SWISS SED Meeting

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Saturday, February 25, 2023

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Programme and Abstracts

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28th SwissSed Meeting, June 2022

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To become a member, please contact:

Prof. Flavio Anselmetti
Institute of Geological Sciences
University of Bern
Baltzerstrasse 1+3
3012 Bern
Switzerland
Tel.: +41 31/ 631 87 06
E-mail: flavio.anselmetti@geo.unibe.ch

Prof. Anneleen Foubert
Department of Geosciences – Geology
University of Fribourg
Chemin du Musée 6
1700 Fribourg
Switzerland
Tel.: +41 26/ 300 89 78
E-mail: anneleen.foubert@unifr.ch

Prof. Vincenzo Picotti
ETH Zurich
Geological Institute, NO E 51.2
Sonneggstrasse 5
8092 Zürich
Switzerland
Tel.: +41 44/ 632 81 60
Email: vincenzo.picotti@erdw.ethz.ch

Prof. Elias Samankassou
Department of Earth Sciences
University of Geneva
Rue des Maraichers 13
1205 Genève
Switzerland
Tel.: +41 22/ 379 66 20
E-mail: elias.samankassou@unige.ch

Dr. Silvia Spezzaferri
Department of Geosciences – Geology
University of Fribourg
Chemin du Musée 4
1700 Fribourg
Switzerland
Tel.: +41 26/ 300 89 77
E-mail: silvia.spezzaferri@unifr.ch

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29th SwissSed

February 25, 2023

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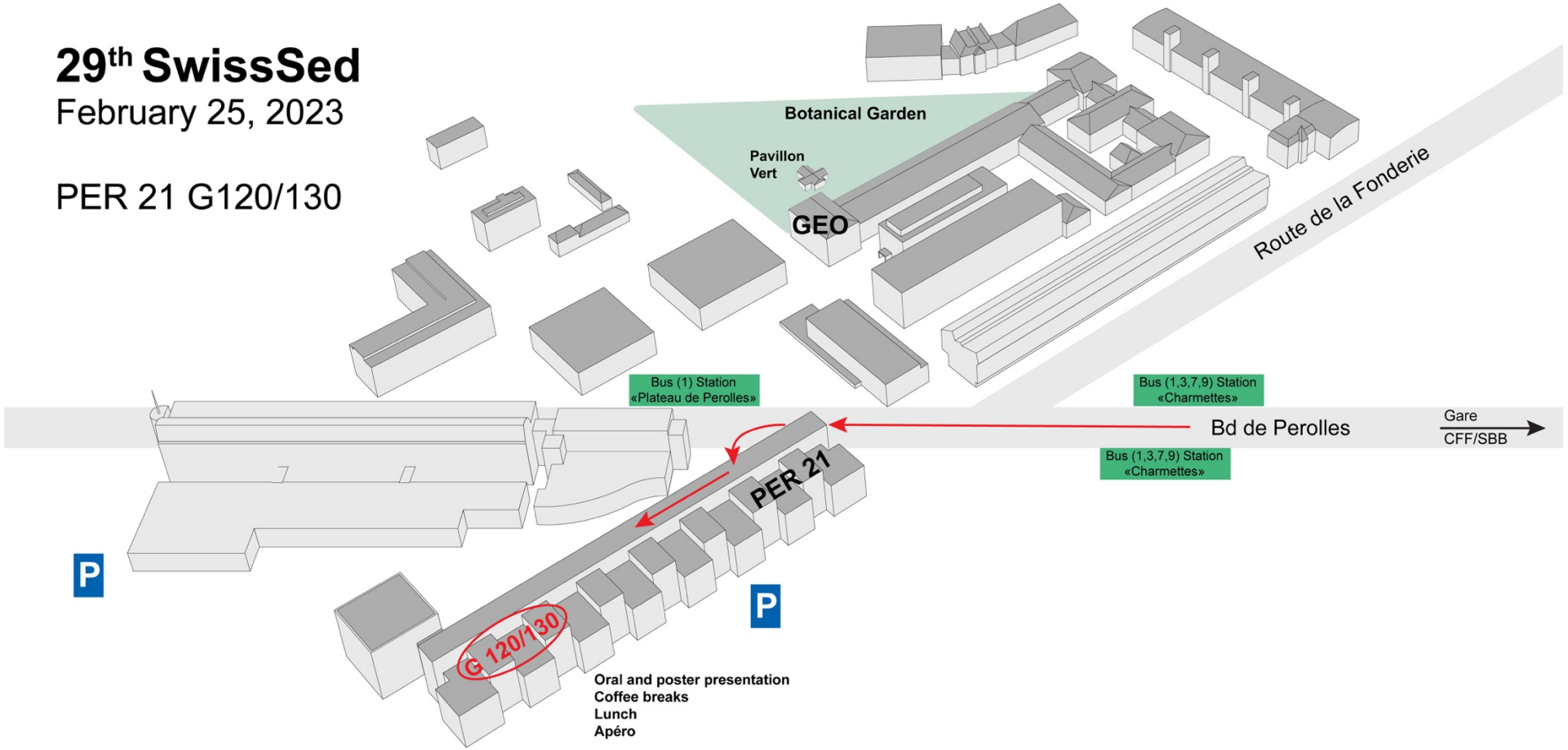

PROGRAMME

09.00 - 09.30 Morning coffee and croissant

09:30 - 09:40 Opening: Anneleen Foubert and Alicia Fantasia

09:40 - 10:20 **Invited talk**
Nina Zeyen et al.: Integrative analysis of the mineralogical and chemical composition of modern microbialites from ten Mexican lakes: what do we learn about their formation?

10:20 - 10:40 **Febbo, M.B.**, Omodeo-Salé, S., Moscariello, A., Cesaretti, N., Tomezzoli, R.: Diagenesis and burial history of the Tunas Formation (Permian) at the Claromecó Basin (Buenos Aires province, Argentina)

10:40 - 11:00 **Müller, M.**, Picotti, V., Hemingway, J.: Diagenesis and dolomitization of a Norian bioherm and the adjacent intraplatform limestone in the Dolomia Principale of the Lombardy Basin (Southern Alps, NE-Italy): insights from petrography and stable isotope proxies

11:00 - 11:20 **Gastineau, R.**, Sabatier, P., Fabbri, S.C., Anselmetti, F.S., Roeser, P., Şahin, M., Gündüz, S., Gebhardt, A.C., Franz, S.O., Niessen, F., Duarte, E., de Sigoyer, J.: Seismic Cycle of the Middle Strand of the North Anatolian Fault: Combined On-Fault and Off-Fault Paleoseismic Evidence in Lake Iznik (NW Turkey)

11:20 - 11:40 **Lazarev, S.**, Maul, L.C., Kuiper, K., Becker, D., Bukhsianidze, M., Hovakimyan, H., Sahakyan, L., Vasilyan, D.: Pliocene volcanic terrain of the South Caucasus: a hidden archive of Eurasian paleobiogeography

11:40 - 12:00 **One-slide Poster presentations** (all poster presenters)

12:00 - 13:00 Lunch (and posters)

13:00 - 13:30 Poster Session

13:30 - 14:15 **Keynote**
Guillaume Suan et al.: Reconstructing sediment and carbon fluxes across Paleogene and Jurassic hyperthermals and implications for carbon cycle dynamics

14:15 - 14:35 **Le Houedec, S.**, Mojtahid, M., Bicchi, E., Hennekam, R., de Lange, G.: High resolution deep-sea ecosystem variability of the Nile prodelta during the past 20 Ka revealed by Benthic Foraminifera

14:35 - 14:55 **N'nanga, A.**, Anselmetti, F.S.: The southward expansion rate of the desertification in the Adamawa Plateau (Central Cameroon): implication for the speed of the Sahel desertification progress in Central Africa

14:55 - 15:15 **Rime, V.**, Negga, H., Jaramillo-Vogel, D., Perrochet, L., Endeshaw, A., Gebru, E.F., Schaegis, J.-C., Atnafu, B., Kidane, T., Foubert, A.: Factors controlling the sedimentary architecture in an active rift basin: lessons learnt from the Danakil Depression, Ethiopia

15:15 - 15:45 ***Coffee break and poster session***

15:45 - 16:05 **DiPaolo, C.**, Vetsch, D.F., Anselmetti, F.S., Kremer, K.: Hydro- and morphodynamic modelling of a lacustrine tsunami and its deposits

16:05 - 16:25 **Douillet, G.A.**, Dietrich, P., Verhoeven, V., Leu, W., El-Alfy, A., Meier, P., Schlunegger, F.: Characterization of the Quaternary glacial overdeepening beneath Bern: infill by local lateral fans

16:25 - 16:45 **Zwaan, F.**, Schreurs, G., Adam, J., Brune, S., Glerum, A., Vasey, D., Naliboff, J.: How erosion and sedimentation impact rift tectonics and mantle exhumation

16:45 - 17:05 **Schlunegger, F.**, Kissling, E.: Controls of slab loads beneath the Alps on the source-to-sink sedimentary pathways in the Molasse basin

17:05 ***Closure and Apéro with poster session***

POSTERS

Adrien Bijoux, Alicia Fantasia, Thierry Adatte, Nils B. Baumann: The Paleocene-Eocene Thermal Maximum at Contessa Road section, Italy: First results of a multiproxy palaeoenvironmental study

Damanik, A., Tournier, N., Fabbri, S.C., Wiguna, T., Rare'a, H., Rare'a, J., Sabintoe, M., Cahyarini, S.Y., Vogel, H.: Modern hydrology and limnology of ancient Lake Poso in Central Sulawesi, Indonesia

Ekoa Bessa, A.Z., Ndjigui, P.-D., Adatte, T.: Paleoenvironmental reconstruction of Holocene sediments from Cameroon lakes (SW-Africa)

El Hossny, T., Cavin, L., Samankassou, E.: New material of Tselfatiiformes, and its impact on the phylogeny of this group of weird Cretaceous fishes

Mangiagalli, M., De Boever, E., Rime, V., Grobéty, B., Foubert, A.: Controls on formation and early diagenesis of gypsum microbialites at Lake Afdera (Ethiopia)

Nighojkar, Y., Wienhues, G., Vogt, D., Armingeon, L., Vogel, H.: Climatic and anthropogenic drivers of productivity in Greifensee, Switzerland from the late Glacial until today

Ödegaard, E., Bomou, B., Adatte, T., and the Paleorhodania association: Palaeoenvironmental study of a Toarcian sedimentary deposits containing Ichthyosaur remains in Digne-les-Bains (SE France)

Ruchat, A., Lathuilière, B., Wohlwend, S., Deplazes, G., Madritsch, H., Eberli, G.P., Feist-Burkhardt, S., Samankassou, E.: A global coral reef event during the Bajocian: Evidence from a new coral reef in Northern Switzerland

Secke Bekonga Gouott, B., Yem, M., Atangana, J.Q.Y., Nkoa, E.N., Eruteya, O.E., Samankassou, E.: Evolution of seafloor pockmarks and associated gullies on the continental slope of the Kribi-Campo sub-Basin, Offshore Cameroon

Tonye, M.D., Secke Bekonga Gouott, B., Ekomane, E., Samankassou, E.: Forms and structures for controlling the emplacement of septarias in the Babouri-Figuil Sedimentary Basin (Northern Cameroon)

Tournier, N., Fabbri, S.C., Damanik, A., Wiguna, T., Rare'a, H., Rare'a, J., Sabintoe, M., Cahyarini, S.Y., Vogel, H.: High-resolution bathymetry and sub-surface architecture of ancient Lake Poso, Sulawesi, Indonesia

Weidlich, R., Bialik, O.M., Pettke, T., Rüggeberg, A., Grobéty, B., Vennemann, T., Makovsky, Y., Foubert, A.: Deciphering the Seepage Acitivity and Formation of Southeastern Mediterranean Cold- Seep Carbonates

Wienhues, G., Temoltzin-Loranca, Y., Vogel, H., Grosjean, M.: Paleohydrological variability of Lake Victoria during the last deglacial transition (20–10 ka)

Zimmerli, G., Lauper, B., Deplazes, G., Jaeggi, D., Wohlwend, S., Wetzel, A., Foubert, A.: Lateral facies correlation of Opalinus Clay in central northern Switzerland using geochemical core logging data: towards a depositional model

SwissSed Meeting 2023 - List of participants

Anselmetti, Flavio	Bern
Ariztegui, Daniel	Geneva
Bijoux, Adrien	Fribourg
Blattmann, Franziska	Lausanne
Bomou, Brahimsamba	Lausanne
Bruggmann, Sylvie	Lausanne
Buckley, Andrea	Fribourg
Buechi, Marius	Bern
Crinière, Aurélia	Geneva
Damanik, Adrianus	Bern
Depedrini, Siria	Fribourg
Deplazes, Gaudenz	Wettingen
DiPaolo, Christopher	Bern
Douillet, Guilhem Amin	Bern
El Hossny, Tamara	Geneva
Ekoa Bessa, Armel	Lausanne
Endeshaw, Addis	Fribourg
Fantasia, Alicia	Fribourg
Febbo, Belén	Geneva
Flöter, Sebastian	Geneva
Förster, Frank	Geneva
Foubert, Anneleen	Fribourg
Garefalakis, Philippos	Bern
Gastineau, Renaldo	Bern
Gebru, Ermias	Fribourg
Hug, Wolfgang	Weilheim
Karabeyoglu, Uygar	Lausanne
Kipfer, Timon	Basel
Lazarev, Sergei	Fribourg
Le Houedec, Sandrine	Geneva
Mangiagalli, Matteo	Fribourg
Meftah, Emna	Geneva
Morard, Alain	Wabern
Müller, Martin	Zürich
Nighojkar, Yugandhar	Bern
N'nanga, Alexandrine	Bern
Ödegaard, Elise	Lausanne
Pietsch, Johannes	Basel
Rime, Valentin	Fribourg
Ruchat, Arnaud	Geneva
Rüggeberg, Andres	Fribourg
Samankassou, Elias	Geneva
Schaller, Sebastian	Bern
Schlunegger, Fritz	Bern
Secke, Boris	Geneva
Suan, Guillaume	Lyon
Tercier, Mélissa	Fribourg
Tonye, Marie Diane	Geneva
Tournier, Nicolas	Bern
Vasilyan, Davit	Fribourg
Vincent, James	Geneva
Vogel, Hendrik	Bern
Weidlich, Reinhard	Fribourg
Wetzel, Andreas	Basel
Wienhues, Giulia	Bern
Winkler, Wilfried	Zürich
Zeyen, Nina	Geneva
Zimmerli, Geraldine	Fribourg
Zwaan, Frank	Potsdam

