unmixing of remanence acquisition curves and magnetic susceptibility versus temperature curves reveal two magnetic assemblages with different magnetic properties. A characteristic low temperature magnetic phase is clearly visible in the heating curves of the Eltville Tuff horizon sampled in different loess sections in Remicourt, Lixhe and Rocourt (see figure below). This fingerprint allowed us to trace this stratigraphic marker in other loess sections and to extend the hitherto known western limit of its occurrence.

Also the humiferous complex of Remicourt above the Rocourt soil differentiates clearly from the immediately over- and underlaying units by a strong magnetic susceptibility signature. Two horizons can be recognized based on magnetic susceptibility and thermomagnetic properties. The high magnetic susceptibility can be explained partly by soil magnetic enhancement due to neoformation of strong magnetic minerals linked to soil formation processes. Features in the heating and cooling curves of samples taken at the level where room temperature magnetic susceptibility attains a maximum indicate the presence of a magnetic phase not visible elsewhere in the humiferous horizon and probably linked to magnetic minerals of volcanic origin called the Rocourt Tephra.

As grain alignment is indicative of depositional mechanisms and environmental conditions during and after deposition, the magnetic fabric of loess and soil samples was visualised by measuring the anisotropy of magnetic susceptibility (AMS). In general a bedding plane parallel foliation or planar S fabric occurs. AMS and oblateness in loess in Belgium is mainly due to the alignment of phyllosilicates and shape alignment of detrital multidomain magnetite. Unexpectedly, an inverse fabric was found for the first time in loess deposits, in the Last Glacial loess (Brabantian) above the Cryoturbated Horizon of Nagelbeek in Veldwezelt.

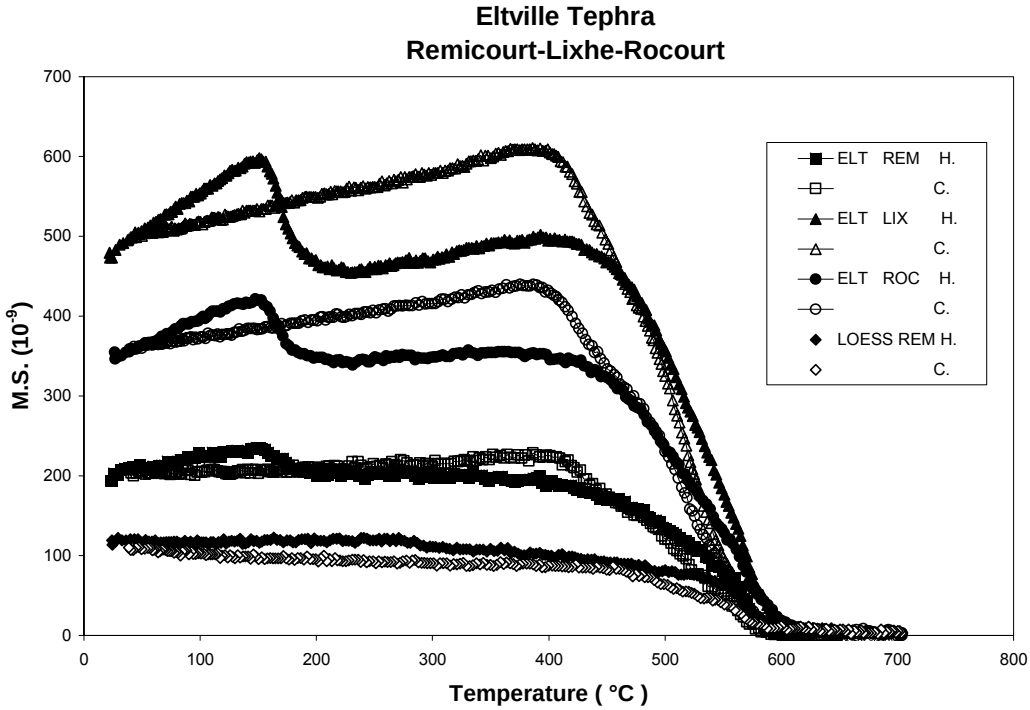

Fig. Magnetic susceptibility versus temperature of the Eltville Tephra in Upper Weichsel loess in Remicourt, Lixhe and Rocourt compared with a pure loess sample (H = heating, C =cooling). The characteristic low temperature phase allows tracing this marker horizon in other sections.

