10. Quaternary environments: landscapes, climate, ecosystems, human activity during the past 2.6 million years

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Swiss Society for Quaternary Research (CH-QUAT)

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10.1

Late Holocene Lacustrine Deposits newly discovered within the Losentse Alluvial Fan in the Central Rhône Valley, SW Switzerland.

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In this study, we focus on the Losentse alluvial fan, one of the largest fans of the central Rhône Valley, SW of Switzerland. This work aims to understand the evolution of the fan through time and space, in particular with respect to the regional evolution of this portion of Rhône Valley.

The Losentse fan extends over c. 8 km^2, with a radius of 3 km and a slope of ~4° to the south. The Losentse channel incises the fan and shows natural cross-sections up to 10 m high and 500-m long where detailed sedimentary logs were measured. The fan mostly consists of a vertical stack of amalgamated gravels and sands interpreted as sedimentary gravity flows and sheet-flows deposits forming gently dipping tabular beds. The beds are occasionally interrupted by graded lenticular gravels and coarse-grained sand associated with bed load processes.

The detailed sedimentary analysis revealed, the presence of c. 2 m-thick clayey and silty deposits containing several wood fragments and well preserved paludal gastropods intercalated within the debris flow succession,. The deposits are draping the distal and mid parts of the fan up to the elevation of 520 m (asl). To explore the fine-grained lacustrine deposits continuity, two Ground Penetrating Radar (GPR) antennas have been used to produce images of the subsurface of the fan. The combination of 250 and 50 MHz antennas provide different resolutions and penetrations useful to better image bellow and above the shallow and slightly conductive layer represented by the lacustrine deposits. Seven kilometres of profiles oriented parallel to the fan slope and along the contour lines have been acquired. The GPR data show the wide 3D spatial extension the conductive layer. The correlation of those profiles with the sedimentary logs allows us to interpret this sharp reflector as being the fine-grained lacustrine layer within the fan. Four AMS Carbon-14 datings of gastropods and pieces of wood contained within the fine-grained deposit yield ages ranging between 2810 and 1970 +/- 30 yrs cal. BP. We interpret those deposits as the record of a major lacustrine event which occurred between the end of the Late Bronze Age and the end of the Iron Age.

The lacustrine deposits found in the Losentse fan are 45 m above the current local elevation of the Rhône Valley, which in this valley segment, measures 3.5 km in width. At present, no geomorphological evidences and no plausible mechanism for the deposit of such a dam have been found. On the other hand, other lacustrine deposits have been discovered at 1.5 km downstream and 15 km upstream of the Losentse fan. These fine-grained deposits are both located below 520 m. They are very similar to the Losentse lacustrine deposits in terms of grain-sizes, thicknesses, lateral extensions and ages.

As a result, we suggest that a common regional lacustrine event occurred in the Rhône Valley between the end of the Late Bronze Age and the Iron Age. The mechanism that should have dammed the Rhône Valley is not known at the moment. The sector of the valley more suitable to locate a natural dam is the Saint Maurice glacial sill, which shows two thresholds at c. 520 m (asl), is cut by two very narrow channels and is highly exposed to landslide and debris-flow events.

The comparison between our hypothesis of the existence of a temporary lake occupying the Rhône Valley seems consistent with the occurrence of several ancient settlements discovered below 520 m (asl) during the period of extension of the lacustrine event. However, the ranges of uncertainties associated with both geological and archeological datings are high and make these comparisons difficult at the moment.

Dating of other lake deposits found in the valley, searching of a potential dam and double-checking the chronological consistency of the archeological and geological data in more detail will have to be carried out in order to validate our hypothesis. The effects of a temporary lake in the Rhône Valley on the known fluctuations of the Geneva Lake's level during the Late Bronze age could also be also explored.

10.2

Response of Cold-Water Corals (CWC) to large-scale paleoceanographic changes in the Western Melilla Mound Field (WMMF) eastern Alboran Sea: evidence from micro- and macrofauna assemblages and stable isotopes

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Cold-Water Corals (CWC) are globally distributed in the oceans, living under limiting growth factors such as sea water temperature, salinity, dissolved oxygen, currents regime and food availability (Freiwald et al., 2004). Only few investigations on benthic foraminifera related to CWC habitat have been performed so far. The area of the Western Melilla Mound Field (WMMF), eastern Alboran Sea, has not been studied for micropaleontological research so far. This area was sampled in 2008 during the cruise TTR-17, retrieving several gravity cores and box-cores to study deep-sea corals. The following work concentrates on the 340 cm long sediment core 399G, recovered at a water depth of 258 m, which is mainly composed of a brown-greyish clay matrix containing fragments of CWC.

The scleractinian coral community is represented by the most common species Lophelia pertusa, abundant from the base of the core to 80 cm. *Madrepora oculata* is mostly present in the upper part from 0–80 cm. The coral *Dendrophyllia* is less abundant and also present in the top of the core together with *M. oculata*. The core was sampled for micropaleontological (benthic foraminifera) analyses at a 20 cm resolution. Additional measurements such as Rock-Eval and Total Organic Carbon (TOC), stable $\delta^{18}O$ and $\delta^{13}C$ isotopes on benthic and planktonic foraminifera, sedimentary Phosphorous (P) and radiocarbon dating were performed on the core. Statistical analyses of the benthic microfauna were carried out on the fractions 250, 125 and 63 µm. Raw data were treated using the Software PRIMER 6 for 165 benthic foraminifera species. The statistical treatment showed three different clusters in the core:

Cluster 1 (300–340 cm) is dominated by the infaunal-epifaunal *Cassidulina laevigata* and shallow infaunal species *Cibicides ungerianus*,
Cluster 2 (100–280 cm) is characterized by *C. laevigata* and infaunal *Bolivina dilatata*,
Cluster 3 (0–80 cm) is linked to infaunal species *Globocassidulina subglosa–Bulimina marginata*.

Radiocarbon dating on benthic foraminifera showed a sedimentary record spanning from 1,120 yr cal. BP until 33,355 yr cal. BP. Inferring that the CWC have approximately the same age of sediments, this result could likely correspond to the oldest CWC discovered in the Melilla mounds until today. The TOC analyses display two positive peaks at 100 and between 240-280 cm.

This could be linked with the deposition of Organic-Rich Layers (ORLs), corresponding to the eastern Mediterranean sapropels, which are linked to enhanced biological productivity, poor ventilated water masses and freshwater input (Cramp and O'Sullivan, 1999).
The organic P correlates with the two ORLs. The detrital P and the Rock-Eval data suggest that the organic matter deposited during the ORLs has a relatively high terrigenous composition, likely from fluvial supply.

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10.3

Timing of Early and Middle Pleistocene glaciations in the Alps

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The onset of glaciations in the northern hemisphere is attributed to approximately 2.7 Ma (Maslin and Ridgwell 2005). Since then, the extent of glaciations is marked by glacial-interglacial cycles on a hemispherical scale. Was the onset of glaciations in the Alps synchronous? It is still unrevealed. Building of ice sheets must have resulted in an environmental change, which is documented in the oldest Quaternary deposits in the Alps. The focus of this study is on this geoarchive, the Deckenschotter, which are glaciofluvial gravels covering Tertiary Molasse or Mesozoic bedrock. These gravels are topographically distinct and discontinuous archives, having a reverse stratigraphic relationship, i.e. older deposits are located at higher altitudes and vice versa. To track the pace of onset of Early and Middle Pleistocene glaciations in the Alps and thus contribute to the understanding of the large-scale evolution history of the Alpine Foreland, we first investigate the sedimentology of Swiss Deckenschotter at key sites in order to determine the depositional environment, transport pattern, provenance and catchment area of these deposits. Then, we reconstruct the chronostratigraphy by applying two different methods: depth-profile and isochron-burial datings. Depth-profile dating uses the fact that the build-up of cosmogenic nuclides decreases with depth following the known principles (Gosse and Philips 2001). The recently introduced isochron-burial dating is based on different pre-burial but same post-burial histories of quartz pebbles originating from the same timeline.

Here we present first results of two Höhere Deckenschtter sites at Stadlberg and Irchel, at an elevation of 600 m and 670 m a.s.l., respectively. At these sites, in an abandoned gravel pit, sediment samples were taken for depth-profile dating with ^{10}Be and additionally quartz pebbles were collected for isochron-burial dating with ^{10}Be and ^{26}Al. First results from Stadlerberg indicate that this sequence was accumulated during a cold period approximately 2 Ma ago. We thus assume that the Quaternary glaciations in the Alps should have begun prior to 2 Ma. Moreover, the petrography of the pebbles indicate that the Deckenschotter units at both sites show a provenance including the Swiss Midland Basin, the Hörnli- and Napf talus fan as well as some parts of the Alps, excluding the Valais and Grisons.

