SWISS SED Meeting

Twenty-third Meeting of Swiss Sedimentologists

Saturday, 28 February 2015

Fribourg

Abstracts

PROGRAMME

09:55 ***Opening***

10:00–10:20 **El Kateb, A., Claudio Stalder, C. and Spezzaferri, S.:** Benthic foraminiferal assemblages as pollution proxies in the Gulf of Gabes: preliminary results

10:20–10:40 **Jaramillo-Vogel, D., Foubert, A., Schaegis, J.-C., Atnafu, B. and Kidane, T.:** The nature and significance of botryoidal and fibrous aragonite microbialites in the Danakil depression

10:40–11:40 ***Coffee and posters***

11:40–12:00 **Baumgartner, P., Baumgartner-Mora, C., Andjic, G., Salazar Ortiz, E. and Rincón Martínez, D:** Short-lived Late Mesozoic - Tertiary carbonate banks along convergent margins, Nicaragua – Costa Rica – Panama – Colombia

12:00–12:20 **Blouet, J.-P., Imbert, P. and Foubert, A.:** Controlling factors of a biogenic petroleum system related to the precipitation of seep carbonates in the Panoche Hills, California

12:20–14:00 ***Lunch***

14:00–14:50 **Keynote: Tucker, M.:** Modern and ancient microbialites, source rocks and reservoirs

14:50–15:10 **Litty, C., Duller, R. and Schlunegger, F.:** Paleohydraulic reconstruction of a 40 kyr-old terrace sequence implies that water discharge was 10 times larger than today

15:10–15:30 **Buechi, M., Menzies, J. and Anselmetti, F.:** Subglacial erosion, deformation and deposition in glacially overdeepened basins – Key observations in drill cores and thin sections

15:30–16:30 ***Tea and posters***

16:30–16:50 **Slootman, A., Cartigny, M., de Boer, P. and Moscariello, A:** Neogene Cool-Water Carbonate Ramps in the Mediterranean: Gradualism versus Catastrophism – A Hydrodynamic Story

16:50–17:10 **Morlock, M., Schilder, J., van Hardenbroek, M., Szidat, S., Wooller, M.J. and Heiri, O.:** How does seasonality affect the $\delta^{13}C$ values of cladoceran and bryozoan remains in lake sediments? Investigating a new approach in aquatic palaeoecology to reconstruct past methane abundance in lakes.

17:10 ***Closure and apéro***

Posters

Andjic, G. and Baumgartner, P.: Discovery of Late Cretaceous Radiolaria in the Loma Chumico Fm. stratotype (Nicoya Peninsula, Costa Rica). New constraints on the tectonostratigraphic evolution of terranes in the Nicoya Peninsula

Baldessin, E., Fischer, G. and Kindler, P.: Geochemical and petrographic evidence for multi-phase dolomitization of the Timber Bay Formation, Pliocene, Mayaguana, SE Bahamas

Barilaro, F., Mc Kenzie, A. and Vasconcelos, C.: Non-marine carbonates: abiotic versus biotic fabric types, porosity and diagenesis

Blouet, J.-P., Imbert, P. and Foubert, A.: Seep carbonates record multiphase fluid flow: a case study from the Panoche Hills (Paleocene Moreno Formation, Central California)

Bôle, M. and Baumgartner, P: Middle Jurassic radiolarite facies of Tethys as a function of paleoproductivity

Buechi, M., Menzies, J. and Anselmetti, F.: Subglacial erosion, deformation and deposition in glacially overdeepened basins – Key observations in drill cores and thin sections

El Kateb, A., Stalder, C., Neururer, C. and Spezzaferri, S.: Dead coral in the Gulf of Gabes: First observations and relation with phosphorus pollution

Fabbri, S., Anselmetti, F., Herwegh, M., Schlunegger, F., Volken, S. and Möri, A.: Neotectonic Activity of the Larger Lake Thun Area as Expressed in the Sediment Displacements

Feenstra, E., Foubert, A., Wehrmann, L., Jaramillo-Vogel, D., Hancock, L., Van Rooij, D. and Pirlet, H.: Understanding the temporal and spatial variability of early diagenesis in cold-water coral carbonate mounds

Fischer, G. and Kindler, P.: Microfacies analysis and paleoenvironmental reconstruction of Miocene Limestones from Mayaguana Island (SE Bahamas)

Heerwagen, E., Ulyanov, A. and Martini, R.: New insights into the paleogeographic relationship of the Antimonio-, Vizcaino terranes, and the North American craton

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Honegger, L., Castelltort, S., Clark, J., Adatte, T., Puigdefàbregas, C., Dykstra, M. and Fildani, A.: Land to sea correlation of clastic series in the Eocene pyrenean foreland basin: new data from field mapping, stable isotopes, and whole rock geochemistry

Hunger, G., Ventra, D., Moscariello, A. and Veiga, G.: Sedimentary Responses to Tectonic and Climatic Forcing: a High-Resolution, Integrated Sedimentological-Geochemical Study in Terrestrial Foreland Deposits (Mendoza, Argentina)

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Marchegiano, M., Gliozzi, E. Ceschin, S., Mazzini, I., Mazza, R. and Ariztegui, D.: Disentangling the relationship between environmental conditions and ostracod assemblages in modern Lake Trasimeno, Italy

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Richter, N. and Anselmetti, F.: Sachsler Seefeld: A high-resolution alpine lake-sediment record from the center of Switzerland

Rohrbach, E., Reitner, J. M., Vogel, H. and Anselmetti, F.: Tristacher See: Lacustrine sediments as an archive for mass movements and paleoclimate (Eastern Tyrol, Austria)

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Schaegis, J.-C., Foubert, A., Jaramillo-Vogel, D., Atnafu, B., Kidane, T. and Henriet, J.-P.: Recent and ancient continental carbonates in the Danakil basin (NE Afar, Ethiopia): Preliminary results.