A Holocene palaeoenvironmental reconstruction based on geochemical research (isotopes and trace elements) on three speleothems from Soqotra Island (Yemen)

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Due to the Global Warming hypothesis (IPCC, 2007) the study of the palaeoclimate and its evolution in the recent past receives more and more attention. Climatic variations are studied by means of proxy data. These are measurable data from biological, glaciological or geological archives. The mostly used terrestrial geological archives are lake sediments, ice cores and speleothems. The latter, especially stalagmites are interesting archives of past climates because they have a stable mineralogy, they contain different proxy data over extended periods, which can be analysed at high resolution and they allow absolute dating of the time series. Certain geographical areas playing a key role in the development of Global Circulation Models (GCM) are still insufficiently studied. This is clearly the case for the Northwesthern Indian Ocean, eastern North-Africa and the Southern part of the Middle-East. On the arid tropical island of Socotra situated in the Indian Ocean between the Horn of Africa and the Arabian Peninsula, the bi-annual rainy season is active due to the passing twice each year of the inter-tropical convergence zone (ITCZ), known as the Indian Ocean Monsoon system. By evaluating local meteorological data (rainfall and temperature) collected at 11 manual stations during the past 5 years, we calculated that the NE Monsoon period accounts for about 85% of the rainfall while only 15% is related to the SW Monsoon period, with an important irregular geographical distribution over the island. Differences in the oxygen isotope composition of meteoric water versus groundwater estimate the amount and timing of karst aquifer recharge, because seasonal fluctuations of rainwater oxygen isotopic composition are related to the amount of rainfall. Karst aquifer recharge at the NE limestone plateau takes place only during the NE Monsoon rainy period when a rainfall threshold of 80-90mm is exceeded. As a consequence cave drip waters and groundwater generally have more negative delta values than average localrainwater.

In this region, the controls on the isotopic composition of currently forming speleothem calcite can be monitored; two caves, Hoq and and Casecas, 6 km apart, were chosen as research locations. From the Hoq cave, two stalagmites 10 m apart, STM-1 and STM-6 were sampled, respectively 6 ka and 4.6 ka old at the base. A 1 ka old stalagmite STM-5 was sampled from Casecas Cave. These ages are based on U/Th-measurements and on the observation that the stalagmites were active when sampled in January 2003, 2006 and 2003, respectively.

To reconstruct the palaeoenvironment, stable isotope ratios of carbon and oxygen ($\delta^{13}C$ and $\delta^{18}O$) were analysed at high and low resolution in all three stalagmites, along with Mg/Ca and Sr/Ca ratios in STM-6 only. Heavy metals such as Pb, Cd and Cu were analysed in STM-6 to study the effect of antropogenic pollution due to industrialisation. Analyses of U concentrations were also carried out. When both are measured, there is a good similarity between high resolution and the low resolution stable isotope time series. Based on the strong correlation between $\delta^{13}C$ and $\delta^{18}O$ in the time series of all three stalagmites, the variations of the isotope ratios are interpreted as been driven primarily by changes in the amount of meteoric precipitation that are supposed to be related to changes in the position of the intertropical convergence zone. Untill about 0.5 ka (~500 BP, i.e. (~1500 CE), and in spite of local differences, the low resolution $\delta^{13}C$ and $\delta^{18}O$ time series of all three stalagmites are rather similar and reveal the occurrence of alternating wetter and dryer periods. The period from ~ 1200 a BP till ~ 500 a BP (or the period ~ 800 CE till ~ 1500 CE and encompassing

the Medieval Warm Period, displays a clear evolution to dryer conditions in all three stalagmites. The observation of the Little Ice Age (~500 - ~150 a BP, or ~1500 CE till ~1850 CE) as a relatively wetter period in both STM-1 and STM-5 however is not confirmed in the time series of STM-6. Consequently, a comparison with the climatic evolution in eastern North Africa during the past ~1500 years is not straightforward.

In a part of STM-1 carbon and oxygen isotopic measurements were carried out at a resolution of up to 50 μm, corresponding to a time resolution of up to one month. The speleothem clearly registered seasonal variations of 1 to 2 ‰ in δ13C and of 0.5 to 1 ‰ in δ18O, coinciding with the alternation of dark compact and white porous layers, presenting annual banding in both stalagmites. These observations suggest that the speleothems reliably registered variability in the Monsoon climate.

It was not possible to draw meaningful conclusions from the high resolution time series of the Mg/Ca or Sr/Ca ratios in STM-6, neither from that of the Pb, Cd and Cu concentrations. The low resolution Mg/Ca and Sr/Ca time series however show an overall evolution to dryer conditions. Still, no clear correlation was noticed with the stable isotopic signals in these low resolution time series. The geochemical analyses in STM-6 show an increase of U concentration at the end of wetter periods and an increase of Cd concentration at the beginning of wetter periods. An increase of the Pb and Cu concentration is only visible in the youngest wet period.