Abstracts

(in alphabetical order)

The Paleocene-Eocene Thermal Maximum at Contessa Road section, Italy: First results of a multiproxy palaeoenvironmental study

Adrien Bijoux[1,2], Alicia Fantasia[2], Thierry Adatte[3], Nils B. Baumann[4]

[1] *Université de Lyon UCB, ENSL, LGL-TPE, F-69622 Villeurbanne, France*
[2] *University of Fribourg, Department of Geosciences, Chemin du Musée, CH-1700 Fribourg, Switzerland*
[3] *Institute des Sciences de laTerre (ISTE), Université de Lausanne, GEOPOLIS, CH-1015 Lausanne, Switzerland*
[4] *Friedrich-Alexander-Universität Erlangen-Nürnberg, GeoZentrum Nordbayern, Schlossgarten 5, 91054 Erlangen, Germany*

Corresponding author: adrien.bijoux@unifr.ch, adrien.bijoux@etu.univ-lyon1.fr

The Paleocene-Eocene Thermal Maximum (PETM, ~56 Myr ago) was the largest climate event of Cenozoic time, which may serve as a yardstick to current global warming. The PETM was associated with major environmental change and marked by a significant carbon cycle perturbation expressed as a negative carbon isotope excursion (CIE) with an amplitude of -3 to -4 in marine carbonates. This reflect the massive input of 13C-depleted carbon into the oceanic and atmospheric system. The PETM closely coincided with the emplacement of the North Atlantic Igneous Province (NAIP), leading to several hypothesis of a causality link between magmatism and the environmental perturbation. Although several studies have already advanced our understanding of the causes and consequences of the PETM, there are still some aspects that remain understudied. In particular, it is still unclear what the long term palaeoenvironmental evolution was after the PETM, how the Earth system did recover from the PETM, what the feedback mechanisms were enabling the recovery and the timing. For this study, the Contessa Road succession has been selected as it reflects a deep marine record of the PETM. The study is based on a multiproxy approach which will allow us to trace the palaeoenvironmental changes associated with the PETM, understand how the Earth system recovered from the PETM and constrain the associated feedback mechanisms enabling the recovery. Here we present the preliminary field data that were recently obtained for the Contessa Road section and the proxies that will be used. The studied succession is 7.15 m thick and was sampled at high vertical resolution with a total of 71 samples. The sediments were deposited in a pelagic environment at a depth between 1000 and 1500 m and at a paleo-latitude of about 30°N. It is mainly composed of reddish marly carbonates, sometimes bioturbated, with discrete clayey interbeds. The PETM interval is marked by two dissolution levels that are composed primarily of clay. Different mineralogical and geochemical techniques will be used: (i) the whole-rock and clay mineralogy to understand changes in the palaeoclimatic conditions and weathering rates; (ii) organic and inorganic carbon isotopes to trace carbon cycle dynamics, constrain the stratigraphic position of the PETM and recovery intervals based on the negative CIE, and correlate our section with coeval sites; (iii) the Rock-Eval pyrolysis to characterise the organic matter type and preservation; (iv) mercury and tellurium content will be used as tracers for NAIP volcanic activity; (v) total phosphorus content to determine nutrient levels.

Modern hydrology and limnology of ancient Lake Poso in Central Sulawesi, Indonesia

Adrianus Damanik[(1,2,*)], Nicolas Tournier[(1,2)], Stefano C. Fabbri[(1,2,3)], Taufan Wiguna[(4)], Herson Rare'a[(5)], Joyce Rare'a[(5)], Marthen Sabintoe[(5)], Sri Yudawati Cahyarini[(4)], Hendrik Vogel[(1,2)]

[(1)] *Institute of Geological Sciences, University of Bern, Baltzerstrasse 1+3, 3012 Bern, Switzerland*
[(2)] *Oeschger Centre for Climate Change Research, University of Bern, Hochschulstrasse 4, 3012 Bern, Switzerland*
[(3)] *Edytem, Université Savoie Mont-Blanc, CNRS, 5, bd de la Mer Caspienne, Le Bourget-du-Lac, France*
[(4)] *Research Center of Geotechnology, Indonesian Institute of Sciences (LIPI), Sangkuriang, Bandung, 40135, Indonesia*
[(5)] *Dolidi Ndano Towale, Jalan Danau, Poso 94663, Indonesia*

*Corresponding author: adrianus.damanik@geo.unibe.ch

Ancient lakes are important archives that document past climate and environmental change but also elucidate on the processes that control biological evolution and biodiversity in their sedimentary records. Lake Poso is an up to 400 m deep and possibly several million year old tectonic lake with a high degree of faunal endemism located in Central Sulawesi, Indonesia. Despite its size and presumed age the lake remained widely understudied until to date. Here we present the first comprehensive dataset of Lake Poso's modern hydrology and limnology. For this we combined ArcGIS-based watershed and land-use assessments based on available satellite imagery with new geophysical and limnological survey data collected in fall 2022. Our survey included high-resolution (4 m) swath bathymetry measurements to create a precise bathymetric. We also measured the physical and chemical parameters of the lake's water column and inlets. For this we assessed the major ion and nutrient concentrations of the lake and the major inlets and conducted multi-parameter measurements (temperature, conductivity, oxygen concentration) throughout the water column. The analysis reveals a relatively small catchment (992 km2) to lake surface area (363 km2) ratio of 2.7 and a relatively large area (~1/3 of the catchment) occupied by land-use (settlements and agrarian). Nutrient levels of the major inlets, also of those close to areas of heavy land-use, are relatively low and within the levels referred to as nutrient poor/oligotrophic. However, the relatively shallow oxycline at ~90 m impaired with continued and intensifying land-use and especially more extensive fertilizer use may result in potentially harmful eutrophication scenarios in which oxycline shoaling could lead to habitat loss of important endemic taxa living in the lake.

Hydro- and morphodynamic modelling of a lacustrine tsunami and its deposits

DiPaolo, Christopher*[(1)], Vetsch, David F.[(2)], and Anselmetti, Flavio S.[(1)], and Kremer, Katrina[(1)]

[(1)] *University of Bern, Institute of Geological Sciences and Oeschger Centre for Climate Change Research, Baltzerstrasse 1+3, CH-3012 Bern, Switzerland*

[(2)] *ETH Zürich, Laboratory of Hydraulics, Hydrology and Glaciology (VAW), Hönggerbergring 26, CH-8093 Zürich, Switzerland*

* Corresponding author: christopher.dipaolo@students.unibe.ch

This study focuses on the simulation of the formation of lacustrine tsunami deposits in Lake Lucerne. Lake tsunamis are long-wave-length lacustrine waves, most commonly triggered by subaqueous landslides, subaerial rockfall impacts, and subaerial landslides (Nigg et al., 2021; Hilbe & Anselmetti, 2015; Kremer et al., 2012). On 18 September 1601 CE, multiple lacustrine tsunamis occurred on Lake Lucerne with maximum amplitudes of several meters. These tsunamis were triggered by subaqueous landslides, which in turn have been triggered by a concurrent M_w 5.9 earthquake (Nigg et al. 2021; Fäh et al., 2011; Schwarz-Zanetti et al., 2003; Hilbe & Anselmetti 2015; Hilbe et al., 2011). This event damaged property in the city of Lucerne and caused ca. eight direct casualties along the shores of the Gersau Basin, who were drowned by the tsunami. Nigg et al. (2021) used the numerical modelling program BASEMENT to model the tsunami in the Vitznau and Chrüztrichter Basins of Lake Lucerne in order to identify tsunami deposits in the Bay of Lucerne. The model used by Nigg et al. (2021) did not include a simulation of sediment transport processes. In our study, as an intermediate step while working towards a morphodynamic model including sediment transport, we use virtual tracers to understand the behavior of the wave in the Bay of Lucerne from a hydrodynamics perspective. The tracers become entrapped in the wave in various regions where Nigg et al. (2021) found a relatively high shear stress on the lake floor able to mobilize sediment particles. A series of simulations show that, while much of the simulated tracers end up along the shore, there are multiple pockets of the Lucerne Bay that may act as potential particle traps where tsunami deposits can be formed. This is a promising step on the way to create a morphodynamic sedimentation model of the 1601 CE Lake Lucerne tsunami. Eventually, the depositional patterns derived from these simulations will be groundtruthed with series short cores to be retrieved in the bay.

References:

Nigg, V., Bacigaluppi, P., Vetsch, D. F., Vogel, H., Kremer, K., & Anselmetti, F. S. (2021) Shallow-water tsunami deposits: Evidence from sediment cores and numerical wave propagation of the 1601 CE Lake Lucerne event. *Geochemistry, Geophysics, Geosystems*, *22*, e2021GC009753. https://doi. org/10.1029/2021GC009753

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Hilbe, M., Anselmetti, F. S., Eilertsen, R. S., Hansen, L., & Wildi, W. (2011) Subaqueous morphology of Lake Lucerne (Central Switzerland): Implications for mass movements and glacial history. *Swiss Journal of Geosciences*, *104*, 425–433. https://doi.org/10.1007/s00015-011-0083-z

Characterization of the Quaternary glacial overdeepening beneath Bern: infill by local lateral fans

Guilhem Amin Douillet[(1,*)], Pierre Dietrich[(2,1)], Veerle Verhoeven[(1)], Werner Leu[(3)], Andre El-Alfy[(4)], Peter Meier[(4)], Fritz Schlunegger[(1)]

[(1)] *Institut für Geologie, Universität Bern, Baltzerstrasse 1+3, Bern, CH 3012, Switzerland*
[(2)] *Univ Rennes, CNRS, Géosciences Rennes, UMR 6118, 35000 Rennes, France*
[(3)] *Geoform AG, Av. Général-Guisan 28 I CH-1800 Vevey*
[(4)] *Geo-Energie Suisse AG, Reitergasse 11 CH-8004 Zürich Switzerland*

** Corresponding author: guilhem.douillet@geo.unibe.ch*

The Quaternary deposits around Bern are restricted to a branching overdeepened valley with steep flanks that was carved into Tertiary Molasse bedrock by glacial incision during repeated Quaternary glacial advances and retreats. Here, we present a survey of borehole data publicly available from the Bernese cantonal database (https://www.map.apps.be.ch/). All boreholes reaching more than 50 m depth within the overdeepened valley were evaluated, resulting in a total of 115 sedimentary profiles covering an area of 5x4 km. The information extracted from these profiles regarding sediment grain-size and their 3D distribution allows the local filling history of the overdeepened valley to be constrained.

The sedimentary infill is dominated by steeply-dipping gravel layers (7 to 24% slope) that are organized as relatively small (ca. 1 km radius) fan systems protruding from the valley flanks and prograding towards the valley axis. Several fan systems were recognized, emanating from morphological "embayments" whose presence is deduced in available maps of Quaternary deposits. It is envisioned that the local fans were fed by glaciofluvial processes occurring in narrow and short-lived side catchments after glacial retreat from the main valley. The source material would have be derived from glacial deposits left at the surface by the retreat of the main Aare and Saane glaciers.
This new view enables the reconciliation of several observations: difficulties of connecting gravel members in individual drillings, common occurrence of well-rounded, fluvial-like pebbles in deep parts of the overdeepening, as well as the absence of a clear provenance signal within the sediments. The findings imply that correlations based on lithology should be avoided on the large-scale as individual fan systems are small and their emplacement potentially temporally disconnected, so that architectural discontinuities are considered as more reliable markers. At a local scale, correlations should instead be based on lithologies and models based on depth-equivalence should be avoided since correlative layers are steeply dipping and local features.

This study was financially supported by the ewb (Energie Wasser Bern) as part of the Forsthaus geothermal drilling project.