Schöllhorn, I., Adatte, T. and Föllmi, K.: A sedimentological and geochemical analysis of Hettangian to Pliensbachian sediments from the Jura Mountains: phosphogenesis, paleoenvironment and paleoclimate

Stalder, C., Camozzi, O., El kateb, A., Blouet, J-P. and Spezzaferri, S.: Reading the (paleo-)environmental message from living (stained) and dead benthic foraminifera assemblages from cold-water coral ecosystems of the Gulf of Cadiz and the Eastern Alboran Sea

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Discovery of Late Cretaceous Radiolaria in the Loma Chumico Fm. stratotype (Nicoya Peninsula, Costa Rica). New constraints on the tectonostratigraphic evolution of terranes in the Nicoya Peninsula

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Outcrops of the Nicoya Peninsula and Gulf area represent a collage of Mesozoic oceanic terranes that became assembled during the latest Cretaceous along the western edge of the Caribbean Plate, at the boundary between the Caribbean Large Igneous Province s.s. (CLIP s.s.) to the south and the Mesquito Composite Oceanic Terrane (MCOT) to the north. In previous studies the subdivision of terranes was 3-fold (Bandini et al., 2008): (1) the Nicoya Complex s.s., a highly deformed mélange of pre-Campanian plateau-like igneous rocks that extruded and intruded into Middle Jurassic to Santonian ribbon radiolarites; (2) the Matambú Terrane, a pre-Albian oceanic basement covered by Upper Cretaceous hemipelagic/turbiditic sediments and characterized by the occurrence of the "Albian" Loma Chumico Formation, (3) the Manzanillo Terrane, a pre-Turonian oceanic basement intruded by the Turonian Tortugal picritic suite. The Manzanillo Terrane is regarded as the westernmost outcrop of the CLIP s.s. and is covered by the Coniacian-late Campanian (Bandini et al., 2008) arc-derived Berrugate Formation cropping out in the southeastern and eastern Nicoya Peninsula and in the Nicoya Gulf area.

Our radiolarian biostratigraphic study focused on hemipelagic, tuffitic siliceous mudstones and cherts exposed in the southeastern and central Nicoya Peninsula. We found green, often organic-rich cherts, shales and tuffacous siliceous mudstones to volcanic sandstones in outcrops mapped as the "Albian" Loma Chumico Formation (Denyer et al., 2014). However, lithostratigraphy, microfacies and geochemistry indicate that these rocks are distal equivalents of the Berrugate Formation defined in the Nicoya Gulf area in somewhat more proximal facies including volcaniclastic turbidites and debris flows (Flores et al., 2003). The tuffitic lithologies contain well-preserved radiolarians with Turonian – Santonian assemblages very similar to those described by Bandini et al. (2008) (see figure). In S-Nicoya the Berrugate Formation grades during the late Campanian into the overlying Piedras Blancas Formation, a pelagic, weakly tuffaceous limestone.

More recently, we sampled the type area of the Loma Chumico Formation, where, allegedly, ammonite fragments of late Albian age were found (*Neokentroceras* sp., Azéma et al., 1979). To our surprise, we found very similar Turonian – Santonian radiolarian assemblages in this locality (see Fig. 1).

As a consequence, the Loma Chumico organic-rich shales are a facies that is coeval with the Berrugate Formation and should be considered as a facies variation, also found in S-Nicoya (e.g, Punta Pochote). The roughly coeval Sabana Grande and Nambí Formations are lateral facies variations probably formed more distally with respect to the arc activity recorded in Berrugate.

We conclude that the former Matambú and Manzanillo Terranes could represent one paleogeographic fore-arc domain with a CLIP-like basement overlain since the Coniacian by siliceous arc-derived or siliceous/calcareous hemipelagic formations depending on the proximity and activity of an intermediate volcanic arc. By late Campanian times the arc became temporarily extinguished, which gave rise to a late Campanian-Maastrichtian pelagic limestone sequence (Piedras Blancas Fm.). The CLIP-like basement became accreted in latest Turonian-earliest Coniacian time, shortly after the Tortugal picritic intrusion (89 Ma). The

Nicoya Complex s.s. is clearly exotic with respect to the above domain, since it contains Middle Jurassic to Santonian ribbon bedded radiolarites of open oceanic origin, devoid of any arc influence. The youngest plateau-like intrusions are dated as 83 Ma (earliest Campanian). We conclude that the Nicoya Complex s.s. became accreted in the late Campanian, when arc activity temporarily ceased in the area. Tectonic uplift and emersion is indeed documented by boulder conglomerates and the unconformably overlying shallow-water El Viejo Formation.

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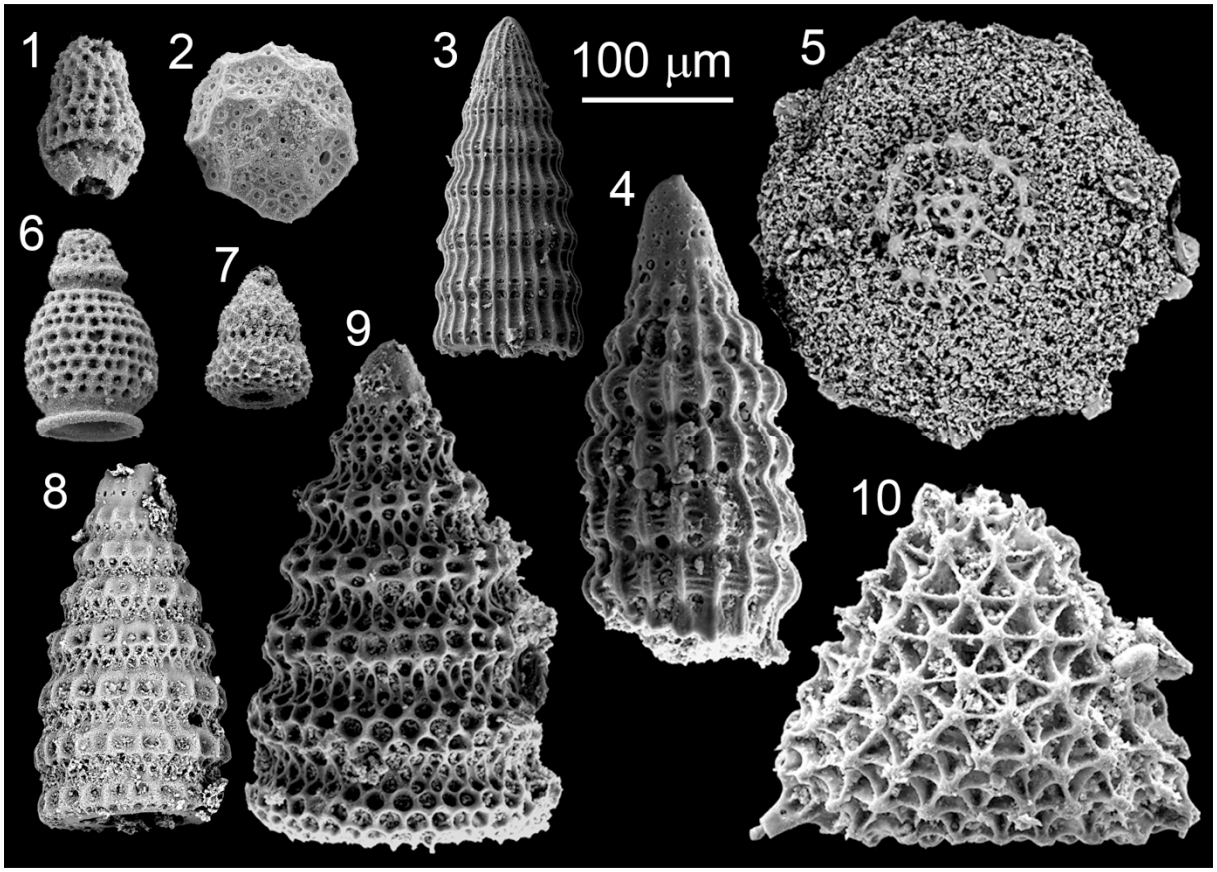