Finally we consider the similarity of the isotopic records of the three speleothems and the presence of well preserved seasonal variations as encouraging observations with respect to the reproducibility of the records.

Holocene Records of Aerosols in Continental Environments (HoRACE)

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Present and future environmental changes, including climate change, will induce variations in atmospheric particle loading that have necessarily environmental feedbacks. It is widely accepted that comparing results of Global Climate Models (GCM) with palaeoenvironmental data is the best way to test their performance of prediction. Europe is especially influenced by Sahara: its source strength for dust transport to Europe was estimated at 80–120×106 t year−1. The changing frequency of Saharan dust events over recent decades has been noted by several authors. Apart ice records, there is no Holocene perspective on these environmental changes in Europe. Records of dust loading summarized in the network DIRTMAP exist for different places in the world on a 102-103 ky. timescale. However, there are no precise investigations on dust loading on a shorter timescale and for the Holocene in Europe. Peat cores from ombrotrophic peatlands can offer high-resolution records of dust intensity and origin in Europe. During the last 20 years, cores from ombrotrophic Sphagnum peatlands have proved to be meaningful archives of atmospheric deposition of trace elements. Lead especially has been extensively studied and its immobility in the peat column is now well demonstrated. Whereas the potential of peat cores as archives of recent and ancient pollutions has been increasingly investigated, using peat cores as archives of atmospheric deposition of trace elements for the entire Holocene remains less investigated. This presentation will first focus on our progress in sampling, analyses and age dating peat profiles to offer a continuous record of atmospheric trace elements deposition and the possibility to compare them with other archives. The behaviour of useful elements like Sr, Rb or REE will also briefly be discussed in order to trace dust origin. Then first results on dust variability investigated in European peat cores will be presented. Local changes in atmospheric dust composition are recorded in peat bogs and could be compared to global records of polar ice cores. For example, this study shows that there is a sharp change in the dust geochemical composition around 3700 B.C. (around 5700 B.P.) recorded in peat cores from Europe. The reason of this change lasting not longer than ca. 100-200 y could be due to a variation in atmospheric sources of dust during the Middle-Holocene. At this time, major climatic changes occurred in Africa as recorded in tropical lakes sediments and Kilimanjaro ice core. A change in the regime of Sahara dust emission, which is the main contributor to natural dust in Europe, can therefore explain this abrupt shift in deposited dust composition for the European bogs. Finally, future work on isotope and mineralogical investigations of Holocene peat samples will be presented in order to trace dust origin.

From the Pleistocene incision of a palaeo-valley until the Holocene formation of sandbanks: the Quaternary evolution of a shelf with low accommodation potential (Belgian Continental Shelf, southern North Sea)

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With respect to the Quaternary deposits, the Belgian Continental Shelf (BCS) was one of the last unmapped and unknown areas of Belgium. Because of the absence of a distinct shelf break and the virtually complete lack of subsidence, the BCS has very little accommodation space to accumulate and preserve Quaternary sediments. The Quaternary on the BCS is very patchy and discontinuous, and has a maximum thickness of only 45 m. From this fragmented record it was very difficult to produce a coherent reconstruction of the Quaternary evolution, in times when only analogue seismic data and sparse sediment cores were available. At present, > 16.000 km of analogue high-resolution seismic profiles have been scanned, converted into digital 'segy' format, and integrated with almost 500 core descriptions, enabling us to develop a genetic model for the Quaternary evolution of the BCS.