Paleoenvironmental reconstruction of Holocene sediments from Cameroon lakes (SW-Africa)

A. Z. Ekoa Bessa[(1)], P.-D. Ndjigui[(2)], T. Adatte[(1)]

[(1)] *University of Lausanne, Bâtiment Géopolis, UNIL-Mouline, CH-1015 Lausanne (armelekoa@yahoo.fr)*
[(2)] *University of Yaoundé 1, B.P. 812 Yaoundé, Cameroon*

Lakes are the most attractive and expressive characteristics of a landscape. Lacustrine sediments provide a historical record of the conditions of catchment environments. They are highly sensitive to paleoenvironmental change. The aim of this study is to reconstruct the paleoenvironment of 3 lakes located in Yaoundé, Dizangué and Ngaoundaba regions (Cameroon, SW-Africa) for the last 1000 years using a multiproxy approach including sedimentology, mineralogy, geochemistry, radiocarbon dating, diatoms and palynology.
Sediment samples were taken from a raft and polyvinyl chloride (PVC) pipes They generally consist of sub-rounded and sometime rounded particles indicative of both aeolian and medium fluvial transport. Their physical and chemical features suggest both proximal and distal origins. The presence minerals such as quartz, kaolinite, smectite, hematite, goethite, feldspars, rutile and calcite with traces of illite, vivianite and ilmenite suggest high weathering under warm and humid conditions.
According to geochemistry, the sediments derived from felsic, intermediate and mafic rocks from nearby granitic, gneissic and basaltic rocks. Weathering indices indicate high intensity of alteration related to both active and passive margin tectonism. Element ratios indicate a low compositional maturity in an oxic depositional condition and low salinity paleoenvironment. These sediments were deposited in a shallow marine and fluvial depositional environments with an increase water depth environmental condition.
According to radiocarbon dating, the studied sediments are Holocene in age. Palynological and diatom data reveal major hydrological changes, which occurred over the last 1000 years, mainly characterized by strong fluctuations in wet and dry conditions during the "Medieval Warm Period" (1100-800 yrs BP) and dry conditions during the "Little Ice Age" (500-300 yrs BP). These hydrological changes have controlled the dynamics of tropical rainforests in this part of Africa, resulting in their expansion during periods of heavy rainfall and contraction during periods of reduced rainfall.

Keywords: Sedimentology, geochemisty, diatoms, palynology, paleoenvironmental reconstruction, lacustrine sediments.

New material of Tselfatiiformes, and its impact on the phylogeny of this group of weird Cretaceous fishes

El Hossny, Tamara*(1)(2), Cavin, Lionel(2), and Samankassou, Elias(1)

(1) *University of Geneva, Department of Earth Sciences, Rue des Maraîchers 13, CH-1205 Geneva, Switzerland*
(2) *Département de Géologie et de Paléontologie, Muséum d'Histoire Naturelle de la Ville de Genève, CP 6434, 1211 Geneva 6, Switzerland*

*Corresponding author: tamara.elhossny@unige.ch

Tselfatiiformes is an enigmatic group of ray-finned fishes with a relatively short stratigraphic range extending from the Albian to the Campanian. This order shows its peak diversity during the Late Cretaceous in the Western Interior Seaway of North America. Haqel and Hjoula, two Lebanese localities, dated to the Cenomanian and representing the richest Mesozoic fish assemblages in the world, also yield several tselfatiiforms. Studies on the Tselfatiiformes began in the 19th century, however, till today, their phylogenetic position is still disputed and the intrarelationships within the clade are far from being resolved. To address this issue, we studied new tselfatiiforms material from the Cenomanian of Lebanon, as well as representatives of this clade from other localities in Europe, Morocco and the Western Interior Seaway of North America. These form the basis for osteological, phylogenetic and palaeobiogeographical analyses. The new Lebanese material consists of several exceptionally preserved specimens. A complete specimen is assigned to the genus *Protobrama* of the Lebanese endemic family Protobramidae. Two additional specimens are placed in two different newly erected taxa: one of the specimens is incomplete, characterized by a long rostrum and shows more affinities with the younger North American genus *Martinichthys* of the family Plethodidae, whereas the other specimen is placed in a newly erected taxon, *incertae sedis*, within the Tselfatiiformes. This material shows the diversity of morphotypes and the different implied ecological niches they have occupied during the Cretaceous. We used this data to include the Tselfatiiformes in a first computer-based phylogenetic analysis using a newly created synthetic matrix. This allowed us to evaluate the position of tselfatiiforms among teleosts, and to question the monophyly of this weird group of fishes.

Diagenesis and burial history of the Tunas Formation (Permian) at the Claromecó Basin (Buenos Aires province, Argentina)

María Belén Febbo[1,2,3*], Silvia Omodeo-Salé[1], Andrea Moscariello[1], Nora Cesaretti[2], Renata Tomezzoli[3]

[1] *University of Geneva, Department of Earth Sciences, Rue de Maraichers, 13, CH-1205 Geneva, Switzerland.*
[2] *Universidad Nacional del Sur, Departamento de Geología, Avenida Alem 1253, B8000ICP, Bahía Blanca, Argentina.*
[3] *Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Argentina.*

* Corresponding author: *belenfebbo@gmail.com*, *belen.febbo@etu.unige.ch*

The Claromecó foreland Basin (Carboniferous–Permian; Ramos, 2008) extends from the Ventania orogenic belt (southern Buenos Aires province, Argentina) to the Argentinean continental shelf, covering about 65000 km^2, with a maximum sediment thickness of 10.5 km. Due to its paleogeographic position, understanding the geological history of this area is key to reconstruct the geodynamic evolution of southwestern Gondwana margin, as it records the tectonic events resulting from the assembly of the continents to form the Pangea in the Permian-Triassic. Also, this basin has attracted industry interest focusing on energy resource exploration due to the presence of subsurface coal beds contained within the sandstone Tunas Formation (Early Permian; Harrington, 1947) which might represent a target for conventional and/or unconventional (CBM) gas resources (Lesta and Sylwan, 2005; Febbo et al., 2022). However, despite its scientific and economic relevance, given the lack of outcrops in the foreland area and few available subsurface data, its geological knowledge is poor.

This study aims at determining the diagenetic evolution of the Tunas Formation and constraining the factors and processes that acted during its burial history. To achieve this goal, different analytical methods were carried out on cores samples of the Tunas Formation (PANG 0001 and 0003 wells), such as microscopy determinations (petrographic studies), fluid inclusions analysis and reflectance vitrinite measurements. The analysed sedimentary sequences are composed of sandstones interbedded with mudrocks, carbonaceous mudrocks, tuffs and coals. Petrographic and fluid inclusion studies (petrography, fluorescence and microthermometry) were performed in sandstones while vitrinite reflectance (%Ro) were carried out in shales, carbonaceous shales and coals.

Sandstones are medium- to fine-grained, framework-supported and moderate-to-well sorting, with 5-20% of matrix. Grain contacts are predominantly concave-convex, with subordinate long and sutured contacts. Quartz, feldspar and lithic fragments dominate framework components. Authigenic minerals are calcite and laumontite and minor proportions of quartz and feldspar (mostly albite) overgrowths and clay minerals (micas and illite). They constitute between 5 and 25% of the bulk rock volume and could occur as cements, with poikilotopic and intergranular textures, or replacement of unstable grains (frequently feldspars and lithic fragments). The porosity measured by optical microscopy varies from 0.1 to 4% of the total rock volume, prevailing values less than 1%. Porosity is secondary type, predominantly by fracturing and dissolution of grains (feldspar and lithic fragments) and carbonate cement.

Fluid inclusions (FIs) studies were performed in sandstones cements and quartz veins. Primary, pseudo-secondary and secondary aqueous and organic inclusions were recognized. Organic FIs show yellow and light blue fluorescence, which could indicate the presence of organics components (liquid or gas hydrocarbons; Roedder, 1984) within the inclusion. Homogenization temperatures (Th) values obtained from microthermometry studies range from 130 to 168°C in carbonate cements and 160 to 230°C in quartz veins. Some measurements do not reach homogenization even above 230°, behaviour that may be due to the presence of hydrocarbons within the inclusion (Roedder, 1984).

Carbonaceous levels analysed are mainly composed of macerals from the inertinite and vitrinite group and minor proportions of solid bitumen and liptinite. Vitrinite reflectance values range from 1.63 to 2.8 %, with an average of 1.9-2.3%. This large variation is related to the great difficulty to distinguish vitrinite from semifusinite (intertinite) particles. The minimum values obtained (1.65 to 1.90%) were measured on very small and scarce particles, which could correspond to vitrinite while the largest population measured (2-2.2%) could be semifusinite.

The results obtained allowed to determine the different diagenetic stages experienced by the Tunas Formation and to estimate the maximum paleotemperatures reached by this unit. The main diagenetic processes that acted during burial are physical and mechanical compaction and cement precipitation, which contributed to the loss of primary porosity. However, dissolution of grains and carbonate cements and fracturing of the rock and grains led to the generation of secondary porosity. The diagenetic minerals recognized as laumontite-albite and illite, which act as geothermometers, indicate a formation temperature between 140 and 200°C (Aoyagi and Kazama, 1980). In addition, the Th obtained in fluid inclusions signal that they were formed between 130 and 230°C. These paleotemperatures confirm that the Tunas Formation reached a mesogenic stage (Choquete and Pray, 1970) within the inorganic diagenesis. Regarding the organic diagenesis, vitrinite reflectance values (VR: 1.9-2.3%) reflect that the unit is in a late catagenesis stage within the wet-to-dry gas window (Suárez-Ruiz et al., 2012).

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Seismic Cycle of the Middle Strand of the North Anatolian Fault: Combined On-Fault and Off-Fault Paleoseismic Evidence in Lake Iznik (NW Turkey)

R. Gastineau*(1,2,3), P. Sabatier (3), S.C. Fabbri (1), F.S. Anselmetti (1), P. Roeser (4), M. Şahin (5), S. Gündüz (5), A.C Gebhardt (6), S.O. Franz (4), F. Niessen (6), E. Duarte (3), and J. de Sigoyer (2)

(1) *Institute of Geological Sciences and Oeschger Centre for Climate Change Research, University of Bern, Baltzerstrasse 1+3, 3012 Bern, Switzerland*
(2) *Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS, IRD, IFSTTAR, ISTerre, 38000 Grenoble, France*
(3) *EDYTEM, Université Savoie Mont-Blanc, CNRS, Le Bourget du Lac, France*
(4) *Geology Section, Institute of Geosciences, Bonn University, Nussallee 8, 53115 Bonn, Germany*
(5) *Bursa Uludağ Üniversitesi, Fen-Edebiyat Fakültesi, Arkeoloji Bölümü, Görükle, Bursa, Turkey*
(6) *Alfred Wegener Institute (AWI) Helmholtz Centre for Polar and Marine Research, D-27568, Bremerhaven, Germany*

* Corresponding author: renaldo.gastineau@geo.unibe.ch

Lacustrine paleoseismological studies provide a continuous and potentially more complete record of seismic shaking than traditional paleoseismological methods such as trenching. However, a single lake core cannot constrain the location of a rupture. Therefore, this study proposes to combine the advantages of both methods to obtain the seismic cycle of a specific fault segment. Lake Iznik (northwest Turkey) is bounded by the middle strand of the North Anatolian Fault (MNAF). Although its seismic activity is discussed due to its quiescence during the instrumental period (last 150 years), its activity during Antiquity has been documented by several records (e.g., Ambraseys, 2002; Benjelloun et al., 2021).

Two active faults were discovered in Lake Iznik thanks to our geophysical and coring campaigns (Gastineau et al., 2021). The study of short (<4m) sediment cores sampled on both sides of the E-W Iznik Fault (IF) running close to Iznik city reveals that the previous rupture (1065 CE) coincides with a highly destructive historical earthquake recorded in the city's archaeological buildings (Benjelloun et al., 2020). In addition to this localised rupture, numerous other event deposits are present in the sediments and are attributed to regional earthquakes. In 2021, new seismic acquisitions across the Iznik Fault allowed differentiating event deposits related to the rupture of this fault itself from deposits related to regional earthquakes. Combined with three long cores (from 8.5 to 15 m; Figure 1), these new data should allow us to estimate the horizontal coseismic offset of this oblique-slip fault and the timing of older ruptures, and then, be considered in the seismic hazard assessment of the NAF system.