Fig. 1: Turonian-Santonian radiolarians from the Southern Nicoya Peninsula (Costa Rica) from outcrops of the Berrugate Formation (so far mapped as Albian Loma Chumico Formation).1. *Dictyoprora* sp. cf. *P. ascalia* (Foreman) (sample OTE18). 2. *Hemicryptocapsa polyedr*a Dumitrica (sample LCH0). 3. *Dictyomitra formosa* Squinabol sensu O'Dogherty 1994 (sample CRPC 03). 4. *Dictyomitra* sp. aff. *D. formosa* Squinabol (sample CRPC03). 5. *Patellula* sp. (sample 1PCH7). 6. *Dictyopora* sp. aff. *D. urna* (Foreman) (sample OTE18). 7. *Dictyopora* sp. aff *D. apicata* (Foreman) (sample OTE18). 8. *Pseudodictyomitra nakasekoi* Taketani (sample 1PCH7). 9. *Eostichomitra* sp. aff. *E. perapedhia* (Bragina) (sample CRPC03). 10. *Alievum gallowayi* Pessagno (sample CRPC03). These species have also been found at the type locality of the Loma Chumico Formation.

Geochemical and petrographic evidence for multi-phase dolomitization of the Timber Bay Formation, Pliocene, Mayaguana, SE Bahamas

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Contrary to data from other Bahamian dolostones that indicate dolomitization from seawater (Supko, 1977; Pierson, 1982; Vahrenkamp, 1988; Dawans, 1988), our geochemical results from the Pliocene Timber Bay dolostones suggest involvement of both seawater and of meteoric-influenced fluids in the diagenetic history of these rocks.

Nested in the southeastern Bahamas between latitudes N 22°15' - N 22°30' and longitudes W 72°40' - W 73°10', Mayaguana is a narrow elongated platform almost entirely capped by one large island. Eight lithostratigraphic units have been identified on the island surface (Godefroid, 2012), including the dolomitic Timber Bay Formation (Pliocene) which is only exposed along the north coast. The presence of these outcropping dolostones at the surface is unique, as dolomites of this age are found at various depths in cores from other Bahamian islands.

The Timber Bay Formation was examined at three localities: Little Bay, Curtis Creek and Timber Bay. Several stratigraphic sections were logged at each locale. The macrofacies and the faunal assemblage were studied in the field. Fifty-seven samples were collected for subsequent petrographic examination with a light-transmitted microscope, and for isotopic analyses (O and Sr).

The Timber Bay Fm (TBF) forms low elevation terraces mainly consisting of dolomitized coralgal framestone, rich in encrusting red algae, with a bioclastic grainstone matrix. The corals assemblage includes *Diploria clivosa*, *Diploria strigosa*, *Meandrina* sp., *Monstastrea* sp., *Siderastrea siderea*, *Stylophora affinis* and *Stylophora minor*. In thin section, the dolomitized grainstone matrix comprises remnants of early isopachous cements, moldic porosity after aragonite allochems, and syntaxial cements around echinoderm fragments. The dolomite occurs as (a) a fine-crystalline, polymodal, planar-s dolomite that mimetically replaced micrite and allochems (mainly red algae, echinoderms and foraminifera), and (b) limpid dolomite cements that form either isopachous rims or blocky fillings in both inter- and intragranular pores. A late phase of low-Mg sparry calcite cement usually occludes the remaining pore spaces. $^{87}Sr/^{86}Sr$ ratios range from 0.709048 to 0.709103. The oxygen isotope signature of the dolostones ranges from -1.95 ‰ to 0.65 ‰ (mean: -0.68 ‰ PDB). Negative O-isotope values appear to correlate with the percentage of late calcite cement.

The TBF certainly represents a fossil high-energy reef as indicated by the abundance of encrusting red algae. The coral assemblage, namely the co-occurrence of *Diploria clivosa* and *Stylophora minor*, constrains the biostratigraphic age of the fossil reef to the Early Pliocene – Early Pleistocene. The remnants of isopachous cements, moldic porosity after aragonitic allochems, and syntaxial cements around echinoderms fragments suggest early phases of marine and meteoric diagenesis. However, the abundance of mimetic replacement argues against a massive stabilization of the particles to LMC prior to dolomitization. The co-occurrence of both replacive dolomite and dolomite cement indicates that dolomitization (*sensu lato*) of the TBF possibly happened in two stages. The $^{87}Sr/^{86}Sr$ values obtained from the TBF correspond to the seawater composition in the Early Pliocene - Early Pleistocene interval (McArthur et al., 2001). These values match the biostratigraphic age of the TBF and show that dolomitization and dolomite cementation occurred shortly after deposition, as

suggested by Swart et al. (1987) for other Bahamian dolostones. O-isotopes ratios from the TBF are lighter than those obtained from other Bahamian and most Caribbean dolomites interpreted as mediated by seawater (Supko, 1977; Pierson, 1982; Ward and Halley, 1985; Vahrenkamp, 1988; Dawans, 1988; Land, 1991; Machel and Burton, 1994; Jones and Luth, 2002). This isotopic difference may solely result from the presence of late calcite cement. However, as samples with 100% dolomite also show a lighter oxygen composition than seawater-derived dolostones, this hypothesis is ruled out as the only explanation. Alternatively, a two-stage diagenetic model is suggested. In this scenario, dolomitization would have been mediated by seawater when the platform was reflooded after an initial emergence. Subsequently, an episode of dolomite cementation by meteoric-dominated fluids would have occurred in a context of platform emergence.