The seismic data show seven seismic-stratigraphic units, in agreement with previous studies on one of the sandbanks of the BCS. Three basal units (U1, U2, U3) infill a large valley, incised during the Saalian ice-age in the Top-Paleogene (former Top-Tertiary) surface, i.e. the Ostend Valley. The three units, separated by tidal ravinement surfaces, represent successive phases of a transgressive estuarine infilling during the Eemian sea-level rise. After the final phase, shoreface erosion was so severe, that seismic unit U3 was completely levelled with the Top-Paleogene surface, and remnants of Eemian deposits were only preserved in depressions. During the subsequent Weichselian lowstand, a minor sinuous river valley was incised in the Eemian transgressive surface, where previously the Ostend Valley was present. Directly on top of this surface no Weichselian cover sands have been encountered, but early Holocene tidal flat deposits, i.e. seismic unit U4. The tidal flat environment developed behind a coastal barrier which migrated landward with the Holocene rising sea-level. In the sand layer left by the barrier migrating over former tidal flat deposits, coastal storm-dominated banks formed (U5). Most likely these coastal banks were partly eroded when the barrier stabilised and started prograding seaward again, in reaction to the slowing down in the Holocene relative sea-level rise. The tidal flat area behind the barrier, silted up and an extensive area with surface peat developed. With a renewed expansion of the tidal environment (*not* the result of a sea-level rise), the barrier migrated landward again, up to the present-day coastline, eroding the underlying clayey tidal flat deposits and surface peat. The remnants settled in the nearshore area as an alternation of clay and sandy storm layers, i.e. seismic unit U6. With continuous rising sea-level, tidal sand banks and intervening swales (U7) developed on top of the former deposits, and form now the main features of the present-day bathymetry. The tidal sand bank deposit is actually only the top part of what is called 'a sand bank' in a broader sense of the word. The lower parts of the sand banks consist of remnants of coastal banks, tidal flat and estuarine deposits, which stand out from the seafloor, i.e. form a 'sand bank' in the broad sense, due to present-day erosion in the surrounding swales.

From what we have observed we can conclude that in an area with low accommodation potential and very little sediment input, amalgamation and reworking of sediments are common processes, and little net accumulation of sediments takes place. Most of the deposits on the Belgian shelf were strongly reworked to form new deposits, and little was preserved, which is what made it challenging to reconstruct the Quaternary evolution.

Paleoseismological exploration of South-Central Chilean lake sediments using reflection seismic profiling

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Giant thrusting earthquakes at the South-Central Chilean subduction zone (e.g. 1960 earthquake; M_w: 9.5) pose a major threat to human society. New paleoseismic data is indispensable to determine the recurrence history (and future?) of such giant earthquake events. The Lake District (39-42°S) in Chile consists of numerous large steep-sloped glacigenic lakes with relatively high sedimentation rates due to active volcanism. Such characteristics make these lake sediments highly susceptible for earthquake-triggered slope instability and consequently could make them good recorders of postglacial paleoseismic activity in this region. Several very-high resolution seismic surveys using a subbottom profiler (3.5kHz) are executed to study the sedimentary infill of these lakes.

Different styles of earthquake-induced structures in the seismic stratigraphy are interpreted. A) Multiple mass-wasting deposits on a same stratigraphic level are relicts of a basin-wide event of subaqueous slope instability. Several types of mass-wasting processes are inferred, ranging from small-scale slumping to voluminous mass-flowing. It seems that tephra layers could be considered as a “weak layer” in the stratigraphic sequence which could act as a distinct sliding surface during slope failure. B) Homogenite deposits in the deepest parts of steep-sided basins indicate the occurrence of lake seiches, which have been frequently witnessed during the AD 1960 earthquake. C) Fluid escape structures, such as fractured sediment layers and sediment volcanoes, document sudden liquefaction in buried mass-wasting deposits and subsequent vertical fluidization flow.

The spatial distribution of these seismically-induced structures in each lake has been mapped and will be discussed in terms of specific sedimentary environments. Basin morphology and sedimentary input seems to be critical factors in determining the paleoseismic potential of lake sediments.

This study illustrates that almost all lakes in the Chilean Lake District contain promising records of Holocene seismic activity. Coring and dating of the revealed paleoseismic horizons in multiple lakes is needed to construct a detailed seismic event correlation, which should allow eliminating the difference in earthquake recording capacity of each lake and how this capacity could have changed in the past. Such a correlation will reveal the recurrence rate of giant AD 1960–like earthquakes in South-Central Chile and will unravel the manner in which the sediments of different lakes react to strong seismic events.