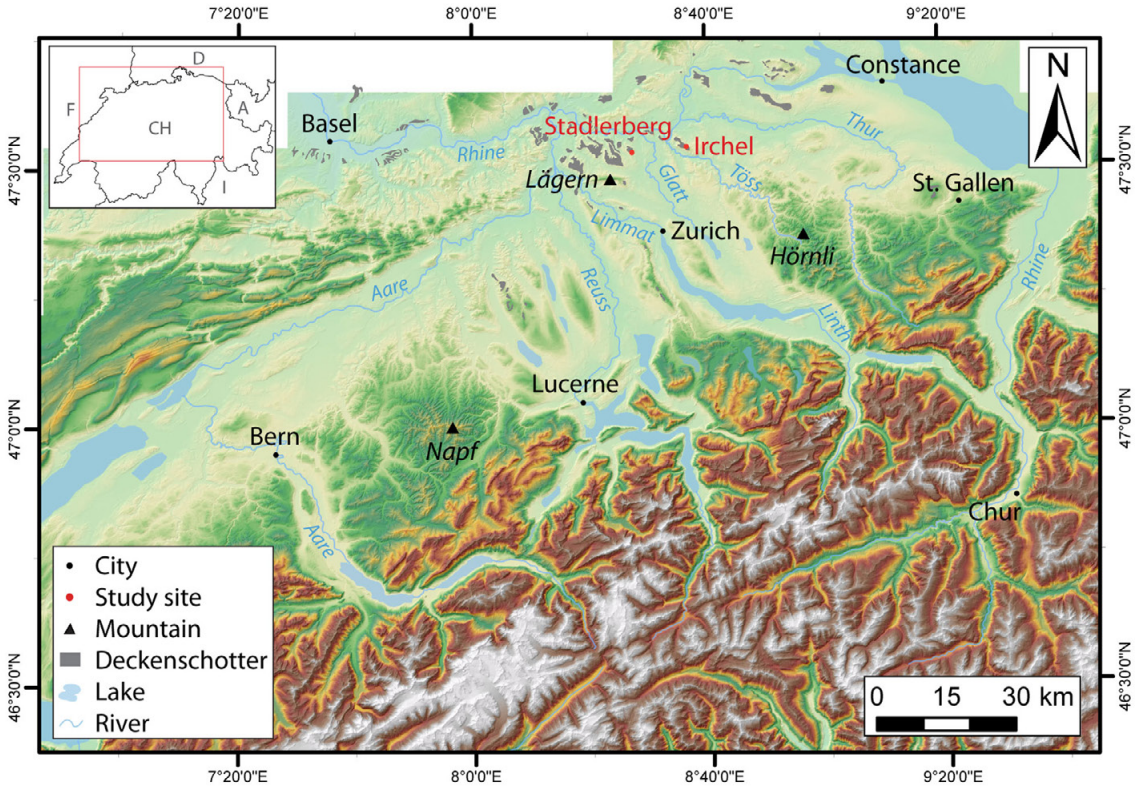

Figure 1. Location of the Stadlerberg and Irchel study sites and distribution of Swiss Deckenschotter.

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10.4

Holocene sediment budget and sediment dynamics of Lake Sils in the Upper Engadin

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Postglacial sediment archives can be used to deduce past climate variations and to infer geomorphic catchment processes. It has been suggested, that tremendous changes in erosion rates and sediment fluxes are characteristic for this time period, commonly framed in the paraglacial cycle. Linking the geomorphic processes and sediment archives of such a sediment cascade from source to sink, however, remains hampered due to limited appropriate tracers and absolute dating techniques. In this study, we employ a multi-method-approach for Lake Sils, upper Engadin, where the majority of the sediment has been supplied from the catchment of the Val Fedoz and has been predominantly deposited in the Isola delta complex. On the one hand, catchment wide cosmogenic ^{10}Be denudation rates within the modern Val Fedoz and from Holocene delta sediments were obtained, suggesting rates of ~1 mm/yr for the late Holocene (Grischott et al, 2013). On the other hand, this presentation focuses on the evaluation of the sink system as a result of climate forced erosion in the Fedoz catchment. A high resolution seismic survey was combined together with two long piston cores from a distal and proximal position in relation to the Isola Delta. Geophysical and sedimentological data were obtained along with an AMS radiocarbon dating approach to reconstruct the Holocene sediment history of the lake. In combination with the seismic survey an isopach map and sedimentation rate time series were derived. The pattern of sediment distribution confirms the observation, that the Isola Delta is the major source of sediment in the lake basins during the Holocene. However, most likely a second tributary system existed during the Younger Dryas phase from the Maloja side. A comparison with regional and local climate records suggests that south Alpine climate trends control the geomorphic processes – and thus erosional an depositional regime - during the Holocene Thermal Maximum. Due to the complexity of deposition and a limited temporal overlap of source archives and sink records a clear linkage is difficult and under further investigation. A classical paraglacial cycle is not immediate obvious and the data imply that the regional climate has a larger influence on the sedimentation rate then the general proglacial sedimentary cycle.

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10.5

Glacier presence petrified in a Swiss high alpine stalagmite

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Speleothems (stalactites, stalagmites, flowstones) are used as paleoclimatic and environmental archives. Minimum conditions for calcite to precipitate are a supply of drip water and a temperature in the cave above 0°C. In high alpine environments, speleothem growth was documented not only during climate optimum intervals, but equally during severe cold condition at the cave site (e.g. glacial intervals, Spötl and Mangini, 2007). This will indicate (1) the presence of a warm-based glacier above the cave (providing both thermal isolation and water supply), or (2) permafrost conditions above the cave were overcome during an interstadial (warm period during a glacial period stage).

We present our results from stalagmite MF3, collected in Schafsloch Cave (Alpstein Mts., Appenzell Alps, 1890 m asl). 23 ^{230}Th ages document eight individual growth phases in the 20 cm long sample. The growth phases cover the time interval between 230 and 130 ka BP, including the penultimate glaciation in the Alps. Stable isotopes and trace element analysis proved to be extremely valuable to investigate surface processes in this area, whereas all other surface evidences were eroded during the last glaciation. Based on a multi-analysis approach, we identified and dated for the first time the former presence of a valley glacier above the cave during the penultimate glaciation. Soil evolution in the area during glacial and interglacial transitions is documented based on the organic matter content and trace elements in the calcite.

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10.6

Chronology of Middle Würm climate changes in the Swiss Alpine foreland

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The northern Alpine foreland plays a key role in the investigation of Quaternary climate evolution and the reconstruction of the glacial history of the Alps. However, the extent and timing of the various phases of glacier advance and retreat (stadials and interstadials) is still debated, in particular for the time prior to the Last Glacial Maximum (LGM). To improve the understanding of the phase of ice build-up during the Middle Würm (~50 to 25 ka), we have performed radiocarbon dating of selected key sites in the Swiss Alpine foreland.

Deposits of compressed peat ("Schieferkohle") in the Swiss Alpine foreland are one important archive for late Pleistocene climate changes. These organic deposits of up to several meters thickness are truncated by LGM glaciofluvial and glacial sediments. The presence of peat is interpreted to correspond to phases of glacier-hostile, interstadial climate conditions. Although several peat sections have already been studied in the 1960s and 70s using pollen analysis, reliable age data are not widely available.

Here, we present radiocarbon ages from several peat deposits located at Dürnten, SE of Zürich. Based on detailed pollen analysis in three drill cores from Dürnten, Welten (1982) has reconstructed several stadial-interstadial cycles since the end of the Riss glaciation and especially throughout the Würm. On one of these well-preserved drill cores, we were able to obtain radiocarbon ages. These allow to place the palynological data into an absolute timeframe and to establish a detailed chronology of the Middle Würm climate variations. Additionally, we present ^{14}C ages from surface outcrops of compressed peat which have been discovered in river beds and due to current construction work in Dürnten.

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10.7

OSL-thermochronology of Na- and K-feldspar from Namche Barwa, Tibet

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In contrast to other thermochronometric methods, optically stimulated luminescence (OSL)-thermochronology has a relatively low closure temperature (~30-70 °C) which offers the potential to constrain near-surface changes in exhumation rates over Quaternary timescales. However, as OSL signals saturate, successful applications of OSL-thermochronology are limited to rapidly exhuming environments or elevated temperature settings (e.g. tunnels or bore holes).

The Namche Barwa massif (eastern Himalayan syntaxis) is thought to have experienced extremely rapid exhumation throughout the late-Cenozoic to Quaternary period (e.g. Seward and Burg, 2008). This setting is therefore challenging for the application of traditional low-temperature thermochronometers, but provides a useful test-site for the application of OSL-thermchronology in resolving late-stage cooling histories. Six bedrock samples were hand crushed before using conventional methods to extract Na- and K-feldspar fractions. A multiple elevated temperature (MET) protocol was used which comprises infra-red stimulated luminescence (IRSL) measurements at 50, 100, 150 and 225 °C to record multiple IRSL signals for each individual sample. The different MET signals may have different thermal stabilities (thus different closure temperatures), and could therefore provide better constraint on cooling and exhumation rates. In addition to thermal trapped-charge depletion, feldspars also exhibit athermal charge loss (fading) which was measured and corrected for.

Preliminary results show that all Na-feldspar IRSL signals are in field saturation, whereas the IRSL50, IRSL100 and IRSL150 signals of the K-feldspar extracts of some samples exhibit thermal signatures. Incorporating sample specific laboratory-constrained kinetic parameters for these signals into a charge-trapping model, results in a predicted cooling rate of ~150 °C Ma^{-1} for sample NB140, in close agreement with independent cooling rate control from apatite fission-track ages adjacent to the sampling site (Seward and Burg, 2008). These results suggest that OSL-thermochronology has the potential to constrain Quaternary cooling histories and exhumation rates in rapidly-exhuming settings.

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10.8

Tectonic Control on Topographic and Exhumational Segmentation of the Himalaya

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Although the Himalayan range is commonly presented as cylindrical along-strike, geological structures, topography, precipitation, and exhumation rates as recorded by low-temperature thermochronology data all vary significantly from west to east. In particular, segments of the belt that are characterized by a clear topographic step between the Lesser and Higher Himalaya, associated with a peak in precipitation and focused exhumation (e.g. central Nepal, Himachal Pradesh) alternate with segments where the topography increases more linearly to the north, precipitation peaks at lower elevations and exhumation rates appear to be lower (e.g. western Nepal, Bhutan). The potential climatic or tectonic controls on these spatially variable topographic, precipitation and exhumational patterns have been widely discussed in recent years but remain unclear.