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Non-marine carbonates: abiotic versus biotic fabric types, porosity and diagenesis

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With the discovery of giant South Atlantic hydrocarbon reservoirs, non-marine carbonate deposits have received significant attention in recent years. This has led to the recognition that there is paucity of data concerning the deposition and diagenetic processes controlling the porosity and permeability of these non-marine carbonates relative to vast information available for marine carbonates. To fill this data gap, we propose: 1) to characterize the varieties of continental carbonate fabrics and establish the link between fabric types and depositional environments; 2) to define a travertine/tufa fabric classification developed using classical carbonate terminology, and 3) to improve the understanding of the processes that control calcium carbonate precipitation in hydrothermal-spring and ambient temperature settings. We will present a multi-scale study of Albegna Valley and Randicofani Basin travertine deposits (Tuscany, Central Italy) and Montevecchia and Valle del Curone tufa deposits (Lombardy, Italy), which provides important insights to better define depositional models applicable to non-marine carbonates. A large variety of fabric types have been characterized for the studied deposits. The tufa and travertine fabrics can be essentially classified into three types: 1) tufa /travertine "boundstone" and "cementstone" in which the original components are directly precipitated from flowing water, 2) encrusted "boundstone" in which the original biological (e.g. vegetation) components act as the substrate upon which the carbonate is directly precipitated by flowing water and 3) carbonate grain "packstone/grainstone" to "floatstone/rudstone" which are formed by cemented fragments of already lithified travertine/tufa precipitates (intraclasts) and other lithoclasts. The individuated fabric types reflect the precipitation processes due to interplay between abiotic and biotic (i.e., biologically induced by microbial metabolic process or simply influenced by nucleation on microbial biofilm substrate) and/or a combination of both processes, which are subsequently modified by diagenesis. Some examples of these fabric types are shown in Figure 1. Pore structure (ranging from depositional to secondary porosity) is an important component of travertine and calcareous tufa fabrics. A relationship exists between the individuated fabric types and the depositional environment with respect to velocity/turbulence and discharged volumes of the flowing water. Based on these observations, we conclude that travertine and calcareous tufa share common characteristics with other classes of continental and marine carbonates, and, therefore, similar methodology and classification criteria may be utilized.

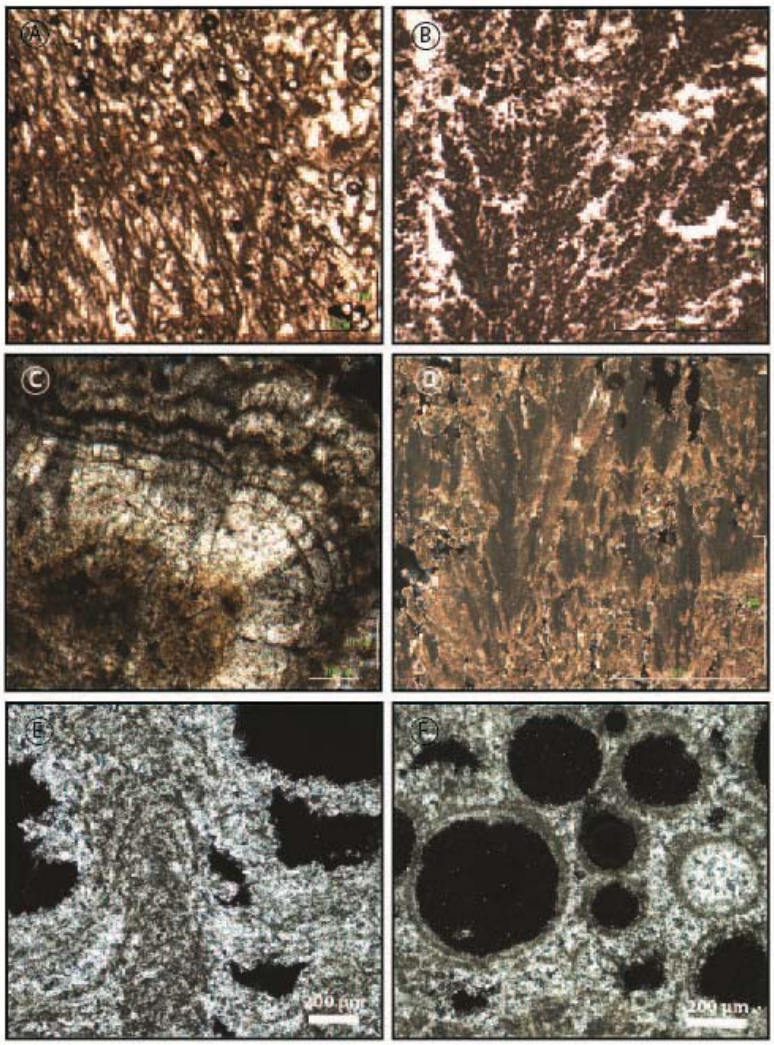

Fig. 1: Thin section photomicrographs showing the principal petrographic features of non-marine carbonate fabrics types. A) Parallel polarizer photomicrograph showing the dendritic "boundstone" formed by mineralized filaments. Porosity is in white. Montevecchia tufa deposit (Lombardy, Italy). B) Shrub-like travertine dendritic "boundstone" composed of dense clotted peloidal micrite arranged into a bush-like architecture. Pore space appears in white. Plane polarized light. Modern Bagni San Filippo travertine deposit (Tuscany, Italy). C) Parallel polarizer thin section of crystalline laminated cementstone formed by the coalescence of fan-shaped spar crystals. Note the micritic laminae that interrupt the vertical alternation of the crystalline laminated cementstone. Modern Curone Valley tufa deposit (Lombardy, Italy). D) Crystalline dendritic cementstone" formed by the lateral juxtaposition of single bladed calcite crystals characterized by symmetrically branched smaller crystals with respect to a central stalk. Crossed polarized light. Pleistocene Albegna Valley travertine deposit (Tuscany, Italy). E) Laminated "boundstone" characterized by micro-columnar structures formed by vertical repetition of the laminae formed by convex upward morphology. The laminae create a porous framework. Crossed polarized light. Pleistocene Albegna Valley travertine deposit (Tuscany, Italy). F) Crossed polarized light photomicrograph showing bubble "boundstone" consisting of sub-spherical to circular porous structures made of micrite layers overlain by columnar cement followed by blocky sparite. Pleistocene Albegna Valley travertine deposit (Tuscany, Italy).