A Holocene sediment budget for the river Dijle

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A Holocene sediment budget was constructed for the 758 km² Dijle catchment in the Belgian loess belt, in order to understand long term sediment dynamics. Hillslope sediment redistribution was calculated using soil profile information from 809 soil augerings, which was extrapolated to the entire catchment using morphometric classes. As large parts of the forests within the catchment prove to have undergone little or no erosion since medieval times, a correction was applied for the presence of forests. Total Holocene erosion amounts 817 ± 66 Mt for the catchment, of which 327 ± 34 Mt was deposited as colluvium. This corresponds with a net Holocene soil erosion rate of 10.8 ± 0.8 x 10^3 Mg ha^{-1} for the entire Dijle catchment. Alluvial deposits were studied through 187 augerings spread over 17 cross-valley transects. The total alluvial sediment deposition equals 352 ± 11 Mt or 42 % of total eroded sediment mass. Results indicate that at the scale of a medium sized catchment the colluvial sediment sink is as important as the alluvial sediment sink and should not be neglected. As a result the estimation of erosion through alluvial storage and sediment export would yield large errors. Dating of sediment units show an important increase in alluvial deposition from medieval times onwards, indicating the important influence of agricultural activities that developed from that period. Mean sediment export rates from the catchment for the last 1000-1200 y range between 0.8 and 1.3 Mg ha^{-1} a^{-1} and are consistent with present suspended sediment measurements in the Dijle. Erosion for agricultural land for this period is 9.2 ± 2.2 Mg ha^{-1} a^{-1}. Sediment budgets for the various tributary catchments provide an insight in the sources and sinks of sediment at different scales within the catchment.

Late Quaternary marine and lacustrine paleoproductivity in relation to ice shelf break-up and ice sheet history in Maritime Antarctica

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During the past 50 years the Antarctic Peninsula has witnessed one of the most rapid climate warming events on earth, leading to large-scale ice shelf break-up and accelerated glacier drainage. Recent studies have revealed that some of these ice shelves previously collapsed during the Holocene, whereas the recently disintegrated Larsen B Ice Shelf remained relatively stable during the past 11,000 years. Little is known however about the link between regional climate dynamics and long-term variations in ice shelf and glacier dynamics.

Polar lakes have emerged as sensitive early warning systems for recent temperature excursions, as their physical and chemical limnological properties respond quickly to environmental changes. These anomalies are readily preserved in the sedimentary record in the form of changes in fossilized biological remains and biogeochemical proxies. Here we present the first results of fossil diatom and pigment analyses on sediment cores from different coastal lakes in maritime Antarctica. These low-altitude lake sites were located below sea level before (and during) the Early and Mid-Holocene, implying that their sediments bear evidence for the exact timing of emergence of these basins from the sea. This permits us to reconstruct relative sea level changes and to infer information about regional glacio-isostasy throughout the past 16,500 years. By reconstructing past diatom community compositions and algal paleoproductivity, we infer past climate-related environmental changes in both the marine and lacustrine realm. This permits us to study the link between regional climate variation and evidence of spatial variability in glacier dynamics and ice shelf stability.

Reconstruction of sea/lake-level changes in an active strike-slip basin (Gulf of Cariaco, NE Venezuela)

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In January 2006, 76 high-resolution reflection seismic profiles were acquired in the Gulf of Cariaco, Northeast Venezuela. In the upper 100 m of sedimentary infill, 17 unconformity-bounded sequences were identified and mapped throughout the basin. Up to now, no core or borehole information is available to provide age constraints on these units.

The connection of the Gulf of Cariaco with the adjacent Cariaco Basin occurs at a present-day water depth of ~ 55 m. This implies that the gulf was disconnected from the world ocean and functioned as a lake during a large part of the last glacial. The main rivers entering the gulf drain the coastal mountain ranges and tend to form pronounced deltas at their inlet. During times when the gulf was a lake, periods with a dry climate resulted in dramatic lake-level lowstands and even complete desiccation/evaporation. The present-day depths of delta offlap breaks and the presence of lowstand/evaporite deposits can thus be used to estimate sea/lake level at the time of their formation. Detailed analysis of these stratigraphic sea/lake-level indicators allowed reconstructing the sea/lake-level history for the period encompassed by the 17 identified sequences. This sea/lake-level reconstruction also needed to be corrected for tectonic subsidence, affecting different parts of the gulf with different intensity.
The reconstructed sea/lake-level curve of the Gulf of Cariaco was compared with the eustatic sea-level curve and with results of previous paleoclimate studies in Venezuela. The striking coherence between the eustatic curve and the amplitudes and absolute heights of successive reconstructed lowstands and highstands compelled us to tune our record to the eustatic curve in order to achieve a rough age estimate for our units. According to this age model, our seismic stratigraphy reaches back to MIS6, and the average sedimentation rate in the central parts of the gulf since MIS5e is 0.92 mm/y.
Our data show that reconstructed lake levels in the Gulf of Cariaco, which represent a proxy for climate in NE-Venezuela, are very strongly coupled to the global stadials and interstadials of the last glacial period. Also the Younger Dryas is recognised in the sedimentary record of the Gulf of Cariaco as lowstand deposit resulting from an (almost) complete desiccation.
Our data reveal that the stratigraphy of the Gulf of Cariaco holds a very accurate, complete and promising record of eustasy and climate change, at least since the penultimate glacial maximum. The quality of this record and the vicinity to the iconic Cariaco Basin make the Gulf of Cariaco an ideal target for future ocean drilling (or long coring).