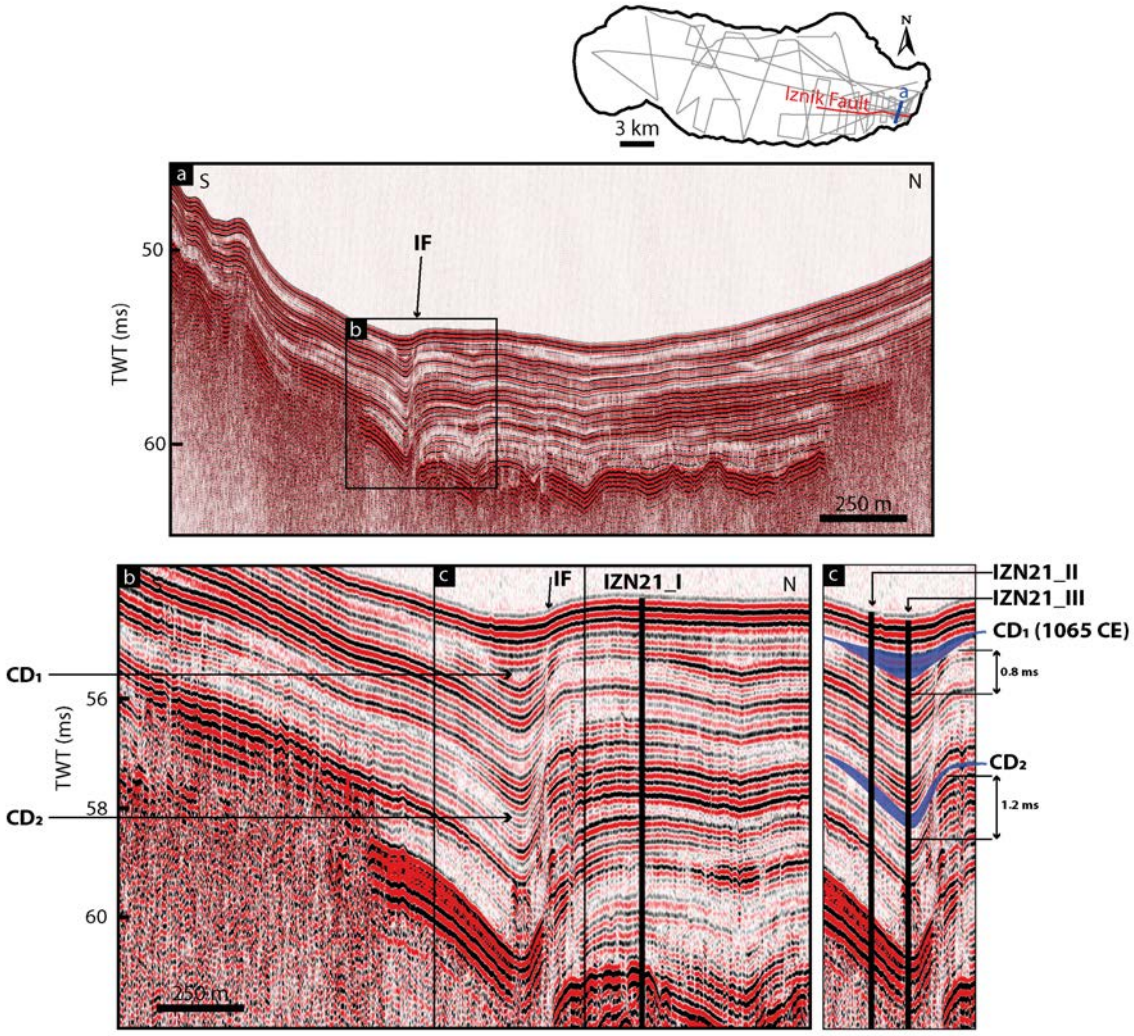

Figure 1. *High-resolution (3.5 kHz) seismic profile across the IF. (a) Complete seismic profile. (b) Zoom of the seismic profile at the fault plane location. IF refers to the Iznik Fault, and CD1 and CD2 refer to the coseismic deposits. CD1 corresponds to the 1065 CE earthquake. The age of CD2 will be determined from sediment cores sampled in November 2021 (resp. IZN21_I, IZN21_II, and IZN21_III).*

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Pliocene volcanic terrain of the South Caucasus: a hidden archive of Eurasian paleobiogeography

S. Lazarev[(1,2,3*)], L. C. Maul[(4)], K. Kuiper[(5)], D. Becker[(2,1)], M. Bukhsianidze[(6)], H. Hovakimyan[(7)], L. Sahakyan[(7)], D. Vasilyan[(2,1)]

[(1)] *University of Fribourg, Department of Geosciences, Chemin du Musée, CH-1700 Fribourg, Switzerland*
[(2)] *JURASSICA Museum, Route de Fontenais 21, 2900 Porrentruy, Switzerland*
[(3)] *Department of Earth Sciences, Utrecht University, Princetonlaan 8A, 3584 CB Utrecht, the Netherlands*
[(4)] *Research Station of Quaternary Palaeontology Weimar, Senckenberg Research Institute, Am Jakobskirchhof 4, 99423 Weimar, Germany*
[(5)] *Department of Earth Sciences, Faculty of Science, Vrije Universiteit Amsterdam, De Boelelaan 1085, 1081HV Amsterdam, the Netherlands*
[(6)] *Georgian National Museum, Purtseladze Street 3, Tbilisi 0105, Georgia*
[(7)] *Institute of Geological Sciences, National Academy of Sciences of the Republic of Armenia, Marshal Baghramyan Avenue 24a, 0019 Yerevan, Armenia*

* Corresponding author: sergei.lazarev@unifr.ch

The South Caucasus is a mountainous region between Africa, Asia and Europe that in the late Cenozoic served as an important land bridge for the intercontinental dispersal of different vertebrate groups, including Miocene apes and early humans (Adler et al. 2014; Adler et al. 2008; Böhme et al. 2021; Derevianko et al. 2015; Gabunia et al. 2000; Kandel et al. 2017; Lordkipanidze et al. 2013). Despite relatively well-studied Miocene and Quaternary geological records, the Pliocene interval of the South Caucasus remains poorly explored. During the late Cenozoic, the South Caucasus was volcanically active with its geological record consisting almost exclusively of volcanic and volcaniclastic deposits (Adamia et al. 2010; Lechmann et al. 2018). The latter ones are known for having a very limited preservation potential (Cas and Wright 1987; Suthren 1985), although, if preserved, comprising fossil remains of excellence preservation (Jiang et al. 2014). Here, we present an integrated stratigraphy of the Jradzor section located in the Gegham volcanic province, Central Armenia. The 57-m thick succession, dated between 4.3 and ~3.03 Ma, comprises 19 fossiliferous horizons with at least 48 identified vertebrate taxa (excluding birds). The palaeoenvironmental reconstruction based on detailed analysis of facies suggests that the locality was formed as a short-lived dammed lake that later became a subject for pyroclastic density currents and pedogenic intervals. Taphonomic observations indicate that a high-mortality of small-size vertebrates in most of fossiliferous horizons was caused by pyroclastic flows and surges while the large vertebrate fauna was buried by a catastrophic lahar (a single horizon JZ-7). The revealed mammalian fauna correlates to the MN15 zone. Comparison with similar age localities from the region shows that Jradzor is the only continuous Pliocene locality with the highest number of fossil taxa that fills the MN15 interregional gap. The so far revealed rich fossil vertebrate faunas have Asian and primarily European affinities. The example of Jradzor demonstrates how an integrative approach combining methods of radioisotope dating, magnetostratigraphy, sedimentology and palaeontology can be applied in presumably barren volcaniclastic formations for the reconstruction of palaeoecosystems in volcanic terrains.

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High resolution deep-sea ecosystem variability of the Nile prodelta during the past 20 Ka revealed by Benthic Foraminifera

Le Houedec, S.[1*], Mojtahid, M.[2], Bicchi, E.[2], Hennekam, R.[3,4], de Lange, G.[3]

[1] *University of Geneva, Department of Earth Sciences, Rue des Mariachers, 13, CH-1205 Geneva, Switzerland*
[2] *UMR CNRS 6112 LPG-BIAF - Laboratoire des Bio-Indicateurs Actuels et Fossiles, Université d'Angers, 2 Boulevard Lavoisier, 49045 Angers Cedex, France.*
[3] *Department of Earth Sciences – Geochemistry - Faculty of Geosciences, Utrecht University, P.O. Box 80.021, 3508 TA Utrecht, The Netherlands.*
[4] *NIOZ Royal Netherlands Institute for Sea Research of Texel, Landsdiep 4 1797 SZ 't Horntje (Texel)*

* Corresponding author: sandrine.lehouedec@unige.ch

We present late Pleistocene and Holocene high-resolution stable isotopes and faunal records from benthic foraminifera from the southeast Mediterranean Levantine basin. As expected in terms of ecology, changes in the food supply as well as the oxygen level are the two main factors controlling the benthic community evolution.
The studied area is closed to the Nile river and therefore influenced by its fresh water inputs. While the Nile discharges are mainly controlled by the solar activity driving the Indian Ocean moisture and therefore the east African climate, the bottom circulation is mainly driven by the European climate variability. To disentangle the respective role of the Nile freshwater discharge and the oceanic circulation on bottom-water environments we coupled both bottom and surface foraminiferal records.
During the glacial termination, the deep-sea environment was characterized by a change in the trophic conditions. Indeed, the onset on the African humid period was linked, in the study area to increased Nile river runoff interrupted by the cold and dry Younger Dryas event. Our results confirm the hypothesis of a sluggish bottom water circulation, starting well before the Sapropel 1 deposit (from 15 Ka) with a period of enhanced ventilation during the Younger Dryas.
The Holocene period is also marked, in our benthic abundance records, by a strong variability linked to changes in the food supply and in the bottom circulation. However, in addition to the influence of the European climate, the Holocene Mediterranean oceanic circulation is also influenced by the Atlantic water masses through the Gibraltar strait. Spectral analyses conducted on our proxies identify a clear multi-decadal to multi-millennial variability, which can be linked to solar forcing, and internal forcing linked to the coupled ocean-atmosphere internal modes of climate system.

Controls on formation and early diagenesis of gypsum microbialites at Lake Afdera (Ethiopia)

Matteo Mangiagalli[(1*)], Eva De Boever[(1,2)], Valentin Rime[(1)], Bernard Grobéty[(1)], Anneleen Foubert[(1)]

[(1)] *University of Fribourg, Department of Geosciences, Fribourg, Switzerland*
[(2)] *TNO, Geological Survey of the Netherlands, Utrecht, the Netherlands*

* Corresponding author: matteo.mangiagalli@unifr.ch

The Danakil Depression, situated in the northern part of the Afar triple junction, is part of an active rift zone associated to the break-up of the Afro-Arabian plateau. The hypersaline lake Afdera is situated in the southern part of the Depression. Gypsum actively precipitates within the lake, but especially around Franchetti Island, a volcanic island in the central part. Gypsum deposits are present as crusts, concretions and meter-sized mounds composed of cauliflower structures and laminated gypsum deposits alternating with microbial mats. In this study we investigate the formation of gypsum and the role of microbial films in the precipitation and early diagenesis of micro-scale fabrics. This study uses a combination of standard sediment petrological techniques, cathodoluminescence microscopy, fluorescence microscopy, XRD and SEM to characterize the gypsum deposits and their evolution trough time.
Samples were collected along two proximal – distal transects (island – open lake) during field expeditions in 2017 and 2019. Preliminary results show a correlation between the different morphologies and micro-scale fabrics along the studied profiles. Mineralogical analysis evidence a distinct gypsum/anhydrite transition across the transects.
SEM images evidence the close spatial relationship between gypsum crystals and biofilms. This study provides new insights into the characteristics and formation of the Lake Afdera's gypsum microbialites. Overall, further investigations will contribute to the characterization of understudied gypsum deposits in the geological record of which the formation mechanisms are often debated and poorly understood.

Diagenesis and dolomitization of a Norian bioherm and the adjacent intraplatform limestone in the Dolomia Principale of the Lombardy Basin (Southern Alps, NE-Italy): insights from petrography and stable isotope proxies

Martin Müller*[(1)], Vincenzo Picotti[(1)], and Jordon Hemingway[(1)]

[(1)] *ETH Zürich, Department of Earth Sciences, Sonneggstrasse 5, CH-8092 Zürich, Switzerland*

* Corresponding author: muellermar@erdw.ethz.ch

Numerous bioconstructed bodies have been studied as part of the Dolomia Principale depositional system (Berra & Jadoul 1996, Claps et al. 1996, Zamparelli et al. 1999, Flügel 2002). However, the diagenesis and dolomitization of bioconstructions is still poorly constrained. Upper Triassic carbonates from the Monte Zenone area in the central Southern Alps, NE-Italy, are investigated due to the well-known paleogeographic setting and the preserved platform-slope-basin transitions. Particularly, this research answers how and why the degree of diagenesis and dolomitization varies between adjacent lithologies, namely the Monte Zenone bioherm and the basinal Calcare di Zorzino limestone. Petrographic observations are combined with X-ray diffraction and stable isotope analyses to reconstruct successive events of diagenesis, dolomitization and dolomite cement precipitation in different sedimentary environments of the Dolomia Principale formation. Therefore, the effects of early marine diagenesis on the seafloor and in the shallow subsurface, burial diagenesis in the intermediate to deep subsurface and late diagenesis during uplift and unroofing on the primary oxygen ($\delta^{18}O$) and carbon ($\delta^{13}C$) isotopic signatures are assessed (Figure 1, 2). Further, possible dolomitization mechanisms are discussed for the individual sedimentary facies.