Thermo-kinematic modelling predicts that the geometry of the main Himalayan detachment (in particular the presence or absence of a major mid-crustal ramp) strongly controls the kinematics, exhumation and topography of the orogen. Where a major crustal ramp is present, the topography shows a steep gradient that focuses exhumation and orographic precipitation whereas the topography is gentler and exhumation less focused in the absence of a ramp. We test this prediction by comparing the pattern of topography, river incision and long-term exhumation in central Nepal, where a major crustal ramp has been imaged by geophysical methods, with new results from the remote Karnali River transect in far western Nepal, where a ramp is predicted to be absent or minor. Our results therefore imply that along-strike climatic variations in the Himalaya respond to tectonics rather than driving it. The presence or absence of a mid-crustal ramp may be due to inherited structures on the underthrusting Indian Plate or, alternatively, may reflect transient behaviour of the accreting Lesser Himalayan thrust stack, which may oscillate between frontal accretion (without a ramp) or basal accretion in the presence of a ramp.

10.9

Challenges in using luminescence dating to provide age control on Late Quaternary soil development on the central Swiss Plateau

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Well developed palaeosols (fBt-horizons) reaching a depth of more than 2 m are a widespread feature on glaciofluvial gravels in the central Swiss alpine foreland. These palaeosols are covered by loess-like sediments containing a weakly developed Holocene soil (Btv-horizon). Assuming full interglacial environmental conditions for the evolution of a Bt-horizon, the fossil Bt-horizons can be interpreted to represent the last interglacial (Eem), but so far there is no numerical age control.

Luminescence dating of the parent material of the palaeosols, i.e. the glaciofluvial sediments, and the overlying loess-like deposits could provide age contrains on the soil formation. Therefore, a case study was performed on 10 samples from the Aebisholz site, at which 5 samples were taken from the loess-like deposits and 5 samples from sand lenses in the glaciofluvial deposits parenting the fossil Bt horizon. Whereas the dating of the loess-like sediment appears straightforward, glaciofluvial sediments are known to be prone to incomplete bleaching during transport, which makes the dating more complex. For potentially partially-bleached sediments the application of a single grain method appears sensible, although the choice of mineral is not evident. Quartz single grain dating is considered a solid approach, but northern alpine quartz appears to exhibit dim signals and potentially unstable luminescence signal components. The use of feldspar for single grain methods is still at an experimental stage as it can be complicated by the presence of varying fading rates, although previous studies have shown that fading seems to be a minor problem for northern alpine feldspar. For the investigated glaciofluvial samples in this study, single grain measurements using feldspar show equivalent dose distributions that are significantly overdispersed pointing to partial bleaching and/or varying fading rates, and making it very difficult to extract the true depositional age. Single grain measurements using quartz lead to equivalent dose distributions showing slightly higher overdispersions than expected for well-bleached sediments, and also raising the question of whether the quartz signal also suffers partial bleaching in those samples. An alternative explanation could be a strongly inhomogenous radiation field. The methodological challenges of dating the glaciofluvial sediment samples, resulting luminescence ages and their implications for potential periods of Bt horizon formation on the central Swiss Plateau will be discussed.

10.10

Excavations at the Middle Palaeolithic site of Mutzig-Rain (Alsace, France)

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The site of Mutzig "Rain" was discovered by chance in 1992 during construction works. Subsequently several test trenches were made in the surounding area between 1992 and 1996. This test trenches brought to light a large Middle Paleolithic site. Since 2009, systematic excavations have been carried out by the Pôle d'Archéologie Interdépartemental Rhénan (PAIR), the Universities of Strasbourg, Basel, Cologne and Lille. During this excavation different layers with a rich archaeological and paleontological record were discovered documented. The abundant lithic and faunal assemblages are well preserved and date back to the Mousterian period ca. 90,000 years ago.

This presentation aims to present the site and its exceptional archaeological record as well as to discuss the first result from the archaeological, paleontological, geomorphological and micromorphological analyses.

10.11

Late Glacial Vegetation Reconstruction based on Leaf Waxes from the Gemündener Maar, Germany

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Lake sediments are valuable archives for the reconstruction of past changes in climate and vegetation. In the present study, we analyze samples from the Gemündener Maar, a lake situated in the western Eiffel, Germany, for their leaf wax composition: In the bottom part of the core, corresponding to the Oldest Dryas (i.e. older than ~15 ka), *n*- alkanes have a high average chain length (ACL), which points to a vegetation dominated by grass. During the Bölling/Alleröd, a decrease of the ACL can be interpreted as signal of more deciduous trees. During the Younger Dryas (~12.8 to 11.5 ka), the ACL increases again. The trees probably became again less abundant, before finally, the ACL records the return of deciduous trees during the early Holocene. In General, the total concentrations of *n*- alkanes are high enough to measure compound-specific isotopes. Fatty Acids are currently being measured to complement the alkane data.

P 10.1

Stratigraphy of Quaternary Deposits of the Mendrisiotto (Southern Swiss Alps)

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In the framework of the geological mapping of sheet 1373 Mendrisio (Geological Atlas of Switzerland 1:25'000), the stratigraphy of Quaternary deposits of the southern alpine foreland was revised. The availability of numerical datings on different kind of deposits maked it possible to drawn a regional stratigraphy based on glacial events and on climate proxies at the continental and/or global scale, which allowed four main chronostratigraphical units to be differentiated.

In particular, were grouped Postglacial deposits ("Depositi del Postglaciale"; 0–0.0117 Ma), referred to the entire Holocene, deposits of the Last Glacial Maximum and the Lateglacial ("Depositi dell'Ultimo Massimo Glaciale e del Tardoglaciale"; 0.0117–0.029 Ma) and deposits preceding the Last Glacial Maximum ("Depositi precedenti all'Ultimo Massimo Glaciale; 0.029–0.781 Ma), both referred to the Middle and Late Pleistocene (Figure 1), and deposits of the Lower Pleistocene ("Depositi del Pleistocene inferiore"; 0.781–2.588 Ma), referred to the Early Pleistocene.

This approach was transferred to the legend of the geological map, making it possible an immediate representation of both facies and age of the Quaternary deposits. Besides allowing a definition of the chronostratigraphical units relevant for other geological maps in the same regional framework (harmonised cartography), this kind of representation makes it possible a quick visualisation of the spatial extent of the main morphoclimatic events, as, for example, the maximal glacial extent during the Last glaciation compared to the previous glaciations.

This kind of representation has also facilitated the knowledge about the dynamics and direction of the main glacial flows in the region of Mendrisio, confirming the important role played by the Larian lobe of the Adda glacier with respect to the glacial lobe of the Lake Lugano.