In addition to a stratigraphic interpretation, we also used our seismic data to map the structural geology of the Gulf of Cariaco. The Depression of Guaracayal in the southern part of the gulf is an asymmetrical strike-slip basin. It is located on the southern side of the fault trace along which the principal displacement of the El Pilar fault takes place. Also the Depression of Cerro Abajo (northern part of the gulf) is bounded by faults.
Riedel faults in the central part of the gulf have a normal as well as a lateral component. Our reconstruction has shown that the activity of these central faults has been more or less constant since MIS5e, although some migration of fault activity has was observed.
The existence of two principal segments of the El Pilar fault within the gulf, as postulated by Audemard et al. (2006), was confirmed and both segments were mapped in detail along with all other segments of the El Pilar fault in the Gulf of Cariaco.

Remarkably well-preserved palaeo-glaciated terrain offshore Anglesey, UK: implications for the final deglaciation phase of the Irish Sea

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High resolution swath bathymetry data was recently acquired 20 km offshore North Wales, UK. The data reveal part of a palaeo-glaciated terrain, unique in its kind on the European Shelf and provide the sole evidence for a grounded part of the Irish Sea Ice Stream. Exceptionally well-preserved ribbed moraines, drumlins, flutes and eskers represent a subglacial environment in which the onset of fast ice flow into the deeper Irish Sea Basin is preserved. De Geer moraines and iceberg scour marks are associated in an ice-marginal system during times of final retreat of the Irish Sea Ice, actively calving into a proglacial water body.

In a reconstructed ice-till-bedrock setting, the spatial distribution and morphology of the observed subglacial bedforms can be explained using the time-space domain "fracturing" model for glacial bedform formation by Kleman & Hätterstrand (1999). A thawing front migrated up-glacier and drumlinised the subglacial bed, partly eroding the edge of the surveyed ribbed moraine field. Directional analyses of the iceberg scour marks show a clear preferential trend nearly parallel to the ice margin. Whether the proglacial water was lacustrine or marine has important implications on ice margin dynamics. The exact nature of the proglacial environment is however difficult to reconstruct with the available data.

As the glacial terrain has been left well-preserved, no significant burial could have taken place, either by glacially or terrestrially derived sediment. The strong tidal currents at present keep the submarine terrain swept clean.

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Variability of northern MOW pathway dynamics and influence on deep-water ecosystems

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The current state-of-the-art involving contourite studies has given more evidence they may act as reservoirs. A large amount of contourite drifts has been described outside the deep-ocean realm of the thermo-haline driven "conveyor belt". These often are smaller sized drifts and are located along mid-slope continental margin sites or even in lake basins and have, beside the obvious palaeoceanographic control, a distinct (morpho)structural or even biogenic control. One of the more impressive of these contourite depositional systems (CDS) is related to the *Mediterranean Outflow Water* (MOW), located on the Iberian margin of the Gulf of Cadiz. Here, the evolution and morphology are strongly controlled by the temporally variable outflow energy and different branches of the MOW from the Upper Pliocene. Once the MOW has left the Gulf of Cadiz, it protrudes into the Atlantic Ocean following a northward course. Evidently, the kinetic flow of the MOW diminishes through gradual mixing with the other water masses. Nevertheless, here we present two contourite depositional systems which are located and interconnected along this northerly MOW pathway. Their characteristics provide more insight in the temporally variable steering, geometry and occurrence of CDS along ocean margins.

After the Cadiz contourite system, the first CDS found is located in an intraslope (structural) basin, located between the Spanish Cantabrian margin and the Le Danois Bank. The dominant steering of this CDS happens through interaction of the MOW with the Le Danois Bank and the morpho-tectonic setting of the intraslope basin. Remarkably, its stacking pattern (depositional architecture) and evolution is largely similar with the Cadiz CDS, in spite the morpho-tectonic features have shaped and conditioned the distribution and formation of different types of contourites. The Le Danois CDS also is closely associated with several mass-wasting and leveed-channel systems.

The following CDS has a longer geological history, but has also been affected by the northernmost occurrence of the MOW. Along the eastern slope of the Porcupine Seabight, west of Ireland, the introduction of the MOW was responsible for a drastic change in palaeo-environment, enabling the growth of deep-water coral banks. The presence of these important biogenic structures together with a pronounced glacial/interglacial influence has shaped several contourite drift types on this part of the margin.