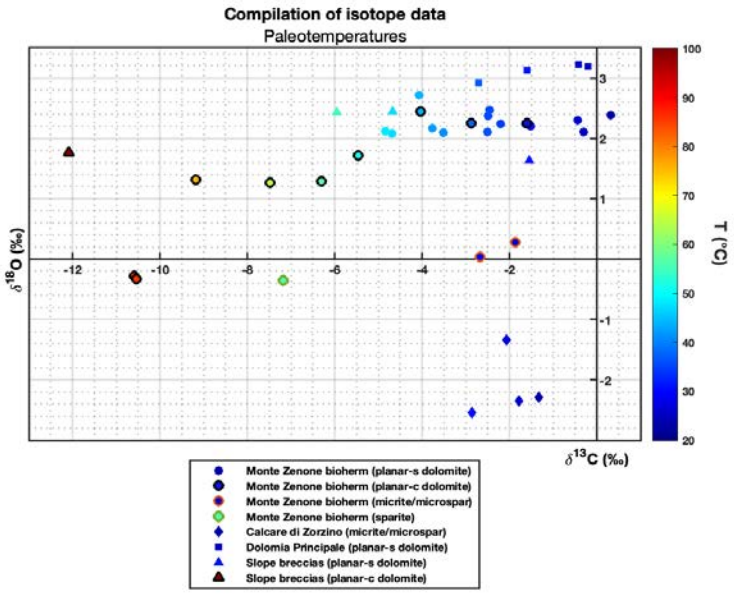

Figure 1. *$\delta^{18}O$-based crystallization temperatures for dolomite and calcite samples, excluding samples with mixed mineralogies. Calculated after Müller et al. (2019) (dolomite samples) and Daëron et al. (2019) (calcite samples). Constant fluid compositions are assumed.*

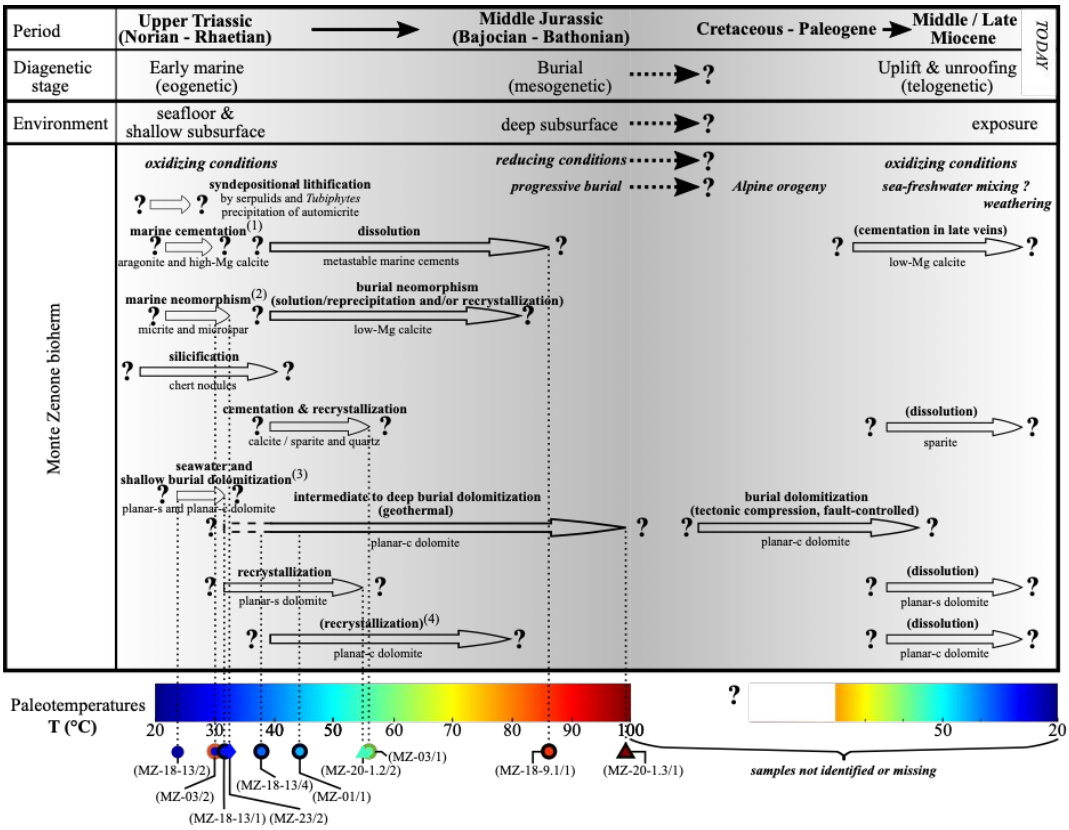

Figure 2. *Reconstruction of diagenetic stages and dolomitization events observed or inferred from the samples of the Monte Zenone bioherm. The same colorbar and legend entries as in Figure 1 apply. The dashed lines indicate theoretical boundaries for certain diagenetic processes based on individual samples. However, the exact position and sequence of most arrows remains highly speculative. Further, the alignment of the temperature scale, i. e. the cooling history after the Middle Jurassic heat flow peak, is uncertain. According to Zattin et al. (2006), cooling started soon after the Middle Jurassic even during progressive burial.*

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Climatic and anthropogenic drivers of productivity in Greifensee, Switzerland from the late Glacial until today

Yugandhar Nighojkar[(1)], Giulia Wienhues[(2)], Dimitri Vogt[(1)], Leo Armingeon[(1)], Hendrik Vogel[(1)]

[(1)] *Institute of Geological Sciences & Oeschger Centre for Climate Change Research, Universität Bern, Baltzerstrasse 1+3, 3012 Bern, Switzerland*
[(2)] *Institute of Geography & Oeschger Centre for Climate Change Research, Universität Bern, 3012 Bern, Switzerland*

Corresponding author: yugandhar.nighojkar@students.unibe.ch

In this study, we explore past productivity changes in response to major climate changes and anthropogenic influence over the last 16,500 years. For this we collected a 9.10 m composite sediment core from Greifensee in 2021 a rather small and only ~30 me deep lake located in the northern alpine foreland east of Zürich. The sedimentary succession was dated by radiocarbon measurements of terrestrial plant fragments and age-depth modelling was performed using a smooth-spline function. Overall, we could distinguish four lithotypes in this succession spanning the late glacial and Holocene. Late glacial sediments comprise fine- to medium bedded silts with low organic matter contents and predominance of detrital clastic material. Most of the Holocene sediments are composed of either finely laminated/varved or finely bedded sediments with high contents of endogenic calcite and overall low but variable organic matter contents. These lithotypes are in stark contrast to the most recent sediments in Greifensee which comprise dark coloured, varved, organic-matter- and biogenic-silica- rich sediments deposited during the intense eutrophication phase since 1936 AD.

To infer past changes in climate and productivity we measured high-resolution elemental geochemistry (1 mm) and chlorophyll-A content (0.07 mm) using scanning µXRF and hyperspectral imaging. These data were completed by lower resolution (3 cm) bulk total organic and inorganic carbon, total nitrogen and total sulfur analysis. These data underwent statistical analysis to identify major tipping points and the rhythmicity of past climate and productivity changes. For this, high-resolution datasets were resampled with a time interval of 5 years and change point analysis was done to identify major tipping points. Data from 950 to 10,960 years BP was detrended further and used for Power Spectral and Wavelet analysis to identify the underlying rhythmicity of past climate changes.

Interestingly, oscillations in Ca intensities between 10,960 to 950-year BP resemble prominent sunspot cycle periodicities at roughly 1000, 750, 500-, 350-, 120- and 60-years. At Greifensee these periodicities are most prominent between 12,950 to 3370 years BP. The loss of signal of some of these cycles after 3370 years BP roughly coincides with the rise of Neolithic pile settlements in the region possibly influencing the lakes trophic state and thereby its productivity as is evident from increased Chlorophyll-a content. A phase of intense eutrophication starting 1936 AD is clearly evident from the dark organic rich sediments and related to increased fertilizer use on agrarian areas, a denser population and lack of sufficient wastewater treatment until the 1970's AD.

The southward expansion rate of the desertification in the Adamawa Plateau (Central Cameroon): implication for the speed of the Sahel desertification progress in Central Africa

Alexandrine N'nanga*[1,2,3], Flavio S. Anselmetti[2,3]

[1] *University of Buea, Department of Geology, Faculty of Science, P.O. box 63 Buea, Cameroon*
[2] *University of Bern, Institute of Geological Sciences, 1+3 Baltzerstrasse 3012 Bern, Switzerland*
[3] *University of Bern, Oeschger Centre for Climate Change Research, Switzerland*

* Corresponding author: alexandrine.nnanga@geo.unibe.ch

Central Africa experiences desertification hazards mostly due to deforestation in context with climate change and human activities like iron melting and agricultural practices (Bayon et al., 2012). However, one of the most severe obstacles for sustainable development in Central Africa is the Sahel desertification whose speed of progress is underexplored. Among multiple lines of evidence recorded in geological archives, which suggest its southward progress in Central Cameroon over the Anthropocene epoch, the southward shift of the Intertropical Convergence Zone (ITCZ) since 3.6 kyr BP (Leroux, 2001; Nguetsop et al., 2013; Byrne and Schneider, 2016) is the most warning signal followed by forest disruption in favor of savannah expansion (Lebamba et al., 2016; N'nanga et al., 2019). The cause of the resulting environmental crisis including successive deforestation, intense soil erosion (Garcin et al., 2018), the ITCZ latitudinal shifts, volcanic activity of the Cameroon Volcanic Line (Lebamba et al., 2016) and intensification of anthropogenic activity (Bayon et al., 2012) are very much debated. However, this shift towards more arid/seasonal climate conditions in central Africa constitutes an outstanding challenge for society. This project aims at estimating the speed of the Sahel desertification progress in Central Africa, by quantifying its progress rate in Central Cameroon located between the sahelian zone, to the north, and the equatorial zone, to the south. For this purpose, four lake-sediment cores were collected in four shallow lakes on the Adamawa Plateau. They are investigated for sedimentology, geochemistry, mineralogy, and radiocarbon chronology. The goal of this study is to characterize the sedimentary sequences, pinpoint related environmental change in sediment supply and source area and differentiate relevant paleoclimate indicators of intensification of dry conditions over time. The importance of these centennial to decadal natural trends and variations as well as possible effects of human activities will contribute to a better understanding of the Sahel desertification progress in Central Africa.

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Palaeoenvironmental study of a Toarcian sedimentary deposits containing Ichthyosaur remains in Digne-les-Bains (SE France)

Elise Ödegaard*[(1)], Brahimsamba Bomou*[(1)], Thierry Adatte[(1)] and the Paleorhodania association[(2)]

[(1)] *Institute of Earth Sciences ISTE, University of Lausanne, Unil Mouline, 1015 Lausanne, Switzerland*
[(2)] *Paleorhodania association, 13001 Marseille*

* Corresponding authors: elise.odegaard@unil.ch, brahimsamba.bomou@unil.ch

During the summer of 2022, palaeontological excavations conducted by the Paleorhodania association took place in Toarcian shales (Lower Jurassic) of the Dauphinois Subalpine basin in Digne-les-bains (southeastern France), in the "Reserve Naturelle Géologique de Haute-Provence", known for its exceptional fossiliferous beds and more particularly for its marine vertebrates. Well-preserved Ichthyosaur vertebraes were found in a marl level of Upper Toarcian age.
The main goal of my bachelor project study is to characterise the palaeoenvironmental and palaeoclimatic conditions that led to the exceptional preservation of these marine vertebrates remains which occurs well after the Toarcian Ocean Anoxic Event (TOAE). We use a multiproxy approach based on bulk rock mineralogy (X-Ray diffraction) and geochemical analyses (Rock-Eval pyrolysis and stable isotopes) in order to constrain the climatic and the environmental conditions associated with these sedimentary deposits. The reconstruction of the palaeoenvironment will lead to a better understanding of the mechanisms linked to the exceptional fossilisation of these organisms. This current study will present our preliminary results (mineralogy and organic carbon contents).

Factors controlling the sedimentary architecture in an active rift basin: lessons learnt from the Danakil Depression, Ethiopia

Valentin Rime[(1*)], Haileyesus Negga[(1)], David Jaramillo-Vogel[(1,2)], Léa Perrochet[(1,3)], Addis Endeshaw[(1)], Ermias Filfilu Gebru[(1)], Jean-Charles Schaegis[(1)], Balemwal Atnafu[(4)], Tesfaye Kidane[(5)] and Anneleen Foubert[(1)]

[(1)] Department of Geosciences, University of Fribourg, Ch. Du Musée 6, 1700 Fribourg, Switzerland
[(2)] Particle Vision GmbH, Fribourg, Switzerland
[(3)] Centre for Hydrogeology and Geothermics (CHYN), University of Neuchâtel, Neuchâtel, Switzerland
[(4)] School of Earth Sciences, Addis Ababa University, Addis Ababa, Ethiopia
[(5)] School of Agricultural, Earth and Environmental Sciences, University of Kwazulu-Natal, Durban, South Africa

* Corresponding author: valentin.rime@unifr.ch

The Danakil Depression is an example of an active rift basin situated between Ethiopia and Eritrea and part of the Afro-Arabian Rift System. It is nearing continental breakup being in a transition phase between continental and oceanic conditions. During the Middle to Late Pleistocene, the basin was flooded several times by the Red Sea. Sedimentary facies alternate at short spatial and temporal scale, including fluviatile conglomerates, lacustrine deposits, marine carbonates and a wide variety of evaporites. The sedimentary architecture of the basin is controlled by numerous processes in the atmosphere, biosphere, hydrosphere, lithosphere and mantle. At large temporal and spatial scale, the rift morphology and basin filling is mainly controlled by far-field stress, pre-rift geology, mantle and igneous processes (in particular plume influence) and tectonic style. At smaller scales, the sedimentary architecture of the basin is strongly influenced by vertical tectonic movements in the basin and its margins, eustatic sea-level variations and local climate. All these processes are connected with multiple and complex feedback mechanisms. Only a holistic approach allows to unravel the factors controlling the sedimentary architecture in an initial rift basin.