Short-lived Late Mesozoic - Tertiary carbonate banks along convergent margins, Nicaragua – Costa Rica – Panama – Colombia

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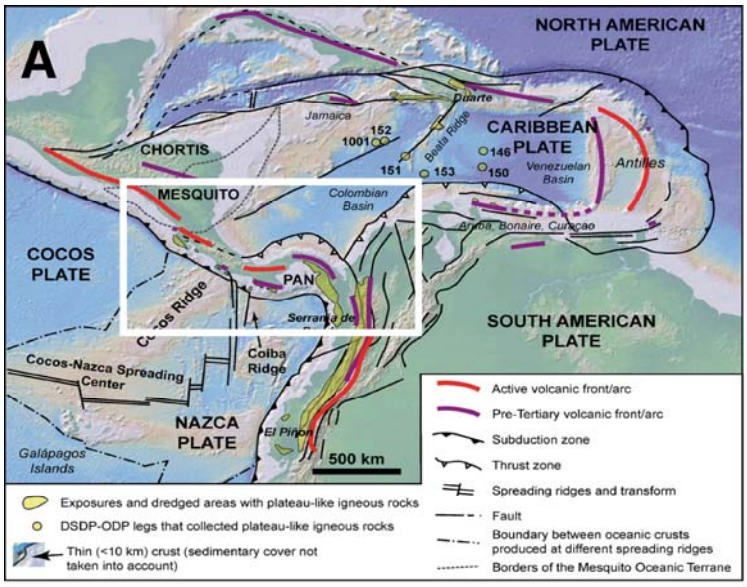
Carbonate-producing paleo-environments along the Late Mesozoic – Tertiary intraoceanic subuction zones of Central America and the Colombian Caribbean (Figure A) were short-lived (1-10 Ma) and of limited areal extension. These small carbonate banks and buildups are fundamentally different from long-lived (10-60 Ma) large carbonate shelves set on (often thinned) continental crust along passive margins such as Florida, Yucatan, Nicaragua Rise etc. Models developed for these carbonates do not apply to the small carbonate banks.

Oceanic basements in isostatic equilibrium are usually deeply submerged. Their rise into the photic zone and eventual emergence was controlled by convergence/collision tectonics, and/or intraoceanic plateau or arc development. In this context, shallow carbonate palaeo-environments were short-lived and formed not only on uplifted accretionary prisms, oceanic plateaus and arcs, but also on (later accreted) volcanic edifices of oceanic seamounts. The age and facies evolution of these carbonates provides valuable keys to the tectonic and paleo-envronmental evolution of active margins.

- Aptian-Albian shallow water limestones (Cerro Vailavas, Siuna area, NE Nicaragua) rest on Early Cretaceous deepwater sediments which seal the exhumation of the Siuna Serpentinite Mélange.
- The Upper Campanian El Viejo Formation (N-Costa Rica) unconformably encroaches on the Nicoya- and Santa Elena basement complexes, with rudistid biostromes (Figure B) followed by platform resediments , overlain by pelagic Maastrichtian-Paleocene sediments.
- The Upper Paleocene/Early Eocene Barra Honda Formation (Tempisque Basin Guanacaste, Costa Rica) transgessively overlies paralic conglomerates and paleosoils on a basement high, whereas to the S a continuous section shows a shallowing upwards pelagic sequence. Barra Honda is covered by Eocene turbidites (Figure C).
- The Upper Eocene Punta Cuevas Limestone (S point of Nicoya Peninsula) rests with a progressive unconformity of siliceous forearc turbidites and a veneer of tempestites.
- A Upper Oligocene carbonate bank at Punta Punta Pelada (Nicoya, Costa Rica) rests on a paralic unconformity cut into Eocene siliceous turbidites. The shallow carbonates are overlain by distal tempestites.
- In the Azuero Peninsula, Upper Eocene carbonates seal the assembly of the Azuero Accretionary Complex which includes Paleocene to middle Eocene seamounts.
- The first shallow water carbonate banks are of Late Eocene age in the Canal Zone and of Oligocene age in the Chuconaque Basin of Panama. They mark a diachronous phase of arc activity and uplift before the formation of the basins.
- In the Colombian Caribbean area the Middle Eocene to Oligocene Formations (Arroyo de Piedra, Chengue, Toluviejo, Cienaga de Oro) show repeated alternations of carbonate banks and detrital sediments representing the combined effects of tectonic uplift/ subsidence and eustatic sealevel changes.

Middle Cretaceous to Oligocene carbonate shoals are characterized by the following features:

- They rest with an angular conformity either on basement highs, or on deep water sediments such as turbiditic forearc sequences, often with intervening tempestites.
- They are often made of pure carbonate: red algal-foraminifer associations, more rarely coral reefs (Oligocene-Miocene), and bivalve associations.
- In general, the carbonate shoals are overlain again by tempestites and/or deeper water turbiditc, hemipelagic-pelagic sediments, often with a progressive unconformity.
- They are transgressive, after collision, uplift and erosion.
- Regressive-transgressive sequences in forearc regions can be the result of seamount accretion and underplating.
- Further origins of shallow carbonate systems are: -Transpressive systems with uplift and subsidence (Romeral Fault Columbia). - Shoulder uplift in oceanic rift systems (Hess Rise). - Emergence of arc volcanoes or later accreted oceanic islands (S-Costa Rica, Azuero, Panama).

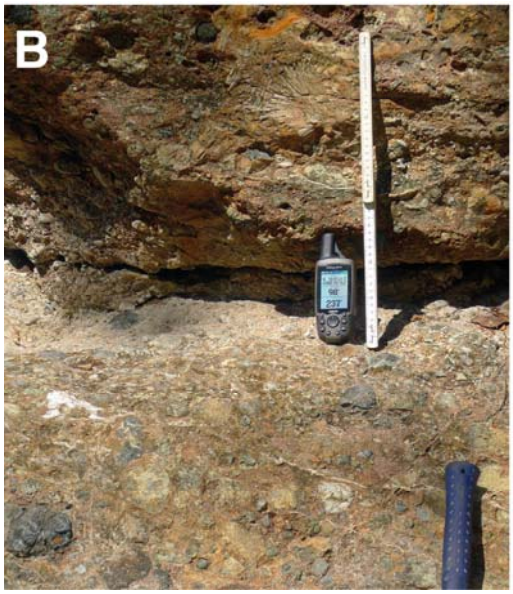


Figures

A: Area of work.

B: Late Campanian rudistid reefs on ophiolitic conglomerate capping the Santa Elena Ophiolite Nappe, N- Costa Rica.

C: Top of the Late Paleocene-Early Eocene Barra Honda Platform. Rapid drowning and onset of forearc turbidites. Tajo Teresita, Nicoya, Costa Rica.



Controlling factors of a biogenic petroleum system related to the precipitation of seep carbonates in the Panoche Hills, California

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Early Paleocene seep carbonates have been identified in the Panoche Hills, Great Valley forearc basin in California by using palaeontological indicators, petrography and isotope analysis. Seep carbonate concretions have been observed to occur above the tip of sandstone dykes which cut across the ca. 700 m-thick shaly Moreno formation. It has been suggested that the dyke systems act as migration pathways for hydrocarbons. $\delta^{13}C$ values of the carbonates are lower than -50 ‰ PDB, indicating an origin from biogenic methane. However no biogenic source rock has been identified in the study area. Based on the burial and thermal history of the basin, the possibility of biogenic gas generation in the organic matter rich interval of the lower Moreno formation at the time of the seep carbonate formation has been modelled.