Late Holocene palaeo-climate reconstruction from stable isotope records of stalagmites from three Belgian caves

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From each of three caves in the south of Belgium a stalagmite was sampled, i.e. “La Timide” stalagmite from the Han-sur-Lesse cave, a stalagmite from the Hotton cave and one from the Vilaine Source cave. Each stalagmite was dated by U/Th measurements and additional for the Vilaine Source stalagmite, AMS ^{14}C measurements made it possible to calculate the dead carbon proportion (dcp). According to the obtained apparent ages, the Vilaine Source stalagmite was deposited between 4382 (±500) a BC and around 1977 a AD. La Timide from 3430 (± 93) a BC to 1941 (± 14) a AD, and the Hotton stalagmite between 8131 (±200) a BC and 802 (±700) a AD. Hendy tests indicated near isotopic equilibrium conditions for the Vilaine Source and Hotton stalagmite and slightly out of isotopic equilibrium for the La Timide stalagmite. This partly explains the higher values for $\delta^{18}O$ and $\delta^{13}C$ for the La Timide stalagmite. In general however, the latter will be due to higher $\delta^{13}C$ values of the DIC. Although non equilibrium conditions exist for the La Timide stalagmite, between the Vilaine Source and La Timide stalagmite a reasonably good correspondence is found within the stable isotope record, i.e. enriched and depleted zones generally correspond in time. This supports the assumption that even when kinetic effects set off the $\delta^{18}O$ and $\delta^{13}C$ values from equilibrium, the speleothem stable isotope records can still provide palaeo-climatic information. In this respect the co-varying $\delta^{18}O$ and $\delta^{13}C$ time series can be interpreted as changes in humidity and temperature and soil zone conditions respectively, reflecting climate variations and associated possible anthropological influences, e.g. afforestation versus increasing agriculture and deforestation. The evolution of the time series between ± 850 - 1550 a CE reveals a warmer and drier period, which corresponds to the so called “Medieval Warm Period” (MWP) and between ± 1550 – 1900 a CE a colder and wetter climate can be deduced from the proxy data, also referred to as the “Little Ice Age” (LIA) (Fig. 1).

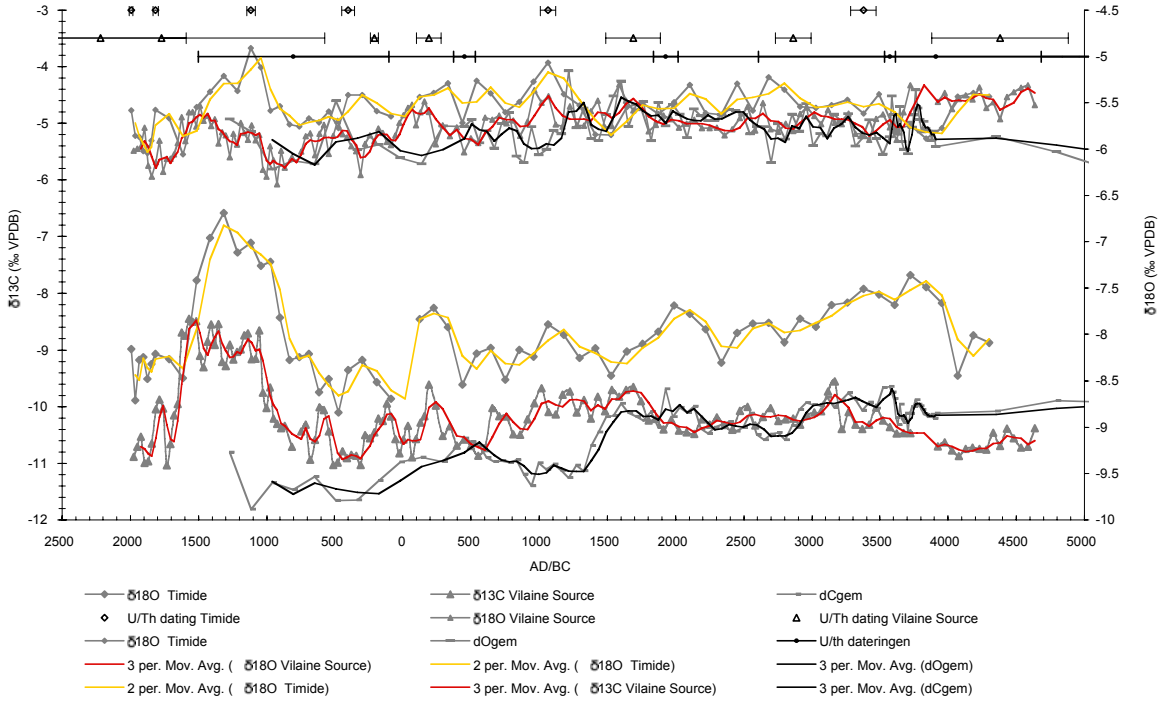

Figure 1: $\delta^{18}O$ and $\delta^{13}C$ record from three Belgian stalagmites