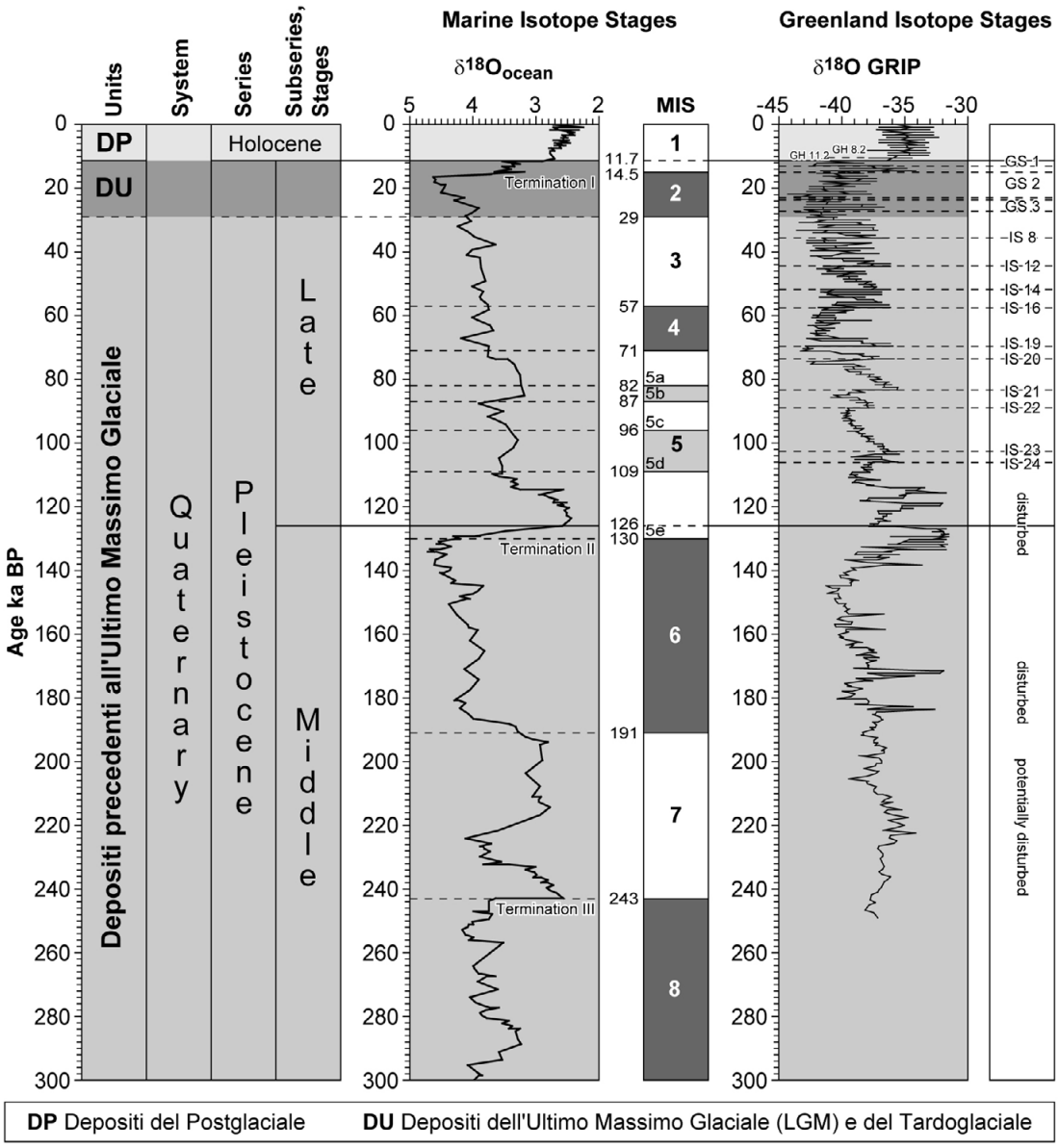

Figure 1. Chronostratigraphical units defined in the Mendrisiotto and correlation with the Marine Isotope Stages (MIS) and the Greenland Isotope Stages (GIS) for the last 300 ka. For GIS older than GS 3, only the main interstadials are reported.

P 10.2

Heavy metal distribution in lake sediments from the Joux Valley

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Located on top of the Jura Mountain, the Joux Valley is quiet unique not only because of her harsh climate but also because of the odd mixture of agriculture and industries, which coexist there since centuries. Until the mid 16th century, forests were intensively cut for the production of wood charcoal, which was then used in forges and steelworks throughout the Valley (ref.). A few iron mines were also exploited (ref). Starting in the 18th century, the Joux Valley slowly became a center for the Swiss Watch Making Industry.

Here we will present preliminary investigations into the heavy metal content in sediments from the Lake Joux, Lake Brenet and Lake Rousses (France). Sediment cores retrieved in 2013 and 2014 were dated by ^{210}Pb and ^{137}Cs radioisotopes. Trace element were analyzed both with an XRF core scanner and sporadically by inductively coupled plasma mass spectrometry (ICP-MS). Anthropogenic metal pollution was traced by normalizing to conservative elements, which record significant changes in soil erosion.

P 10.3

Pollution by phosphogypsum discharge into the Gulf of Gabes (Tunisia): Preliminary results.

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Phosphorites are the main mineral resource of Tunisia. Important deposits are located in the western part especially in the Gafsa basin. Five mining centres are currently exploited and ore phosphate is treated in three main industries located along the eastern marine coast: Sfax, Skhira and Gabes.

Phosphate treatment consists of the transformation of phosphorite into phosphoric acid using sulfuric acid with consequent production of large amount of phosphogypsum waste.

Phosphogypsum as a waste product is stored in spoil tips along the coasts and near the industries of Sfax and Skhira causing contamination of the marine environment by leaching processes (Zairi and Rouis, 1999). At Gabes, the waste products are discharged directly into the sea, including waste waters, industrial sludges and phosphogypsum.

In July 2014, an expedition was organized in Tunisia to collect the necessary information and samples to estimate the environmental impact by the phosphate industry of Gabes. Two different transects were sampled: A) from the shore to around 18 km off-shore in the Gulf of Gabes, considered as a polluted site and B) from the north-western margin of Djerba Island to around 15 km off-shore, considered as a pristine site.

During this campaign, sediments and water from the sea floor were sampled, video survey was performed and multiparameter (pH, temperature and dissolved oxygen) of the water quality were measured with a landing system. Water sampler, video survey system and landing system were developed and built at the Department of Geoscience of University of Fribourg especially for this study. Additionally, different analyses are being performed on sediment samples at the University of Fribourg as: 1) Total organic carbon (TOC); 2) elemental CHN; 3) Mineral carbon (MINC); 4) Grain size; 5) X-Ray diffraction.

Preliminary data from the landing system show low pH value (<6) next to the pollutant discharge area of Gabes. The overall temperature is generally higher along the Gabes transect than the Djerba transect and the dissolved oxygen values follow the opposite trend. The absence of sea grass prairies and siltation in the Gulf of Gabes were observed by the video survey. These different parameters are possibly caused by an important anthropogenic impact with consequent eutrophication of the marine environment.

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P 10.4

Khuzestan dust source identification with using Satellite images and Sedimentary Geochemistry

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Dust storm is one of the most important environmental problems in the west of Iran. To indicate the environmental impact of these phenomena, the characterization of dust storm loads is vital(Najafi etal. 2013). Recently Khuzestan province in southwest of Iran is affected by dust storm phenomena. This feature makes some problem in agriculture, Transportation, Communication and human health side effect in this province. Due to no enough research and study on physical and chemical characteristics of this dust storm in Iran, providing a systematic investigation is necessary. In addition of Geochemistry of particles Geo-Environmental characteristics of Trace elements as a major pollution is very important (Darvishi khatooni, 2014).

To indicate the environmental impact of these phenomena, the characterization of dust storm loads is vital. The objective of this study is to identify the mineralogical and chemical composition, trace elements of dust particles deposited during two years dust storm event over the west of Iran to obtain total suspended particulate. For example in 2 June 2012 according to satellite images the dust have risen from deserts(dried wetlands and lakes) of South East Iraq such as Horolazim and Horohhemar. In Ahvaz and Abadan Were sampled from dust that Elemental and mineralogical analysis of sediments shows very different Compounds. Differences in the source of dust (Various dried wetlands) is a major factor in this subject (table 1 & fig 1-A).

mineralogical analysis show HALITE+ CALCITE+ DOLOMITE+ QUARTZ for Abadan and CALCITE+QUARTZ+ GYPSUM(minor) for Ahvaz.

According to analysis and source of dust that Introduced, Mineralogical composition of dust that rising from the East and North-West Jordan, Syria and Iraq (Regions 1 and 3), Often is contains calcite, quartz, clay minerals and traces of dolomite, gypsum and feldspar that supplied from the dried lakes and wetlands and ancient lake sediments. Mineralogical composition Region 2 (South East Iraq) include halite, dolomite, calcite, quartz, gypsum. that supplied from the dried lakes and wetlands South West of Iraq, such as Horolazim and Horohhemar. Calcite, quartz, and feldspar is dust mineralogical composition that are incoming of Saudi Arabia (fig 1-B).

EL	Ahvaz	Abadan	EL	Ahvaz	Abadan	EL	Ahvaz	Abadan
Ag	<0.1	0.1	Hf	3.66	10.7	Hg	<0.04	0.06
As	4.6	3.6	La	11.25	27.1	Ho	0.42	1.1
B	28.64	21	Li	13.41	25.1	Th	3.48	12.2
Ba	193	315.2	Lu	0.12	0.3	Ti	1912	3182.1
Be	0.32	1.4	Mn	402	523.7	Tl	<0.5	0.8
Bi	<0.5	<0.5	Mo	3.72	1.3	Tm	0.13	0.2
Cd	0.31	0.1	Nb	8.25	18	U	5.42	3.4
Ce	12.46	28	Nd	1.64	24.8	V	55.07	97
Co	29.38	20.4	Ni	130	115.8	Sn	1.42	4.4
Cr	46.84	147.9	P	755	852.6	Sr	373	565.9
Cs	4.94	3.8	Pb	24.89	6.6	Ta	0.91	0.7
Cu	12.46	30.9	Pr	3.09	3.8	Tb	0.27	1.2
Dy	3.55	3.5	Rb	27.87	153.3	Te	0.29	<0.03
Er	<0.5	1.5	S	23869	>10000	w	1.29	
Eu	0.23	0.8	Sb	0.48	0.3	Y	9.61	15.6
Ga	3.52	11.4	Sc	6.99	11.7	Yb	0.95	1.9
Gd	2.22	3.7	Se	0.09	0.1	Zn	91.83	80.5
Ge	1.26	1	Sm	2.4	4.3	Zr	94.51	138.1

Table 1. Elemental analysis of dust sediments (2012.06.02)

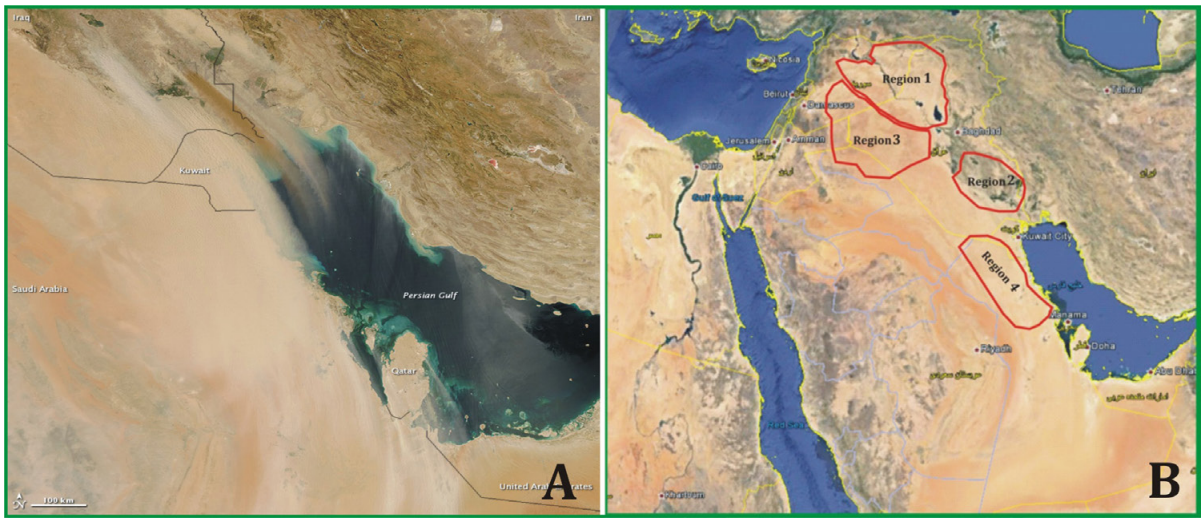

Figure 1. A: Dust storm, Imaging Date 2012.06.02 & B: Source of the dust in Khuzestan in order of preference