A global coral reef event during the Bajocian: Evidence from a new coral reef in Northern Switzerland

Arnaud Ruchat[(1)], Bernard Lathuilière[(2)], Stephan Wohlwend[(3)], Gaudenz Deplazes[(4)], Herfried Madritsch[(4)], Gregor P. Eberli[(5)], Susanne Feist-Burkhardt[(1)], Elias Samankassou[(1)]

[(1)] *Department of Earth Sciences, University of Geneva, Rue des Maraîchers 13, 1205 Geneva, Switzerland*
[(2)] *Université de Lorraine, CNRS, Lab. GeoRessources, UMR 7359, BP 70239, 54506 Vandoeuvre-lès-Nancy Cedex, France*
[(3)] *Geological Institute, ETH Zürich, Sonneggstrasse 5, 8092 Zürich, Switzerland*
[(4)] *National Cooperative for the Disposal of Radioactive Waste (Nagra), Hardstrasse 73, 5430 Wettingen, Switzerland*
[(5)] *Department of Marine Geosciences, Rosenstiel School of Marine and Atmospheric Science, University of Miami, FL 33149, USA*

On a global scale, the Middle Jurassic (Bajocian, Bathonian, Callovian) is currently not considered favourable for coral reef growth. During this time, most reef constructors were still recovering from devastating climate-induced crisis of the Late Triassic and of the Early Jurassic (Pliensbachian-Toarcian events) (Krencker et al., 2020). Climate warming, a global perturbation of the carbon cycle and increased continental weathering produced one of the most intense extinction events for corals (Vasseur et al., 2021). Therefore, the Middle Jurassic was not yet an opportune time for coral reef development, perhaps due to lingering environmental factors slowing the recovery of reef-constructing organisms. By updating the previous bibliographic syntheses (Beauvais, 1976; Leinfelder, 2002), reassessing the coral assemblage of known reefs or by new dating, it is possible to show a substantial number of Bajocian locations that have been mapped. This has shed new light on the coral reef population of the Bajocian by highlighting the fact that it was very probably much more substantial than previously thought. Most of these Bajocian localities are distributed along a hypothetical paleo-geographical belt on the northern margin of the Tethys. The number of reefs and their presence in a pattern could be indicative of a global coral reef event during the early Bajocian, substantially greater growth of reef builders (Leinfelder et al., 2002) and a quicker than expected recovery of those organisms in the Tethyan realm and across the globe. In occidental Europe, Bajocian coral reefs are mainly known from the western and central part of the Burgundy Platform, a large platform covering most of eastern France and Luxembourg (Gonzalez & Wetzel, 1996). Bajocian reefs are however uncommonly found to the southeast of the Burgundy Platform (Switzerland e.g., in Jura Mountains at Gisliflue, Wullschleger, 1966). Furthermore, little is known about the eastern part closer to the Tethys in deeper environments, corresponding today to Switzerland, where outcrops are rare or absent (Gonzalez & Wetzel, 1996). Here we present a recently discovered Bajocian reef in the informal «Herrenwis Unit» located in the northern part of Switzerland. As part of the exploration program of Nagra, which is currently investigating three siting regions in northern Switzerland as potential repositories for radioactive waste. In the Nördlich Lägern siting region, the boreholes Bülach-1 and Stadel-3 show well-preserved corals. The «Herrenwis Unit» is a good example of new Bajocian reef still unknown in the literature and offers a rare point of comparison for coral reef growth outside a large carbonate platform during the Bajocian. The usage of accurate biostratigraphy markers with robust dating is necessary to assess the possibility of a global reef event during the Bajocian. In the case of the «Herrenwis

Unit», palynological data acquired during this study shows clearly that the reef growth occurred at the same time as the development of the Burgundy Platform over Eastern France and Luxembourg.

This new reef was studied from two cores drilled in a paleo-relief feature revealed by seismic exploration. Core descriptions, with attention to the well-preserved corals were performed, along with lithostratigraphic description and additional data on microfacies and biostratigraphy. The use of well calibrated palynological assemblages allowed precise dating of the reef using the intervals established by Feist-Burkhardt & Wille, (1992), which were also cross referenced with the standard scales established by Cariou & Hantzpergue (1997).

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Controls of slab loads beneath the Alps on the source-to-sink sedimentary pathways in the Molasse basin

Fritz Schlunegger[(1)], Edi Kissling[(2)]

[(1)] Institute of Geological Sciences, University of Bern, fritz.schlunegger@geo.unibe.ch
[(2)] Institute of Geophysics, ETH Zürich, kissling@tomo.ig.erdw.ethz.ch

The stratigraphic development of foreland basins has mainly been related to surface loading in the adjacent orogens, whereas the controls of slab loads on these basins have received much less attention. This has also been the case for the Molasse basin situated on the northern side of the European Alps. Here we relate the evolution of this basin between Geneva (Switzerland) and Linz (Austria) to the subduction processes beneath the European Alps (Schlunegger and Kissling, 2022). At 30 Ma, the western and central portions of the basin (between Geneva and Munich) experienced a change from deep marine (underfilled Flysch stage) to terrestrial conditions (overfilled Molasse stage), while the eastern part in Austria remained a deep Flysch-type of basin and the final sedimentary sink. This is considered as response to oceanic lithosphere slab-breakoff beneath the Central and Western Alps, which resulted in a rise of the Alpine topography, in an increase of surface erosion rates and sediment discharge, and finally in the overfilling of the basin west of Munich. Beneath the Eastern Alps, however, the subducted oceanic slab remained attached to the European plate and down-warped the plate in the East, thereby controlling the east-directed routing of the clastic material and maintaining the Austrian part of the basin in underfilled conditions. The situation changed at 20 Ma, when an oceanic slab breakoff beneath the Eastern Alps resulted in a rebound of the European plate in the East. Beneath the Central and Western Alps, however, the buoyant crustal rocks of the European continental plate continued to be delaminated from the mantle lithosphere, which itself was further subducted by c. 60 km between 30 Ma (time of oceanic slab breakoff beneath the Central/Western Alps) and 20 Ma (Schmid et al., 1996). Because in the central/western part of the Alps, the mantle slab of the continental lithosphere remained attached to the European plate at 20 Ma, the foreland plate continued to be down-warped in its central and western portions. Accordingly, while in the Austrian Molasse basin, the facies changed at 20 Ma from deep underfilled (Flysch-type of sedimentation) to terrestrial filled/overfilled conditions (Molasse sedimentation), the central and western Molasse basin became the final sedimentary sink and remained in the Molasse stage of basin evolution. As a further consequence, the drainage direction in the basin axis changed from an E-directed material transport prior to 20 Ma to a W-directed sediment discharge thereafter. We thus propose that slab loads beneath the Alps were presumably the most important drivers for the development of the Molasse basin at the basin scale.

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Evolution of seafloor pockmarks and associated gullies on the continental slope of the Kribi-Campo sub-Basin, Offshore Cameroon

Boris Secke Bekonga Gouott*[(1)], Mbida Yem [(2)], Joseph Quentin Yene Atangana[(2)], Eric Nkoa Nkoa[(3)], Ovie Emmanuel Eruteya[(1)], Elias Samankassou[(1)]

[(1)] *University of Geneva, Department of Earth Sciences, Rue des Maraîchers 13, CH-1205 Geneva, Switzerland.*
[(2)] *University of Yaoundé I, Department of Earth Sciences, P.O. Box: 812, Yaoundé, Cameroon.*
[(3)] *National Hydrocarbon Corporation (NHC), Department of Geosciences, P.O. Box: 955, Yaoundé, Cameroon.*

* Corresponding author: boris.secke@etu.unige.ch

Pockmarks are (sub) circular bathymetric depressions developed by the expulsion of fluids along the seafloor (Judd and Hovland, 2007; Eruteya et al., 2018). They have been documented in many locations around the world and occur mainly in marine and some lacustrine environments. In West Africa, pockmarks have been documented along most of the continental margins including Namibia, Congo, Angola, Gabon, Equatorial Guinea, and Nigeria (Pilcher and Argent, 2007, Andresen et al., 2011). However, the understanding of the underlying geological mechanism/control in relation to their evolution, distribution, and relationship to the slope gullies is limited, particularly along data-poor continental margins such as the Kribi-Campo sub-Basin, offshore Cameroon (Figure 1a). In this study, analysis of a high-quality 3D seismic reflection data from the continental slope reveals at least 93 individual pockmarks in water depths ranging from 600 to 1200 m. These pockmarks have been classified into three types defined by their appearance and distribution: single pockmarks, pockmark clusters, and pockmark trains (Figure 1b). Morphologically, the single and clustered pockmarks are circular in shape, while the pockmark trains are elongated in shape, with diameters and depths ranging from 102 to 1020 m and 10 to 110 m, respectively (Figure 1b). Pockmark trains are more elongated and associated with areas of steeper seabed gradient. Petrophysical analyses of the basin show the presence of deep thermogenic fluids produced in the Cretaceous source rocks. We hypothesize that these fluids are preferentially trapped in Eocene–Miocene paleo-channels and eventually reached the seafloor by preferentially migrating along a strongly faulted interval consisting of a polygonal fault system (Figure 1c). This is also evident by the presence of the 120 – 280 ms TWT m thick gas hydrate layer marked by a strong bottom-simulating reflectors on seismic profiles. The generation of excess pore fluid pressure in the free gas accumulation leads to the release of fluids along the faults forming different types of pockmarks, depending on the physiography of the seafloor. Ultimately, we suggest that the gullies are formed by the amalgamation and coalescence of aligned pockmarks under the continuous erosion of gravity flows and bottom currents along the steeper seabed. These deep-water pockmarks open the possibility that such fluid escape features may be more widespread than currently documented in the Kribi-Campo sub-Basin. The findings of this study have implications for understanding the petroleum system here and their potential role on the West African marine ecosystems and global climate change in terms of the expulsion of climate forcing gases via these pockmarks.

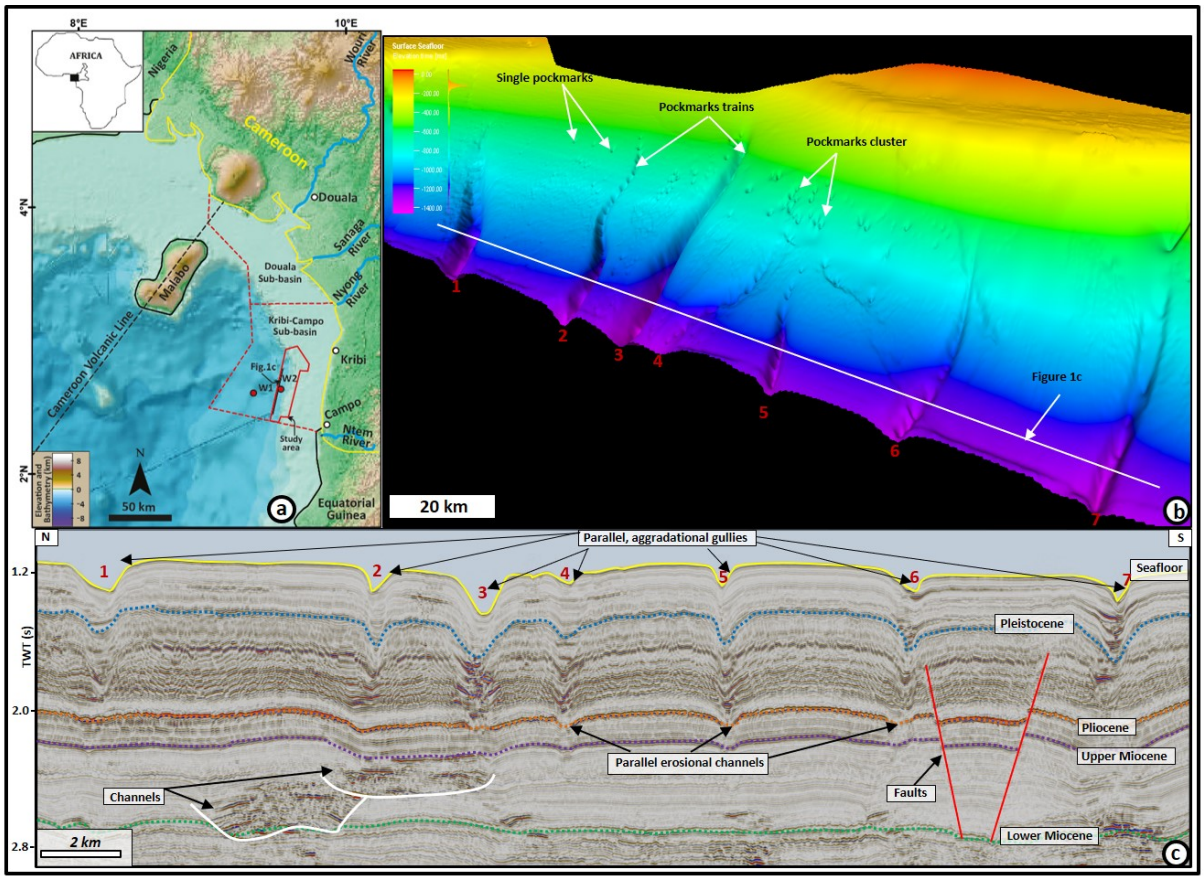

Figure 1. (a) Location map of the study area (b) 3-D visualization of the seabed time structure map of the study area showing single, trains and clusters pockmarks (c) Seismic cross section showing aggradational gullies, channels, and polygonal faults. These channels show high connectivity, creating migration paths for fluids from deep in the basin up to the seafloor.

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KEYNOTE

Reconstructing sediment and carbon fluxes across Paleogene and Jurassic hyperthermals and implications for carbon cycle dynamics

Guillaume Suan*[(1)], Nicolas Pige [(1)], Pierre-Henri Blard [(2)], Emanuela Mattioli [(1)]

[(1)] *Université de Lyon 1, ENSL, CNRS, LGL-TPE, 69622, Villeurbanne, France*
[(2)] *CRPG, CNRS, Université de Lorraine, 54500 Vandoeuvre-lès-Nancy, France*

* Corresponding author: guillaume.suan@univ-lyon1.fr

The Paleogene and Jurassic periods were punctuated by several hyperthermal events, defined as episodes of geologically rapid warming associated with massive injection of carbon to the ocean-atmosphere. The Paleocene-Eocene Thermal Maximum (PETM: - 55 Ma) and Toarcian Oceanic Anoxic Event (T-OAE; -183 Ma) record some of the most severe and intensively studied hyperthermal events. The detailed timescales of the different phases of these two events, however, remain vividly debated, thus limiting the identification of the main feedbacks that may have amplified or mitigated the initial input of carbon to the superficial reservoirs. In this presentation, I will present recent progress realized by our group in the reconstruction of sediment and carbon fluxes across the Paleocene-Eocene deep-sea carbonate oozes from Shatsky Rise (N Pacific) using extraterrestrial helium contents and astrochronology. The new data allow to reconstruct relative changes in sedimentation rates with unprecedented resolution and reveal that both eolian and carbonate fluxes dropped dramatically across several hyperthermal events including the PETM. Combined with independent findings from more proximal nearshore sites, the new results offer both an empirical and conceptual framework that allow to reevaluate the fundamental drivers of sedimentation rates and carbon fluxes across Paleogene and Jurassic hyperthermals. The implications of these findings for our understanding of the nature and magnitude of carbon cycle feedbacks regulating Earth's climate will be discussed.