In order to assess the palaeo-thermal state of the Moreno shales, the initial decompacted thicknesses were calculated. Thermal boundary conditions of the heat diffusion model were estimated with an actualistic approach; the geothermal heat flow in this fore-arc geodynamic setting can by constrained to 40-45 $mW*m^{-2}$ (Blackwell and Richards ; 2004) and the temperature at an estimated paleo-seafloor depth of 100-200 m to 15±4°C (Martin, 1964).

Calculation results reveal that the lower Moreno formation experienced temperatures varying between 30-40°C during the precipitation of authigenic seep carbonates, corresponding to the optimal temperature window for biogenic gas generation. An important factor that impacts the biogenic gas generation rate is the sedimentation rate. The time constraints on the deposition of the Moreno Fm. are not very precise; however, 7 km of sediments were deposited during Cretaceous times. This corresponds to a fairly high burial rate, which is favorable for biogenic gas generation.

To conclude, the Moreno formation is probably the source rock for biogenic gas production playing a role in the precipitation of the overlying seep carbonates. The Panoche Hills are believed to be one of the rare outcrops exposing a complete venting system composed by the lower Moreno Formation as hydrocarbon source rock, sandstone dykes as migration pathways and seep carbonates as fluid expulsion structures just below the palaeo seafloor. The future work will focus on the further mapping of the seep carbonates and tightening the stratigraphic framework to better constrain depositional times and burial rates of the Moreno Formation.

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Seep carbonates record multiphase fluid flow: a case study from the Panoche Hills (Paleocene Moreno Formation, Central California)

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The outcrops of the Paleocene Moreno Fm. in the Panoche Hills of the Great Valley Forearc Basin of Central California offer a unique opportunity to study seep carbonates precipitation just below the seafloor and their relation to a dense network of sand injectites which are inferred carrier beds for migrating fluids (Minisini and Schwartz, 2007). While previous publications focused on the large-scale statistical relationship between the density of injectites and the occurrence of seep carbonates over the 20 km-long outcrop, this study focuses on the detailed interaction between the injectites and the origin and nature of the seep carbonates.

Clusters of subspherical nodules surrounding mounded carbonate concretions which are between 1 to 3 m in diameter, are observed in restricted areas directly above the dyke tips. Lucinids clams, a representative chemosynthetic bivalve, has been found in and around the carbonate concretions. The occurrence of clams extends over *ca.* 50 m above and below the highest dyke tips. This indicates that seepage lasted for a long time, and that the dyke emplacement occurred in several episodes. The matrix of the concretions is micritic characterized by vuggy porosity and burrows filled with peloidal sediments and different cement generations. The succession of cements is consistent and characterized by resp. dendritic Mg-rich calcite, acicular barite, botryoidal and acicular aragonite and finally anisopachous laminated meniscus micrite. The $\delta^{13}C$ isotopic values of each of the authigenic carbonates (matrix and cements) are varying around -50 ‰ PDB, indicating a methane derived authigenic origin. The above –cited cements form a successive paragenetic sequence which may repeat up to ten times, indicating cyclic fluid circulation probably linked to the reactivation of fluid overpressure in the dykes.

Late diagenetic minerals witnesses the circulation of marine and finally meteoric fluids, the latter linked to the exhumation of the basin. The first marine-related microsparitic cements have $\delta^{13}C$ values around 0 ‰ PDB and are cementing the micritic authigenic carbonate concretions. Later diagenetic phase are found in septarian cracks and constitutes at least seven generations of calcite, hematite, and quartz cements.

To conclude, this study evidence the link between gas migration through dyke systems and methane-derived seep carbonates. The dykes remain open fluid pathways through the encasing shales during the whole basin story, circulating hydrocarbons, but also marine and meteoric waters.

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Middle Jurassic radiolarite facies of Tethys as a function of paleoproductivity

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Middle Jurassic radiolarites are quite common in the Tethys with two different facies (Baumgartner, 2013). The Basal Radiolarites are almost lime-free, have a green color and were deposited from late Bajocian to Bathonian-Callovian. The overlying Knobby Radiolarites are red, sometimes calcareous, and grade upsection into siliceous limestones of the Rosso ad Aptici Formation. The red lithologies formed during Callovian/Oxfordian to early Tithonian.

The color in radiolarites seems related to the presence of ferrous minerals in different oxidation states (Matsuo et al., 2003); Hematite tends to give a reddish color to radiolarites whereas pyrite is responsible of the green color. The green color of Basal radiolarites is compatible with reducing conditions and the Bajocian occurrence of numerous black shale deposits around the Tethys (Zaton et al., 2008). Tribovillard et al. (2012) pointed out that semi restricted basins were present in the Western Tethys. Restriction was more important in the western part, and also dependent of the basin geometry.

Our analysis of trace elements in both Panthalassan and Tethyan radiolarites have shown that Mo, V, U are enriched in black cherts which is typical for organic matter preservation under oxygen-poor conditions (Tribovillard et al., 2006). On the other hand, the enrichment factor of many trace elements increases with the proportion of biogenic SiO_2 in the sediment. Covariation of the calculated biogenic silica and trace element content can be taken as a proxy of biogenic productivity. This paleoproductivity trend is particularly well marked by the Barium enrichment in the Basal Radiolarites.

Continuous anoxic or dysoxic conditions in the water column during the deposition of the Bathonian-Bajocian Basal Radiolarites can be excluded on the basis of trace element enrichment. It rather suggests reducing conditions within the sediment (U/Th and V/Cr proxies). The higher productivity might be related to a climatic change from arid to humid conditions around the Tethys during the Bajocian (Hesselbo et al. 2003, Ghandour et al., 2002) supplying more nutriments to the ocean.

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Subglacial erosion, deformation and deposition in glacially overdeepened basins – Key observations in drill cores and thin sections

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The erosional processes involved in the formation of overdeepened subglacial basins ("tunnel valleys") in the area of Pleistocene piedmont-style glaciation in the Northern Alpine Foreland are poorly understood. A major obstacle is that direct observations from the base and the overlying sediments are very limited. We present results from a set of drill cores that recovered the entire sedimentary infill of a prominent overdeepened basin (Lower Glatt valley, Switzerland) and that gave detailed insight into the lithologies of these basal units.