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P 10.5
Study Khuzestan dusts pollution with using Sedimentary Geochemistry

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Dust storm is one of the most important environmental problems in the west of Iran. To indicate the environmental impact of these phenomena, the characterization of dust storm loads is vital(Najafi etal. 2013). Recently Khuzestan province in southwest of Iran is affected by dust storm phenomena. This feature makes some problem in agriculture, Transportation, Communication and human health side effect in this province(FIG 1). Due to no enough research and study on physical and chemical characteristics of this dust storm in Iran, providing a systematic investigation is necessary. In addition of Geochemistry of particles Geo-Environmental characteristics of Trace elements as a major pollution is very important (Darvishi khatooni, 2014).

To indicate the environmental impact of these phenomena, the characterization of dust storm loads is vital. The objective of this study is to identify the mineralogical and chemical composition, trace elements of dust particles deposited during two years dust storm event over the west of Iran to obtain total suspended particulate.

Dust samples were collected from 3 cities in the south west of Iran. In addition to determining the sources of dust samples on the dates of sampling, synthetic approaches including remote sensing technique of dust detection and analysis of weather map were used. In this way, 27 samples from dust storms during 2 years in Khuzestan province were collected for XRD and ICP-MS analysis.

XRD result show that composition of these dust particles is similar to other dust particles in the world and Silty-Clay is dominant composition.

Enrichment factor values are classified as follows: EF <1, there is no enrichment (Ag, Mn, Sc, Ti, Tm, w),: EF <3 low enrichment (Ba, Be, Ce, Co, Cr , Dy, Er, Eu, Ga, Gd, Ge, Ho, Lu, Nd, Nb, P, Pr, Sb, Sm, Sr, Ta, Tl, V, Y),: EF: 3-5 enrichment medium (B, Bi, Cs, Cu, Hf, Hg, La, Li, Mo, Ni, Rb, Se, Sn, Tb, Th),: EF: 5-10 enrichment of moderate to severe (U), EF: 10- 25: severe enrichment (In, Pb), EF: 25-50: very severe enriched (As, Cd),: EF> 50 extremely severe enriched (S). In this study, the enrichment factor values for trace elements has been calculated. Enriched in some elements such as Hf and Ni are dangerous and Enriched heavy metals, especially Ni, V, Ba Hf, can be caused by hydrocarbon material pollution in Iraq and Khuzestan. Radioactive elements such as uranium enriched high concentrations show that it can be achieved remnants of war. Elements such as sulfur and arsenic, which are highly toxic and highly enriched indicate that anthropogenic sources are obtained (FIG 2).

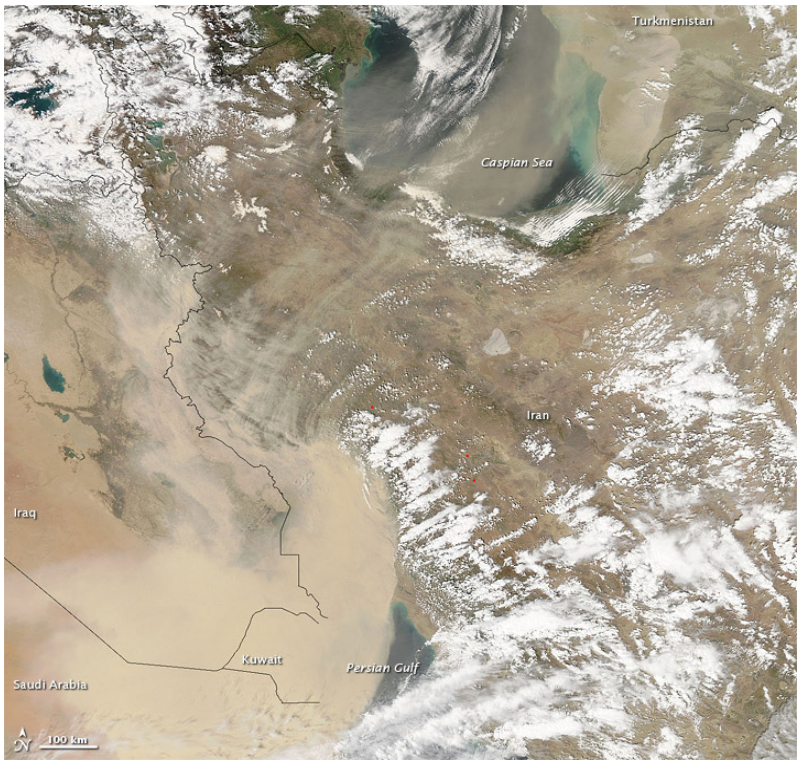

Figure 1. Dust storm, Imaging Date 2011.04.13

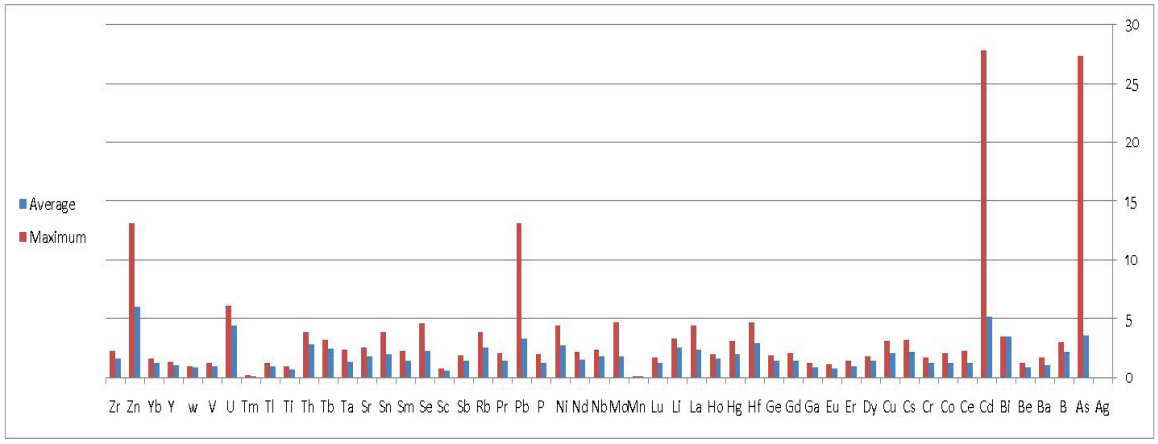

Figure 2. Enriched factor for different elements of dust particles in Khuzestan

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P 10.6

Dust containment priority in Khozestan plain, Iran

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Dust storm is one of the most important natural phenomena and a kind of severe natural disaster that begins and diffuses under the influence of atmospheric systems. It occurs frequently in desert lands and their surrounding areas in arid and semi-arid regions (Miri et al. 2009). The main factors influencing the amount of dust in the air include precipitation, vegetation cover, wind velocity, and soil particle size of dust-generating sources(Ta et al. 2004). Playa lakes are an important source for Aeolian and dusty storm sediments because of their location in the low land, arid and desert region with strong windy systems and exit fine and unconsolidated sediment. Iran is located in the west of Asia, and in the arid and semi-arid belts (Hojati et al. 2011). The annual rainfall ranges from 224 to 275 mm, and the central Iran has remarkable dust emission sources, which are one of the most prominent dust sources in the dust belt.

The northern parts of the region (northern Khuzestan), especially the mountainous areas, experience cold weather in winter and warm weather in summer. In mountainous areas, the annual mean of minimum temperature in the coldest month is less than –4 °C (in January). The southern parts of Khuzestan province, especially the low elevations and coastal areas, experience tropical weather. The annual mean of maximum temperature in the warm period is about 50 °C (in July) and the minimum winter temperature is 9 °C (in February).

In this research 71 surface sediment samples were taken for sedimentology and sedimentary geochemistry investigation. These samples were analyses in the geological survey of Iran laboratory. Sieve analyses, laser analyses, calcimetry, mineralogy (XRD), morphoscopy, morphometry and chemical analyses (ICP & AAS) have been done. The Results show that silt and clay size sediments are dominated that have suitable potential to wide distance and long time transportation. Sediments type in Khozestan plain is Slightly gravelly sandy mud, Slightly gravelly mud, Gravelly muddy sand, Slightly gravelly sand, Sandy mud.

With respect to particle, Most of the samples form very little silt and clay and gravel. Five area was found as dust containment priorities. Distribution of clay minerals (less than 2 microns) showed that Lands between the Abadan and Khorramshahr, Shadegan and Mahshahr cities in the South and in the North West Susangerd city is the main source that produced dust in the Khozestan province(Darvishi khatooni, 2014).