Forms and structures for controlling the emplacement of septarias in the Babouri-Figuil Sedimentary Basin (Northern Cameroon)

Marie Diane Tonye*[(1)], Boris Secke Bekonga Gouott[(2)], Emile Ekomane[(1)], Elias Samankassou[(2)]

[(1)] *University of Yaoundé I, Department of Earth Sciences, P.O. Box: 812, Yaoundé, Cameroon.*
[(2)] *University of Geneva, Department of Earth Sciences,* Rue des Maraîchers 13, CH-1205 Geneva, *Switzerland.*

* Corresponding author: tonyediane2@gmail.com

The Babouri-Figuil Basin is located in the northern part of Cameroon and is part of the Bénoué trough (Figure 1). One of the most remarkable features of this basin is the presence of carbonate concretions commonly known as septaria. Septarias are typical diagenetic features commonly found in fine-grained sedimentary rocks (Luciano et al., 2015). However, the understanding of the nature of these concretions in the Babouri-Figuil Basin remains limited. In the first phase of this study, detailed fieldwork was carried out in the basin. The Babouri-Figuil Basin has four lithofacies comprising limestones, marlstones, sandstones, and conglomerates. Its depositional environment is fluvial to fluviolacustrine. These facies are organized in asymmetric synclines and crossed by basaltic intrusions (Ndjeng, 1992). The concretions identified are found in the marly facies. Numerous descriptive criteria collected in the field made it possible to estimate their size, their genesis, as well as the factors that control the shapes of these septarias. The septarias studied are greyish or dark brown in color and massive in structure. Their size varies from 15 to 57.5 cm with circumferences ranging from 23 to 87cm. They also show intersection cracks due to their maturity or aging. The intersection of septarian cracks are filled in and indicate different generations. Ovoid, rounded, disc, elongated, and chocolate bar morphologies were observed in the study area (Figure 2). These shapes are controlled by the thickness and shape of the marls. Thus, where the thickness is high, the septarias are well developed and generally exhibit ovoid, rounded, or spherical shapes because the marl has weak planes (Figure 2). In contrast, when the marl is thin or in lens-like, septarias tend to follow only the space and the shape that the marl occupies. This tends to make it disappear, creating elongated, flattened, or even rounded shapes (Figure 2). Consequently, the septarias of the Babouri-Figuil Basin postdate the marl deposits. The findings of this study hold the potential to help understanding the genesis of septarias so widespread in the sedimentary rock record.

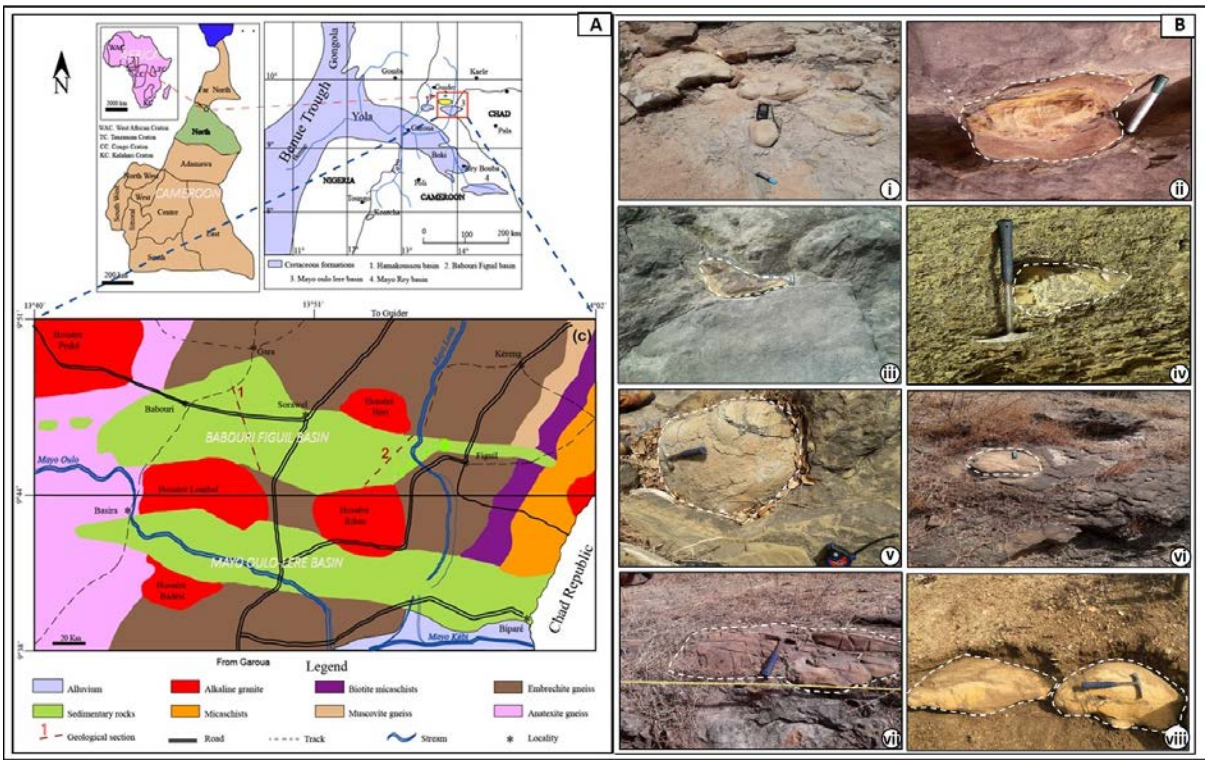

Figure 1: *(a) Location map of the study area. (b) Field photographs showing septaria in their host rocks in the study area, (i) rounded septaria in silty claystone with an alluvial fan, (ii) flattened septaria contained in a thin layer of claystone interbedded between carbonate cemented fine sandstones, (iii) lenticular septaria contained in a thin layer of claystone interbedded between carbonate cemented fine sandstones (iv) flattened septarias contained in the argillite, (v) circular septaria up to 60cm of diameter in the fine sandstones, (vi) septaria in the fine grained sandstones, (vii) elongated septaria resembling chocolate bars in the sandstones over about ten put, (viii) abundant septaria enclosed in weathered shale layers.*

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High-resolution bathymetry and sub-surface architecture of ancient Lake Poso, Sulawesi, Indonesia

Nicolas Tournier*[(1)], Stefano C. Fabbri[(2)], Adrianus Damanik[(1)], Taufan Wiguna[(3)], Herson Rare'a[(4)], Joyce Rare'a[(4)], Marthen Sabintoe[(4)], Sri Yudawati Cahyarini[(3)], and Hendrik Vogel[(1)]

[(1)] *Institute of Geological Sciences & Oeschger Centre of Climate Change Research, University of Bern, Baltzerstr. 1+3, 3012 Bern, Switzerland*
[(2)] *Edytem, Université Savoie Mont-Blanc, CNRS, 5, bd de la Mer Caspienne, Le Bourget-du-Lac, France*
[(3)] *Research Centre for Climate and Atmosphere, National Research and Innovation Agency (BRIN), Indonesia*
[(4)] *Dolidi Ndano Towale, Jalan Danau, Poso 94663, Indonesia*

* Corresponding author: nicolas.tournier@geo.unibe.ch

The Island of Sulawesi, in Indonesia, is located at a triple junction where the convergence of the Eurasian, Australian and Pacific plates is accommodated by large-scale strike-slip faults. Stress release along these faults often occurs in the form of large magnitude earthquakes such as the 2018 Mw 7.5 Palu earthquake with its epicenter located along the Palu-Koro Fault. Historical data on past earthquakes are lacking in this area. To this end, we explored the potential of the sedimentary fill of ancient Lake Poso as a natural archive of past earthquakes and tectonic processes. For this we conducted geophysical surveys including high-resolution multibeam swath bathymetry and 3.5 kHz seismic reflection surveys to image the surface morphology and sub-surface sediment architecture of the basin, respectively. These surveys conducted in fall 2022 yielded one of the first high-resolution bathymetric map of an entire Southeast Asian lake. In combination with sedimentological and chronological analyses to be performed on sediment cores also collected during the same campaign these data will provide insight into the active tectonics of the region and reveal traces of earthquake-triggered mass wasting.

Deciphering the Seepage Acitivity and Formation of Southeastern Mediterranean Cold- Seep Carbonates

Reinhard Weidlich[(1)], Or M. Bialik[(2,3)], Thomas Pettke[(4)], Andres Rüggeberg[(1)], Bernard Grobéty[(1)], Torsten Vennemann[(5)], Yizhaq Makovsky[(3,6)], Anneleen Foubert[(1)]

[(1)] University of Fribourg, Department of Geosciences, Chemin du Musée 6, CH-1700 Fribourg (reinhard.weidlich@unifr.ch)
[(2)] Marine Geology & Seafloor Surveying, Department of Geosciences, University of Malta, Msida, MSD, 2080 Malta
[(3)] The Dr. Moses Strauss Department of Marine Geosciences, Leon H. Charney School of Marine Sciences, University of Haifa, ISR-3498838 Haifa
[(4)] University of Bern, Department of Earth Sciences, Baltzertstrasse 1+3, CH-3012 Bern
[(5)] University of Lausanne, Institut des dynamiques de la surface terrestre, Bâtiment Géopolis, CH-1015 Lausanne
[(6)] The Hatter Department of Marine Technologies, Leon H. Charney School of Marine Sciences, University of Haifa, ISR-3498838 Haifa

Authigenic seep carbonates are unique archives to characterise the paleo-seepage activity of hydrocarbon-enriched fluids through the subsurface towards the seafloor. This study aims to identify past seepage activity in the south-eastern Mediterranean Sea and the formation conditions of authigenic seep carbonates collected during the 2016 EUROFLEETS 2 SEMSEEP expedition aboard the RV AEGEO and the 2011 Nautilus expedition. Seep carbonates with three different morphologies (chimneys – advective seepage, crusts – advective seepage and pavements – diffusive seepage), are studied using sediment petrography, X-ray diffraction, LA-ICP-MS, Raman spectroscopy, and stable isotope geochemistry. Recurrent cement and replacement phases identified contain aragonite, low-magnesium calcite (LMC), high-magnesium calcite (HMC) and dolomite. Chimneys consist of micrite ($\delta^{13}C_{VPDB}$ of -10 to +5 ‰), fan-shaped aragonite ($\delta^{13}C_{VPDB}$ of -52 to -30 ‰), botryoidal LMC cements and blocky HMC replacements. Crusts consist mainly of micrite, LMC breccias, HMC nodules ($\delta^{13}C_{VPDB}$ of -35 to -20 ‰) and cements, and several stages of fan-shaped aragonite cement. Pavements consist of micritic dolomite and clotted HMC, LMC microsparite and locally fan-shaped aragonite. Fe-oxy-hydroxides are coating the low- and high-Mg calcite and dolomite phases. Raman spectroscopic analysis indicate the presence of specific organic compounds associated with the aragonite and dolomite. LA-ICP-MS analyses evidence distinct REY patterns for each phase.

Sediment petrography, XRD and stable isotope analysis support several pulses of methane seepage through time. Distinct mineralogies (dolomite and aragonite) within the seep carbonate morphologies, result from different formation mechanisms. LA-ICP-MS analysis, combined with Raman spectroscopy suggests that distinct carbonate mineralogies formed from different fluids under variable redox conditions and in the presence of specific organic compounds.

Paleohydrological variability of Lake Victoria during the last deglacial transition (20–10 ka)

Giulia Wienhues*[(1)], Yunuen Temoltzin-Loranca [(2)], Hendrik Vogel [(3)], and Martin Grosjean[(1)]

[(1)] *University of Bern, Institute of Geography and Oeschger Center for Climate Change Research, Hallerstrasse 12, CH-3012 Bern, Switzerland*
[(2)] *University of Bern, Institute of Plant Sciences, CH-3012 Bern, Switzerland*
[(3)] *University of Bern, Institute of Geological Sciences, CH-3012 Bern, Switzerland*

* Corresponding author: giulia.wienhues@giub.unibe.ch

The desiccation of Lake Victoria (LV), Africa's largest lake, during the dry last glacial (>20– ~16 ka) and subsequent deglacial refilling had a profound impact on the lake's ecosystem. Reconstructing hydrodynamic variability is critical for understanding Lake Victoria's ecosystem history and the evolution of its diverse endemic fish community. Whereas consensus exists on widespread desiccation ~18 – 17 ka, the re-filling history (16 - 13 ka) has remained highly controversial.