Key observations were made in a ca. 15 m thick unit consisting of a) matrix-supported stratified and massive diamicts with beds of poorly sorted gravels with rounded clasts, intercalated with b) laminated fines and sand (dm-thick). The alternation between these different lithofacies points towards distinct changes in the energy levels at which the sediment was transported and deposited. We interpret this basal unit as a deposit that formed in subglacial meltwater channels and cavities. The occurrence of gravelly diamicts and gravel beds indicates temporarily active subglacial fluvial transport. A switch to the deposition of laminated fines supports a sudden reduction in the hydraulic gradient at the glacier base, e.g. due to the closure of a channel.

Micromorphologic analysis also supports this interpretation, with a high abundance of ductile and brittle deformation features (turbation features, grain stacking, lineations, and crushed grains) indicating subglacial deformation, i.e. during re-incorporation into the glacier bed. We therefore interpret these basal sediments as laterally and vertically amalgamated channel fills that accreted in response to the coupling and uncoupling of the glacier with its bed. Our findings support the concept that subglacial meltwater is the main eroding agent forming the overdeepened bedrock structures in the terminal areas of Alpine paleo-glaciers.

Benthic foraminiferal assemblages as pollution proxies in the Gulf of Gabes: preliminary results

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Phosphorites are one of the main mineral resources of Tunisia. Important deposits are located in the Gafsa basin (Western part of Tunisia). 80% of the ore phosphate extracted is treated in three main industries located along the eastern marine coast: Sfax, Skhira and Gabes. Phosphate treatment consists of the transformation of phosphorite into phosphoric acid using sulfuric acid with consequent production of large amount of phosphogypsum waste.

This pollutant is stored in spoil tips along the coasts and near the industries causing contamination of the marine environment by leaching processes (Zairi and Rouis, 1999). At Gabes, the waste products are discharged directly into the sea, including waste waters, industrial sludges and phosphorus.

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

A video survey was conducted to select the sampling sites, sediments were sampled, and multiparameter (pH, temperature and dissolved oxygen) were measured with a landing system. Video survey system and landing system were developed and built at the Department of Geoscience of University of Fribourg especially for this study. Different analyses are presently on-going: 1) Total organic carbon (TOC); 2) Mineral carbon (MINC); 3) Phosphorus sequential extraction; 4) Grain size; 5) X-Ray diffraction; 6) Living foraminifera determination.

Video survey and box cores observation were used to trace facies development along both transects. The Djerba transect is basically characterized by abundant presence of *Posidonia oceanica,* wich is totally absent along the Gabes transect. The Gabes transect is characterized by high turbidity and siltation probably caused by intense pollution.

Water quality parameters measured along both transects reveal a high degree of pollution at the sites closer to the coasts. Low pH, low dissolved oxygen and high water temperatures characterize these sites. High phosphorus concentrations in the sediment were measured along the Gabes transect, especially on the four stations closer to the coasts. Total Organic Carbon values are high along the Gabes transect and reach up to 3%. And may be related to the discharge of waste-water and industrial sludge.

XRD analyses reveal the presence of Quartz, Calcite, Aragonite and high magnesium calcite at both transect. The semi-quantitative XRD analyses spectra based on RIR values (i.e., reference intensity ration values) show a very high abundance of calcite 3.45 km from the coast along Gabes transect. At 2.44 km from the coast calcite concretions could be observed. These features are probably originated by dissolution and re-precipitation of biogenic compounds. The fluctuating pH at these stations may be responsible for these processes.

Faunal assemblages were treated following the FOBIMO protocol (Schönfeld et al., 2012). Living foraminifera (stained) from the Gabes transect were picked and determined in the fractions 125-250 µm, 250-500µm, > 500µm. A total of 58 species were found. Four

dominant species characterize the sediments of Gabes: *Ammonia parkinsoniana, Asterigerinta mamilla, Eggerelloides scabrous* and *Textularia conica*.

Combined living foraminiferal assemblages, water quality parameters and geochemical data show that three main areas of pollution are present along the Gabes transect: 1) the area closest to the discharge (0 to 1.5 km from the coast) can be considered as almost "azoic zone"; 2) the area from 3.5 km to 6 km can be considered and is mainly characterized by pH variations and formation of calcite concretion; 3) the area from 6 km to 17.5 km can be considered as the less impacted by pollution in the Gulf of Gabes. However, by comparing geochemical data and video survey from Gabes and Djerba, we suggest that the Gulf of Gabes is more impacted by anthropogenic activity and especially by the phosphate industry.

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Dead coral in the Gulf of Gabes: First observations and relation with phosphorus pollution

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The Gulf of Gabes, situated in the southern area of Tunisia, is well known for its particular high biodiversity. During the last century, the Gulf of Gabes was considered as an important fishing reserve providing two-third of the Tunisian's fishing activity. Additionally, this region is very well known for the abundance of sea grass (*Posidonia oceanica*) which provides marine habitats for the macrofauna.

Since 1972, the city of Gabes is an important industrial location for production of phosphoric acid. During this treatment, large amounts of industrial waste are produced and directly discharged into the seawater, leading to a severe marine pollution.

In July 2014, a sampling expedition was organized in the Gulf of Gabes to evaluate the anthropogenic impact on the marine environment using benthic foraminifera. Sediments were sampled with a box-core system along a 18 km long transect composed of 16 stations. The water-depth was measured at each station with an echo-sounder and a video survey of the seafloor was conducted with a Go-Pro® camera.

During sampling, many dead coral fragments were collected. These findings are surprising, because the presence of recent coral has been mentioned only along the southern coast of the Kerkennah Island (El Lakhrach et al., 2012). So far, no corals have been found or described next the phosphate industry of Gabes.

Most coral fragments collected during the expedition were strongly corroded and bioeroded. However, a 10 cm large fragment was exceptionally well preserved. Radiocarbon dating revealed that this fragment is relatively recent (1985AD±29y) compared to the other poorly preserved coral fragments (1842AD±29y).

Coral fragments are only present in coarser sediments, which containing also a more diversified macrofauna (e.g., bivalves, bryozoans, gastropods). The stations where corals were founds are located on bathymetric reliefs, suggesting the presence of paleo-reefs in the Gulf of Gabes close to the phosphate industry.

Previous studies reported high concentrations of heavy metals in the sediments next to the industries as for instance Zinc that can exceed 10'000 ppm (Ayadi et al., 2014). Although pollution presently heavily affects the fauna in this region, additional studies are needed to identify the causes of their decline in the Gulf of Gabes.