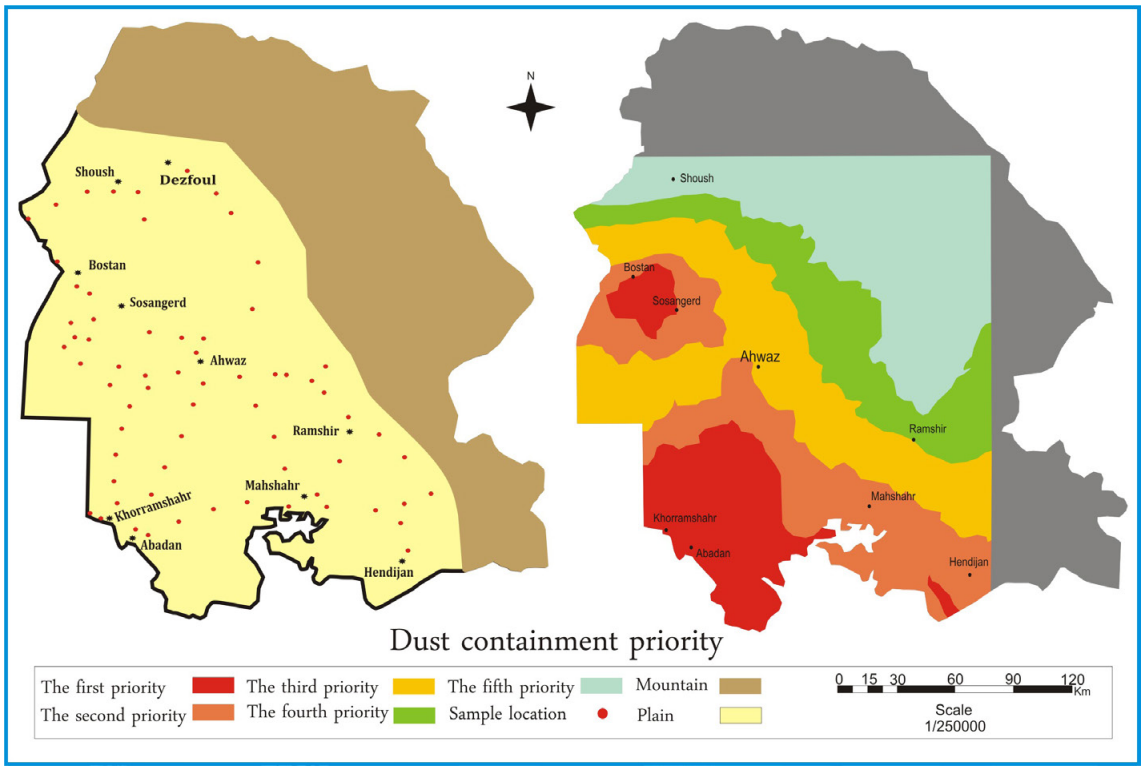

Figure 1. Dust containment priority and sample location in Khozestan plain

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P 10.7

Long chain n-alkanes and n-carboxylic acids as molecular proxies for paleovegetation

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Leaf waxes, such as long chain *n*-alkanes and *n*-carboxylic acids, may have a great potential for the reconstruction of past environmental and climate conditions (e.g. (Zech et al. 2013). The *n*-C_{27} and *n*-C_{29} alkanes often predominantly occur in trees and shrubs, *n*-C_{31} and *n*-C_{33} are more abundant in grasses and herbs while *n*-C_{23} and *n*-C_{25} characterize the input of freshwater plants (Ficken et al. 2000) or Sphagnum moss (Pancost et al. 2002). A decrease in humidity can also affect the synthesis of the dominating *n*-alkane, because it leads to a synthesis of *n*-alkanes with higher carbon chain lengths (Smith et al. 2001). However, little is known about chain-length distributions of *n*-carboxylic acids, and very few studies have systematically investigated leaf waxes in topsoils.

The aim of our study is to examine the potential of *n*-alkanes and *n*-carboxylic acids as proxies for the reconstruction of past vegetation. First results come from a study of approximately 100 litter and topsoil samples that were taken during a sampling campaign in November 2012 on a transect from Southern Germany to Sweden. The data show that sites under deciduous trees often contain a lot of C_{27} *n*-alkanes and C_{28} *n*-carboxylic acids. Coniferous sites are characterized by dominance, yet relatively low concentrations in *n*-alkanes C_{29} and C_{31} and have relatively high concentrations of *n*-carboxylic acids C_{22} and C_{24}. Grass sites show a Cmax at C_{31} for *n*-alkanes and have more C_{32} and C_{34} *n*-carboxylic acids than tree sites. Differences in homologue patterns are most pronounced in the litter samples, but are well preserved also in the topsoils (0-3 cm depth, a little less in the lower topsoils from 3-10 cm). These results illustrate the potential of combining *n*-alkane and *n*-carboxylic acid analyses for paleo-vegetation reconstructions, yet indicate that the degree of degradation may have to be taken into consideration (Zech et al. 2013). To assess the full potential of the *n*-alkanes and *n*-carboxylic acids as proxies for past vegetation we are currently analyzing additional samples from Spain, southeastern Europe, Armenia and Siberia.

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P 10.8

The age of terrestrial biomarkers in lacustrine sediments as an historical indicator for anthropogenic soil erosion

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Soils are an invaluable resource, as they represent the base for food production, and play an essential role in nutrient and hydrological cycles, and atmospheric carbon dioxide levels. Human activities have accelerated their natural erosional processes to a critical point (e.g. Le Bissonnais et al., 2001; Gobet et al., 2003), so that the preservation of soils now becomes a major challenge. The knowledge of the extent and rate of soil degradation is though still very limited. To accurately assess the impacts of human activities on soil, information is needed on organic carbon dynamics before farming started, as well as how it changed with the evolution of agricultural practices.

Lake sediments are reliable continuous high-resolution archives recording natural and anthropogenic conditions that prevailed in their surroundings, integrating a catchment-wide signal (e.g. Dearing, 2006; Jacob et al., 2008; Ariztegui et al., 2010; Lavrieux et al., 2013). Paleolimnological records have already revealed the impacts of land use changes on lake sedimentation (e.g. higher detritism caused by deforestation) and how it affects lacustrine trophic levels. However, the impact on the soil itself remains poorly known.

This pilot study aims at evaluating the impact of human activities on the residence time of organic carbon in soil, *i.e.* to establish the links between development of agricultural practices and soil degradation. The rationale is that the emergence of modern agricultural practices, such as plowing, deeply affected the soil, entailing a rapid flushing of old soil and the release of a stock of fossil terrestrial molecules (*i.e.* biomarkers) towards the sedimentary archive. These biomarkers are radiocarbon (^{14}C) dated to assess their age. Then, their age difference with "fresh" (*i.e.* instantaneously deposited) terrestrial plant macrofossils found in the same sedimentary horizon, and therefore contemporaneous, is estimated. In our hypothesis, these terrestrial biomarkers are thus supposed to be older than the surrounding sediment. However, it may be possible that soil was significantly destabilized centuries before by early deforestation. This hypothesis will be validated or invalidated by ongoing measurements.

This presentation will show the preliminary results obtained on a sedimentary core recovered in Lake Joux (Jura Mountains, Switzerland). Information provided by the different proxies (magnetic susceptibility and X-ray fluorescence measurements, high-resolution pictures, radiocarbon dates) illustrate anthropogenic activities imprints on the sedimentary dynamics.

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P 10.9

Recent mass transport deposits in Lake Biel: tracking their ages, causes and consequences

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In 2010, a seismic reflection survey in Lake Biel's North Eastern basin revealed a recent mass transport deposit in the vicinity of the intake pipe of a drinking water treatment plant. During this work, sediment cores were retrieved in and around the identified zone in order to provide evidences of the timing, causes and consequences of the observed deposit. The spatial distribution of the identified lithologies, the correlation of the cores with the seismic lines and the chronologies indicate that not only one but several mass movements occurred repeatedly, initiated at the East bank of the lake. Results need to be confirmed by a multibeam survey, and will be of interest for the optimisation of the location of the treatment plant's intake.