By analysing sediment cores along a near-shore to offshore coring transect covering the past 17,000 years, we aim at a more accurate spatial and temporal reconstruction of LV's deglacial lake level history in response to regional hydroclimate changes. We use lithostratigraphic core correlation, sediment facies, XRF, Typha pollen and 14C chronologies with unprecedented precision to document deglacial lake-level variability.

Our core transect revealed prolonged wetland conditions in the Victoria basin: At our coring site in the central basin, local Typha wetlands existed >16.7 ka alternating with periods of desiccation. Moisture increased gradually between 16.7 – 15 ka and wetlands with permanent ponds established simultaneously in the center and marginal parts of the lake basin. At that time, a shallow lake (<5 m) developed. After 14.5 ka, lake levels increased; wetlands in the central basin were flooded and replaced by lacustrine environments. Finally, at ~13.4 ka, a deep lake established with an overflow and reached modern or even above-modern levels around 10.8 ka. This lake-level history is consistent with regional paleoclimate records.

Integrative analysis of the mineralogical and chemical composition of modern microbialites from ten Mexican lakes: what do we learn about their formation?

Nina Zeyen[1,2], Karim Benzerara[2], Olivier Beyssac[2], Damien Daval[3], Elodie Muller[2], Christophe Thomazo[4,5], Rosaluz Tavera[6], Purificación López-García[7], David Moreira[7] and Elodie Duprat[2]

[1] Department of Earth Sciences, University of Geneva, Rue des Maraîchers 13, 1205 Geneva, Switzerland (Nina.Zeyen@unige.ch)
[2] Sorbonne Université, Muséum National d'Histoire Naturelle, UMR CNRS 7590. Institut de Minéralogie, de Physique des Matériaux et de Cosmochimie (IMPMC), 4 Place Jussieu, 75005 Paris, France
[3] Laboratoire d'Hydrologie et de Géochimie de Strasbourg, EOST-ENGEES, Univ Strasbourg, EOST CNRS UMR 7517, 67084 Strasbourg, France
[4] UMR CNRS/uB6282 Biogéosciences, Université de Bourgogne Franche-Comté, 6 Bd Gabriel, 21000, Dijon, France
[5] Institut Universitaire de France
[6] Departamento de Ecología y Recursos Naturales, Universidad Nacional Autónoma de México, DF México, México
[7] Ecologie, Systématique et Evolution, CNRS, Université Paris-Saclay, AgroParisTech, Orsay, France

Interpreting the environmental conditions under which ancient microbialites formed relies upon comparisons with modern analogues. This is why we need a detailed reference framework relating the chemical and mineralogical compositions of modern microbialites to the physical and chemical parameters prevailing in the environments where they form. Here, we measured the chemical, including major and trace elements, and mineralogical composition of microbialites from ten Mexican lakes as well as the chemical composition of the surrounding waters. Saturation states of lakes with different mineral phases were systematically determined and correlations between solution and solid chemical analyses were assessed using multivariate analyses. I will show that a large diversity of microbialites was observed in terms of mineralogical composition, with occurrence of diverse carbonate phases such as (Mg-)calcite, monohydrocalcite, aragonite, hydromagnesite, and dolomite as well as authigenic poorly crystalline Mg-silicate phases (kerolite and/or stevensite). Interestingly, all lakes harboring microbialites were saturated or supersaturated with monohydrocalcite, suggesting that such a saturation state might be required for the onset of microbialite formation and that precursor soluble phases such as amorphous calcium carbonate and monohydrocalcite play a pivotal role in these lakes. Subsequently, monohydrocalcite transforms partly or completely to aragonite or Mg-calcite, depending on the lake (Mg/Ca)aq. Moreover, lakes harboring hydromagnesite-containing microbialites were saturated with an amorphous magnesium carbonate phase, supporting again the involvement of precursor carbonate phases. Authigenic Mg-silicates formed by homogenous or heterogenous nucleation in lakes saturated or supersaturated with a phase reported in the literature as "amorphous sepiolite" and with a H4SiO4 concentration superior to 0.2 mM. A strong correlation between the alkalinity and the salinity of all the lakes was observed. The observed large variations of alkalinity between the lakes relate to varying concentration stages of an initial alkaline dilute water, due to a varying hydrochemical functioning. In all cases, the size of microbialites in the lakes correlated positively with salinity, (Mg/Ca)aq and alkalinity (Figure 1). Last, some microbialites poorly affected by detrital contamination showed (REE+Y)

patterns with features commonly reported for marine microbialites, questioning the possibility to infer the marine versus lacustrine origin of a microbialite only based on (REE+Y). Overall, while microorganisms can impact nucleation processes and textural arrangements in microbialites, we observed that the hydrogeochemical evolution of lakes exerts a primary control over the onset of microbialite formation and the evolution of their chemical and mineralogical composition.

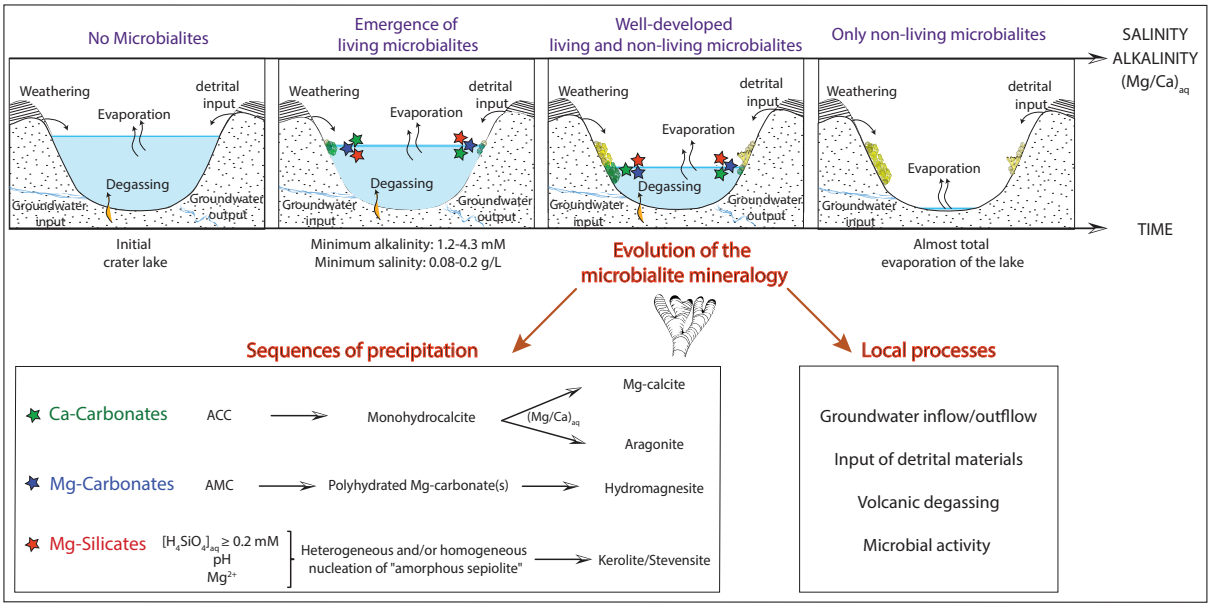

Figure 1. *Model of lake evolution over time. Microbialites start emerging at a certain stage of evaporation and/or weathering of the lake (when [Na+]aq and alkalinity become higher than certain threshold values). Then microbialite mineralogy changes according to key parameters such as the aqueous (Mg/Ca), which controls carbonate mineralogy, and aqueous [H4SiO4] controlling the precipitation of authigenic Mg-silicate.*

Lateral facies correlation of Opalinus Clay in central northern Switzerland using geochemical core logging data: towards a depositional model

Géraldine Zimmerli*[(1)], Bruno Lauper[(1)], Gaudenz Deplazes[(2)], David Jaeggi[(3)], Stephan Wohlwend[(4)], Andreas Wetzel[(5)], & Anneleen Foubert[(1)]

[(1)] *Department of Geosciences, University of Fribourg, 1700 Fribourg, Switzerland*
[(2)] *Nagra, 5430 Wettingen, Switzerland*
[(3)] *Federal Office of Topography swisstopo, 3084 Wabern, Switzerland*
[(4)] *Geological Institute, ETH Zurich, 8092 Zürich, Switzerland*
[(5)] *Department of Environmental Sciences, University of Basel, Basel, Switzerland*

* Corresponding author: geraldine.zimmerli@unifr.ch

The Opalinus Clay, an argillaceous to silty claystone formation, is known in Switzerland as being the selected host rock for deep geological disposal of radioactive waste. Since the 1990's, various geotechnical, mineralogical and sedimentological studies addressed the Opalinus Clay have been studied within the framework of the Nagra (National Cooperative for the Disposal of Radioactive Waste) deep drilling campaigns and the Mont Terri Project (international research program dedicated to the investigation of claystone). The Opalinus Clay succession accumulated from the Late Toarcian to Early Aalenian in an epicontinental sea covering central Europe.

The Opalinus Clay appears relatively homogeneous at large-scale compared to other Mesozoic formations in northern Switzerland. At higher spatial resolution, however, sedimentological facies vary clearly. Besides m-scale lithofacies variations, considerable lithological variability occurs at dm- to cm-scale. In order to harmonize petrographic descriptions in a standardized, quantitative and comparative way, a subfacies classification scheme has been developed (Lauper et al., 2018, 2021) and is being improved. The five initial subfacies are distinguished mainly by texture (grain size, sedimentary structures, fabric and colour) and composition (nature and mineralogy of components). Accurate petrographic descriptions are an important prerequisite to many geotechnical and geochemical studies and the predictive modelling of petrophysical properties.

For this purpose, geochemical core logging data (x-ray fluorescence) were compared with petrographic descriptions and the so far distinguished subfacies for nine newly acquired Nagra drillings using multivariate statistics and end-member modelling. The results provide evidence that XRF core logging data can be used to quantify the lithological variability of Opalinus Clay. Both small-scale vertical lithological variations and marker horizons can be correlated at regional scale. The new descriptions, combined with geochemical core logging data, forms the base for the revision of previous depositional models for the Opalinus Clay at basin-scale.

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How erosion and sedimentation impact rift tectonics and mantle exhumation

Frank Zwaan*[1,2,3], Guido Schreurs[2], Jürgen Adam[3], Sascha Brune[1,5], Anne Glerum[1], Dylan Vasey[6], John Naliboff[7]

[1] *GFZ German Research Centre for Geosciences, Potsdam, Germany*
[2] *University of Bern, Bern, Switzerland*
[3] *University of Fribourg, Fribourg, Switzerland*
[4] *Royal Holloway, University of London, Egham, UK*
[5] *University of Potsdam, Potsdam, Germany*
[6] *University of California, Davis, USA*
[6] *New Mexico Institute of Mining and Technology, Socorro, USA*

* Corresponding author: frank.zwaan@gfz-potsdam.de

Tectonic deformation of the earth's lithosphere is known to influence erosion and sedimentary processes, thereby strongly impacting depositional environments and the evolution of sedimentary systems overall. However, it can also work the other way around; erosion and sedimentation themselves can have a significant impact on tectonic deformation. A major obstacle to our understanding of the impacts of erosion and sedimentation on tectonic processes are the long time-scales involved, which prevent us from directly observing these impacts. Luckily, analogue and numerical modelling methods provide an excellent means to circumvent this obstacle by either allowing us to simulate these processes in a matter of hours in the laboratory, or by directly calculating the evolution of these processes through numerical codes, respectively. Here, we present the insights from two series of models, the first series is from an analogue modelling study by Zwaan et al. (2018) exploring the impact of sedimentation on the evolution of continental rifts, the second series is from a numerical modelling study by Zwaan et al. (in prep) revealing the influence of erosion efficiency on the exhumation (i.e., moving towards the surface) of mantle material in rifts and inverted basins.

The analogue modelling study on the impact of sedimentation on continental rift evolution was analysed with X-ray computed tomography (XRCT or CT) methods and 3D digital volume correlation (DVC) techniques to reveal the internal evolution of these otherwise opaque sandbox experiments. The results of these models suggest that syn-rift sedimentation does not significantly influence the (initial) large-scale arrangement of rifts and transfer zone structures connecting individual rift basins. Yet syn-rift sedimentation can strongly affect the structural architecture developing within the rift basins themselves: sedimentary loading reinforces the rift wedge, decreasing rift wedge faulting, and increases subsidence within the rift basin. These effects are most significant in areas where most accommodation space is available. Rift segments that undergo high degrees of oblique extension develop less accommodation space and are significantly less influenced by sedimentary loading. We furthermore derive from our models that a high sediment influx could significantly delay continental break-up by continued replenishing and reinforcing of the (upper) crust, which would also prevent the mantle from rising to the surface.

The numerical modelling study on the impact of erosion on mantle exhumation in rift and subsequently inverted basins was completed with the geodynamic code ASPECT (coupled to FastScape for the inclusion of erosion and sedimentation). The models show that although increasing or reducing the efficiency of erosion does have some effect during continental rifting and break-up, variations in erosion efficiency do not strongly affect the volume of mantle material being exhumed during the extension phase. However, efficient erosion during the subsequent basin inversion phase, when plate motion directions are inverted, has a strong effect on mantle exhumation. Efficient erosion swiftly removes accumulating low-density crustal material so that the relatively dense mantle material can rise to the surface. By contrast, inefficient erosion allows large volumes of crustal material to accumulate at the surface so that mantle material is forced down into the earth again.

These two series of models highlight the impact erosion and sedimentation can have on plate tectonic systems, and they provide strong incentives to further explore these impacts and interactions, both by means of modelling and by studying data from the natural world.

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