The Holocene salinity changes in the southwestern Black Sea: A reconstruction based on dinoflagellate cysts

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Dinoflagellate cysts are used as a proxy for the reconstruction of the salinity variations during Holocene times in the southwestern Black Sea. Core GeoB 7625-2, located 50 km northeast of the mouth of the Sakarya River, was sampled with a 200 year time interval between 0.25 ka BP – 7.8 ka BP. In the lower part of the core, some crucial intervals were sampled with a higher resolution for the determination of the reconnection between the Black Sea and the Sea of Marmara. A drastic change in the dinoflagellate cyst assemblage – from a fresh-brackish water to saltwater association – is observed between ~9.6 and ~8.1 ka BP. The fresh to brackish water indicator species are *Spiniferites cruciformis* form 1-4 and *Pyxidinopsis psilata*, while the most important saltwater species are *Lingulodinium machaerophorum* and cysts of *Pentapharsodinium dalei.* The first occurrence of euryhaline species took place synchronous with a sea level rise and an increase in productivity. The process length of *L. machaerophorum*, a salinity proxy, indicates a gradual salinity increase. This assumes a gradual reconnection between the Black Sea and the Sea of Marmara, which conflicts with the catastrophic flood (Noah's Flood Hypothesis) introduced by Ryan *et al.* (1997, 2003). The 500 to 800 year cycles observed in the sedimentary record by Lamy *et al.* (2006), and related to the North Atlantic Oscillation, were not only recorded by us in the salinity variations but also in dinoflagellate cyst abundances (productivity). The observed productivity changes are furthermore related to the sedimentation rate: the increase in precipitation in Anatolia possibly results in a higher sediment discharge leading to a better preservation of the organic-walled microfossils. This makes it difficult to determine whether the fluctuations of the dinocysts/gram ratio are the result of fluctuations in productivity or are an artefact due to changes in the sedimentation rate. Furthermore, it is shown that *Peridinium ponticum*, a species restricted geographically to the Black Sea, is a good proxy for the reconstruction of Holocene salinity variations since its relative abundance fluctuates synchronous with the process length variations of *L. machaeorophorum*.

"Out of Africa 2" and Egypt - an evaluation

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There seems to be no doubt that AMH originated (mainly) in Africa sometimes at the end of the Middle Pleistocene. There is still some discussion which geographical corridor was used to reach Asia (Cavalli-Sforza et al., 1994; Lahr and Foley, 1994; Underhill et al., 2001; Maca-Meyer et al., 2001; Luis et al., 2004). Based on MtDNA and on Y-DNA most authors suggest that AMH first left Africa crossing de Bab-el-Mandab. The Nile Valley is considered as not important because no haplotypes of the early AMH are present in the actual population.

The implications of such a model will be evaluated against the data provided by research in the Egyptian Nile Valley.

1. Few human fossils in the Nile Valley and in Arabia.
2. Climatic and geomorphologic conditions in the Arabian and the Egyptian area during the presumed time of the "Out of Africa 2".
3. Reduction of the human population in the Nile Valley during the later Middle Palaeolithic and the Upper Palaeolithic.
4. During the OIS 3, dunes from the Sahara have invaded the Egyptian Nile Valley, damming the valley at several points. Large intra-valley lakes were created along which fishers have settled. The catastrophic events (dam breaching) in the Egyptian Nile Valley at the start of the Tardiglacial (Bølling) resulted in a disappearance of a human population in the Egyptian Nile Valley (Vermeersch, in press).
5. The repopulation of the Egyptian Nile Valley started with the increased dryness of the Sahara (Kuper and Kröpelin, 2006) around 5500 BP.
6. The present Egyptian population should not be used for DNA studies related to "Out of Africa 2".
7. The absence of good comparable Middle Palaeolithic sites in the area.
8. Very early Upper Palaeolithic presence in the Egyptian Nile Valley.


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