P 10.10

Understanding Pre-Columbian environmental adaptations strategies in agriculture: A case study of raised fields in Exaltación, in the Bolivian lowlands

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The floodplain of Llanos the Moxos (LM) situated in the Bolivian lowlands is subject to annual variability in flooding with extreme floods resulting in substantial impacts on people's livelihoods. This year's flooding was extremely severe and indigenous communities, who always live on the most elevated parts along river levees, were highly affected; their houses were heavily damaged and entire crops were lost (Ecologist 2014). Since the early Holocene the LM has been inhabited (Lombardo et al. 2013). Studies regarding South America, also including the LM, have shown that the Holocene time period experienced significant climate fluctuations to which people had to adapt (Carson et al. 2014, Plotzki et al. 2013; Mayewski et al., 2004). A variety of Pre-Columbian earthworks in the lowlands of Bolivia, belonging to different time periods, can be found in this region and are one important source to help understand past adaptation strategies to climate and landscape changes during the Holocene (Lombardo et al. 2013; Prümers et al., 2006; Michel, 1993; Walker, 2014). One of the most striking examples is the thousands of kilometres of raised fields built in the LM, in south-western Amazonia. Pre-Columbian Raised Fields are earth platforms of differing shape and dimension that are elevated above the landscapes natural surface. There is still little explanation concerning their construction, management or time frame during which they were in use. A detailed study in the proximity Exaltación has shown this site to be of considerable importance for the study of raised fields because fields here co-occur in two totally different settings. Some Fields were built in a depression consisting of silty clay and organic rich material while others were constructed on the upland on a palaeo-leeve comprising highly weathered loamy sediments (Fig 1). Nowadays during the rainy season the fields in the depression are inundated whereas the fields located on the elevated paleo-levee are not subjected to flooding. The coexistence of this two distinct settings raises some important questions regarding the time of construction and use or/and cultivation of different

kind of crops. In order to investigate this issues a topographic transect of 630m from the paleo levee through the depression was measured using a digital level Sokkia D50 (Fig.1). Three sites were chosen for excavation of pits comprising always the elevated bed of the Field and the adjunct canal. Description and standard soil horizon/layer identification procedures were carried out followed by sampling every 10 cm for standard soil lab analysis. The results show that the fields in the depression, in reference to the fields on the elevated part, were built on an area lying approximately 1m lower. This difference in elevation in combination with the fact that the sediments are silty clay suggest the existence of prolonged local wet conditions (until well into the dry season when water can be scarce). The results of the cation exchange capacity (CEC) indicate that the soil in the depression is much more fertile compared to the soil of the nearby elevated part. Nevertheless, also the soil in the depression has a very high amount of exchangeable aluminium; which is toxic to most plants in these quantities. For a better understanding of this subject further analysis are in progress. So far the most likely explanation is that the fields in the depression were very probably not used during the same season as the fields in the surrounding upland. This site seems to be a unique example were fields co-exist in different settings and is of considerable importance for further studies to understand why and how Pre-Columbian people were using and managing the raised fields in the LM.

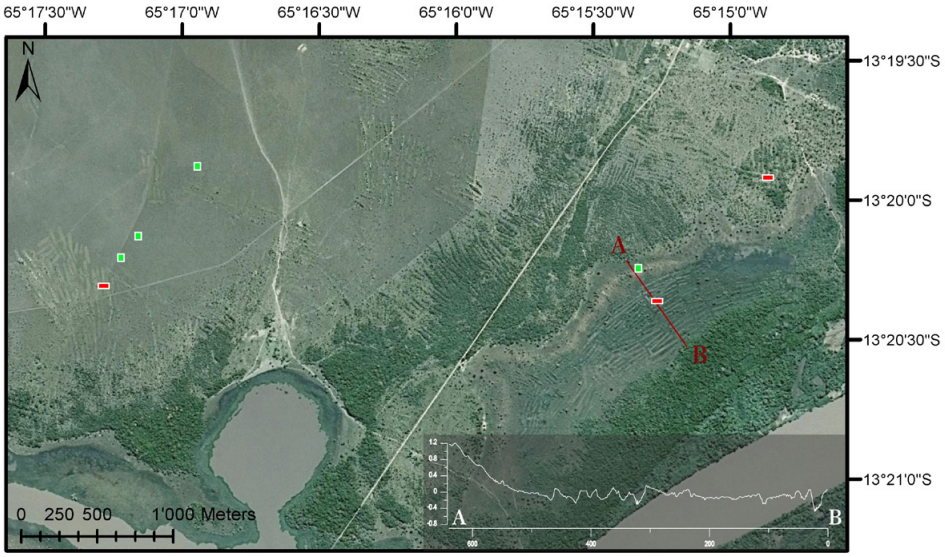

Figure 1: Study site close to Exaltación showing excavated pits of fields (red squares) and reference profiles (green squares). Transect trough the depression from A to B showing the elevation profile.

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P 10.11

Development of an RF-EMF exposure surrogate for epidemiologic research from modelling, personal measurements and operator data

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Introduction
Nowadays exposure to radiofrequency electromagnetic fields (RF-EMF) is ubiquitous and their potential effect on health, behaviour and cognition are still unknown. For epidemiologic research on that topic accurate exposure assessment is a crucial part. The aim was to develop an integrative exposure surrogate measure to estimate both, whole-body and brain exposure which can be applied in epidemiological research on RF-EMF emitted from different sources.

Methods
The HERMES (Health Effects Related to Mobile PhonE use in adolescentS) study, an ongoing cohort study conducted in Central Switzerland, aims to prospectively investigate whether the exposure to RF-EMF emitted by mobile phones and other wireless communication devices affects cognitive functions or causes behavioural problems and non-specific health disturbances in adolescents. 439 adolescents with a mean age of 14 years participated in the baseline investigation of the HERMES study conducted in 2012 and 2013.
In a subgroup of the study participants personal measurements were conducted. The adolescents carried a portable measurement device, a so-called exposimeter, to measure individual near- and far-field exposure on 13 different frequency bands for three consecutive days.

Far-field exposure to fixed site transmitters was modelled using a geospatial propagation model(Bürgi et al. 2010). Contribution of far-field exposure from WLAN (Wireless Local Area Network) and DECT (Digital Enhanced Cordless Telecommunications) base stations have been identified by means of regression models from personal measurements. Predictors of the near-field exposure were identified from the literature (Lauer et al. 2013).

To evaluate the impact of differences in the power control of GSM (Global System for Mobile Communications) and UMTS (Universal Mobile Telecommunications System) mobile phones, personal measurement data was related to mobile phone operator data.

Results
Based on personal measurements from 71 adolescents carrying an exposimeter between 42 and 121 hours and filling out an activity diary, the following far-field WLAN and DECT exposure predictors have been identified: WLAN at school, WLAN at home and not switching off the base station during night and DECT phone base station placed in the bedroom, the living room or the kitchen. For the uplink far-field exposure the number of smartphones used by the family and the time spent in trains and buses were relevant predictors.

We found indication that type of network is relevant since duration of GSM calls was associated with personal uplink exposure levels whereas duration of UMTS calls was not (see table 1).

mean uplink [mW/m²]	coefficient	standard error	p value	95% confidence interval
duration calls GSM [min/day]	0.015	0.004	0.001	[0.007,0.023]
duration calls UMTS [min/day]	-0.023	0.015	0.134	[-0.053,0.007]
duration calls Unknown [min/day]	0.091	0.63	0.886	[-1.182,1.365]
constant term	0.032	0.017	0.072	[-0.003,0.066]

Table 1: Result of the multivariable regression predicting the mean uplink exposure by means of duration of calls with the mobile phone using different networks (number of observations = 44).

Conclusion
The preliminary results indicate only a few relevant exposure predictors.
Although the proposed approach is proven to be feasible to combine near- and far-field exposure sources to an integrative whole-body and brain exposure value, more data is needed to obtain more robust and significant estimates.

The HERMES-cohort study will use the developed exposure surrogate for epidemiological studies on mobile phone use in adolescents and its potential detrimental health, behavioural and cognitive outcomes. It will provide a more accurate assessment of this variable than subjective or modelled exposure assessment since it takes different sources of exposure in account and is based on personal measurements.

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P 10.12

Quantifying the impact of anthropogenic activities on the erosional and sediment budget in the Rhône River basin– the SEDFATE project.

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In the most recent geological past, mountainous landscapes such as the European Alps have been shaped by erosional and sediment transport processes during multiple glacial and interglacial cycles. In addition to a climate driving force, seismic (short-term), tectonic and realted exhumation processes have a profound impact in shaping the sediment availability in these systems. The glacial inheritance of these landscapes has influenced the sediment availability through the conditioning of the hydrological and geomorphic responses of the system. During the past ca. 200 years, human activities have modified the processes operating in these environments, which has changed the sediment budget in the watersheds. Specific tasks like dam construction flow abstraction, sediment flushing, river channelization, gravel mining and changes in land use,have had measurable impacts on the hydrologic and geomorphologic conditions in these environments.

SEDFATE is a collaborative project, funded through the Swiss National Science Foundation (n. CRSII2_147689), which aims at disentangling the controls of human activities from those associated with climatic variations on the erosional and sediment transport mechanisms. It focuses on the Rhône River basin where the routing of the sediment will be traced from the source to its sink in Lake Geneva. We have framed these tasks in 4 sub-projects, where specific aspects relevant for the overall scope will be addressed..

Sub-project A (UniGe) focuses on the pattern of sediment flux to Lake Geneva. Sedimentation rates, detailed bathymetric and seismic data will be used to quantify the sediment flux. Sedimentological signature of the sediments will be characterized and traced upstream to the Rhône River basin.

Sub-project B (UniBe) analyzes the sediment assemblage of selected sub-basins of the Rhône River and will correlate them with sedimentation rate changes in the Lake Geneva sedimentary record. Sediment sources will be determined through XRF, REE and heavy mineral assemblage analyses. Erosional fluxes will be measured with in-situ ^{10}Be. Physical sediment fluxes will be determined through cosmogenic nuclide dating and geomorphological analysis..

Sub-project C (UniL) will focus on the Val d'Hérens basin, which hosts the Grande Dixence dam that retains 30% of the total water abstraction in the Rhône River. The impact of water abstraction, sluicing and flushing on the downstream sediment transport and redistribution will be assessed. This will be achieved by the analysis of representative water intakes, remote sensing, in-stream measurements and sediment transport modeling.

Sub-project D (ETHZ) upscales the findings of sub-project C in the Val d'Hérens and will implement a physically-based model to the Rhône River basin. Sediment production and transfer, and their uncertainties, is the main focus of this sub-project. Variations and trends in the in sediment transport will be assessed through hydroclimatic and streamflow analysis of data for the last ca. 100 years.

The interdisciplinary approach of the SEDFATE project is designed to successfully quantify the sediment transfer rate variation in the Rhône River as a result from anthropogenic activities against a background of climatic change.

P 10.13

Building high resolution radiocarbon dating chronologies for the reconstruction of late Holocene landslide events in the Mont Blanc area, Italy

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The Ferret valley Arp Nouva peat bog located in the Mont Blanc massif was critically evaluated since previously published radiocarbon dates have led to controversial conclusions on the formation of the swamp. Radiocarbon dating of roots from three pits of up to 1 m depth was applied to discuss the question whether the historical documented rock avalanche occurring in AD 1717 overran the peat bog or formed it at a later stage. For the deepest root samples ages between 302-145 cal yr BP and 284-84 cal yr BP were obtained, which fit very well into the time frame of the historical documented AD 1717 rock avalanche event. It can therefore be concluded that the rock avalanche formed the Arp Nouva peat bog by downstream blockage of the Bellecombe torrent. Furthermore, careful sample preparation with consequent separation of roots from the bulk peat sample has shown that the problem of too old ^{14}C ages can be circumvented. This work demonstrates that a combined geomorphological and geochronological approach is the most reliable way to reconstruct landscape evolution, especially in light of apparent chronological problems. The key to successful ^{14}C dating is a careful sample selection and the identification of material that might be not ideal for chronological reconstructions.

P 10.14

A Record Of Late Glacial And Holocene Environmental Changes In The Bohemian Forest, Czech Republic: The History Of A Central European Upland After LGM

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During cold periods of the Late Pleistocene, the Bohemian (Bavarian) Forest, a central European Hercynian mountain range, belonged to an area lying between the extensive Alpine and Scandinavian ice sheets. Only local mountain glaciation, mostly limited to cirques, developed in the Bohemian Forest during the Late Pleistocene. These small glaciers could more sensitively react to environmental changes and reflect regional climate changes. The objectives of the research were (i) to compare the sedimentary record and local glacial chronologies from the Bohemian Forest and (ii) to determine the impact of regional and supraregional (European) climate changes on the environment and the dynamics of natural processes in the central European medium-altitude mountain range.

A multi-proxy reconstruction of the mid-altitude environment of the Bohemian Forest in the Late Glacial and Holocene is established. A core in a peatbog in the Černé Lake cirque was analysed with respect to various lithological and geochemical parameters, pollen and macrofossil content, supplemented by 2 OSL and 10 AMS radiocarbon dates. The sediment sequence indicates not only high synchronisation of the local processes with environmental changes in the larger region of central Europe but also some local specific events. Unlike the central European mountain ranges the Younger Dryas in the Bohemian Forest was not connected with glacier readvances but it was a dry cold episode with low lake levels which prevails till the early Preboreal. Most of the environmental changes during the Late Glacial and Early Holocene were sudden compared to gradual changes in the Middle and Late Holocene. Consecutive changes in the sedimentation and vegetation succession (limnic environment – fen/peatbog – open raised bog) correspond to the Holocene Sub-series. Further, we discussed rubidium content in the sediment as a proxy of environmental changes (wind activity, soil erosion, and afforestation) during the Late Glacial and Early Holocene. Afforestation and soil development began in the region during Early Holocene. Treeline exceeded the altitude of ~1000 m a. s. l. before 9.7–9.3 cal. ka and coincided with rapid geochemical changes in the sediment. The beginning of the Middle Holocene was connected with peat aggradation and decline of shallow water reservoirs in the mountain range.

P 10.15

Subglacial erosion rates quantified by cosmogenic Be-10 and Cl-36 nuclide concentrations

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The accumulation of cosmogenic nuclides in exposed rock surfaces is frequently used by geomorphologists as a chronometer to determine absolute ages of various landforms. In the Alps, numerous landslide deposits and moraines have been dated with this method.

Looking beneath the surface, production of cosmogenic nuclides decreases with depth in the rock. This decrease follows an exponential relationship for the dominantly spallogenic Be-10. At approximately 2-3 m below the surface, almost no more Be-10 is produced. Muons penetrate deeper into the rock. Stronger contributions of muonic production pathways therefore cause Cl-36 to be continually produced at greater depth, typically reaching minimum detectable limits at 4-5 m depth.

Consequently, recently exposed bedrock surfaces in glacial forefields are not expected to contain significant cosmogenic nuclide concentrations, if the glacier is assumed to have eroded more than 5 m in total. However, with less subglacial erosion, nuclides accumulated during previous periods of exposure are preserved in the rock. They can be used to quantify the depth of subglacial erosion.

We present the results of AMS measurements conducted at the Laboratory of Ion Beam Physics at ETH Zürich of cosmogenic Be-10 and Cl-36. The samples were collected on a bedrock ridge in front of the Goldbergkees in Nationalpark Hohe Tauern, Austria, that recently became ice-free. The information is used to derive a spatial pattern of subglacial erosion on the ridge.

P 10.16

The D/H signal of Holocene and modern leaf waxes in the sediments and catchment of a south-Alpine lake

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The hydrogen isotopic composition (D/H) of leaf waxes is a high-potential tool for studying past and present hydro-climatic conditions (Sachse et al. 2012). Yet, for an improved understanding and thus interpretation of D/H paleo-records more research on the climatic and catchment-specific mechanisms governing the D/H composition of leaf waxes is required.

Here we present a Holocene D/H record of *n*-C_{28} fatty acids from the sediments of Lake Ghirla, located at the foot of the southern Alps (N-Italy). Complementing the paleo-record, we conducted a catchment study investigating the D/H composition of modern leaf waxes of the main tree species, river-bed sediment, and riverine water samples. This study on modern samples serves for assessing potential isotopic effects on the sedimentary leaf wax D/H signal due to the catchment's altitude profile (600 m) as well as tree vegetation changing over time.

The leaf wax paleo-record is characterized by an overall three-part division showing a δD enrichment trend (-155 to -140 vs SMOW ‰) from 11.5-6.6 cal kyr BP, followed by a period with more depleted values (~-160 ‰) from 6.5 cal kyr BP until 100 years ago, and an abrupt increase (plus 30 ‰) in the δD composition for the most recent 60 years. These main characteristics are interrupted by shorter excursions, of which the most conspicuous occur at 8.5-8.1 cal kyr BP (minus 15 ‰), at 2.7-2.2 cal kyr BP (minus 10 ‰), and at 400-150 cal yr BP (plus 15 ‰). Catchment samples collected during the dry and warm spring of 2014 indicate an inverse altitude effect for riverine water samples (+0.3‰/100m) and leaf waxes (+6.3‰/100m), which we interpret as increasing evapotranspiration with higher altitude. No altitude effect is observed for catchment samples collected during the wet spring of 2013. In regard to the leaf samples from different tree species, no systematic difference of the leaf wax δD values was recognized.

Interpreting the paleo-record, our results suggest isotopic enrichment during dry and warm climatic periods (early/mid-Holocene, recent decades), which may be primarily due to enhanced evapotranspiration. In fact, warm Alpine climate of the past has been attributed with rather dry summer conditions (Wirth et al. 2013a,b) favoring evapotranspiration during the vegetation period. In contrast, the more depleted D/H signal from 6.5 cal kyr BP until 100 years ago may reflect wetter and possibly also cooler climatic conditions. The isotopic enrichment at 400-150 cal yr BP (Little Ice Age, cool and wet), however, does not follow this pattern and thus requires further research. Two potential scenarios are an increased contribution of Mediterranean moisture, which is compared to North Atlantic moisture isotopically enriched (LeGrande & Schmidt 2006), or erosion of older soils due to enhanced precipitation and thus deposition of compounds out of chronological order with the lacustrine sediment sequence.

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P 10.17

Post-glacial Landscape Evolution of the Upper Haslital Aare between Handegg and Guttannen (Bernese Alps)

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Postglacial environments in alpine settings are affected by the adjustment to the prevailing interglacial climate conditions by various geomorphic processes. Quantitative information of valley reshaping processes, ages of landforms and specifically valley fillings, however, are scarce in the Central Alps. The upper Haslital (Bernese Oberland) between Handegg and Guttannen represents an ideal study area to investigate the post-glacial evolution of an alpine valley. The mapping of the inner valley revealed that mass-wasting processes with debris flow and rock fall deposits as well as talus cones dominate the valley floor. One of the largest fan-systems, beside the Rotlaui Fan, is the currently active Spreitlaui fan system which was investigated in detail in terms of geomorphic forms and processes, sedimentary units and dated for an absolute age chronology. Cosmogenic surface exposure dating of thirteen boulders on distinct geomorphic units yielded ages between 1.4 kyr and 7.7 kyr. Further absolute ages were obtained by the radiocarbon dating by sampling the modern Spreitgraben and investigating an available 90 m core. The measured ages show an oldest age around ~10 kyr cal. BP at a core depth of 85 m. Together with interpretations of available seismic profiles a qualitative reconstruction of the Holocene sedimentation pattern was possible. An early phase of the Spreitlaui formation, right after the retreat of the Aare glacier, was characterized by high sedimentation rates. Afterwards, at least one but possibly two landslide events (likely ~8 and ~3 kyr) occurred within the Spreitlaui system. Their timing correlates broadly with the landslide activity observed elsewhere in the Alps, specifically in the late Holocene. Additionally, dated debris flow events overlap with phases of high flood activity in the northern Alps. This suggests that the postglacial landscape evolution of the Haslital is largely controlled by climate forcing in combination with a glacially preconditioned landscape, characterized by threshold slopes and large amounts of freely available debris.