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Neotectonic Activity of the Larger Lake Thun Area as Expressed in Sediment Displacements

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The Swiss earthquake catalogue ECOS-09 (Fäh et al., 2011) and several paleoseismic studies (e.g. Monecke et al., 2006; Strasser et al., 2011) indicate that the northern margin of the Central Swiss Alps is affected by strong earthquakes with magnitudes larger than 6, even though with low recurrence rates. Such events are supposed to cause significant surface ruptures, simply due to the size and displacement of the slipping surface. However, such ruptures can scarcely be found in the Alps and its surroundings as obvious imprinted geomorphologic features, such as offset moraine crests, displaced fluvial terrace risers, deflected river courses and fault scarps and are rare to absent. Likewise, only a few studies successfully showed the existence of an active fault cutting through Alpine nappe stacks (e.g., Sue et al., 2004; Ustaszewski et al. 2007).

This study aims to locate direct earthquake effects in the form of imprinted geomorphologic features in quaternary deposits. The study area is part of the upper Aare valley and crosses the North Alpine nappe front. The overdeepened basin of Lake Thun is surrounded by steep flanks of the Helvetic and Penninic thrust nappes with a westwards descending topography shaped by the subalpine Molasse, which in turn builds the transition to the Alpine foreland.

In a first step, we focus our investigations on Lake Thun and its subsurface. A review of high-resolution seismic data (3.5 kHz) acquired in 2007 (Wirth et al., 2011) revealed potential faults displacing the lake floor requiring further attention. Unlike in terrestrial environments where erosional surface processes complicate the recognition of earthquake-induced topographic offsets, the high preservation potential at the lake floor is expected to conserve earthquake-induced structures. Only the occasional occurrence of a turbidite blurs a sharp offset through time by accumulating sediment in preferably deeper regions and depressions. Topographic data from a recently acquired bathymetric map of Lake Thun is complemented with observations from seismic cross sections so that candidates for active faults are evaluated.

In a second step, we extend our research to terrestrial areas using LiDAR data and field observations to characterize potential fault structures. In this context, a gravel pit close to Einigen (Spiez) consisting of postglacial alluvial deposits shows signs of potential faulting. Its mainly horizontally bedded unconsolidated gravels, deposited by the river Kander before its deviation into Lake Thun in 1714, show some disturbance. A significantly offset of an oxidized layer in the gravel pit, highlighted moreover by locally steeply dipping clasts, points to the possibility of a neotectonic fault structure. The proposed fault lines up with a lineament cutting through a large moraine crest along the shoreline and leads directly into morphologic depressions revealed by the bathymetric data set in Lake Thun. These structures, highly reminiscent of pockmarks line up with mapped faults from GeoCover data and hence indicate a potentially active structure.

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Understanding the temporal and spatial variability of early diagenesis in cold-water coral carbonate mounds

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Cold-water coral carbonate mounds are considered as unique palaeo-environmental records of the mid to deep ocean. However, past geomicrobiological investigation in the 'deep-biosphere', i.e. the sub-seafloor sediments, has shown that metabolic processes substantially impact biogeochemical cycles and cause dissolution and precipitation of solid mineral phases, a process referred to as early diagenesis, changing the architecture of the mound. On one side, this elucidates the link between microbial processes and the formation and growth of carbonate mounds, and on the other side it poses important questions regarding how this affects the sedimentary record by overprinting the primary environmental record.

4D-DIAGENESIS@MOUND aims to decipher the temporal and spatial variability of early diagenesis in carbonate mounds influenced by a shallow sulphate-methane transition zone (SMTZ). Therein the study is two-fold. At first instance, the spatial variation will be deciphered through characterization and quantification of (microbial-mediated) diagenesis of gravity cores taken along core transects on Recent to Sub-recent (Plio-Pleistocene) mounds on Pen Duick Escarpment in the Gulf of Cadiz and Melilla Mound Field in the Alboran Sea. The cores have been recovered within the framework of the EuroFLEETS campaign 'The Mediterranean-Atlantic Gateway Code: The Late Pleistocene Carbonate Mound Record' aboard the R/V Marion Dufresne.

The second phase of the project will focus on in-vitro flow experiments by means of a bioreactor. In the bioreactor, a mixture of microbial communities and carbonate mound sediments will be subjected to high pressure, moderate temperatures and continuous fluid flow, i.e. methane flux, to monitor dissolution and precipitation of mineral phases through time. During the entire project, special attention will be paid to the 3D-visualization of diagenetic phases within the mound sediments by means of multi-scaled nanotomography.

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Microfacies analysis and paleoenvironmental reconstruction of Miocene Limestones from Mayaguana Island (SE Bahamas)

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Microfacies analysis of Miocene rocks from Mayaguana Island reveals an atoll-like morphology of the bank with low-energy reefs close to the platform margins and a deeper lagoon in the bank interior. Petrographic studies reveal a tripartite distribution of depositional settings within the lagoon, from an open lagoon to a sheltered lagoon and to a restricted lagoon with diffuse boundaries. Evolution through time of these environments shows that the bank was a relatively steady, slowly subsiding platform where depositional realms were influenced either by slight fluctuations of sea-level or intermittent breaches in the barrier reef through the Miocene.

Mayaguana Island forms the emerged part of a small (57 x 13 km), elongated carbonate platform in the SE Bahamas between latitudes 22°15' N and 22°30' N and longitudes 12°40' W and 73°10' W. The bank margins are steep and rise from depths over 2.5 km (Pierson, 1982). The stratigraphic record of the island ranges from the Early Miocene to the Holocene and consists of peritidal carbonates (Kindler et al., 2011; Godefroid, 2012).

The present study focuses on microfacies analysis of Miocene carbonates recovered in fourteen drill cores from Mayaguana Island, measuring in average 34.3 m in length. Three cores are located along the northwestern coast and 12 are scattered close to the southwestern margin of the island (Fig. 1). 441 samples have been studied. Petrographic descriptions are based on the classification of carbonate rocks of Dunham (1969) and Embry and Klovan (1971).

Fifteen microfacies have been distinguished, ranging from coralgal rudstones to microbioclastic mudstones, and have been gathered in four distinct facies belts summarized below:

Facies belt 1 (FB1): Coralgal rudstones to floatstones dominate in this facies zone with minor amounts of bioclastic-foraminiferal grainstones to packstones. These facies are characterized by a very high faunal diversity containing corals (e.g. *Montastrea* sp., *Porites* sp.), large hyaline foraminifera, Miogypsinidae (e.g. *Miogypsina globulina*) and Lepidocyclinidae (e.g. *Lepidocyclina (Nephrolepidina) brouweri*) and are extremely rich in encrusting organisms: red algae, serpulids and foraminifera (e.g. *Borodinia*).

Facies belt 2 (FB2): Coralgal floatstones and foraminiferal packstones to wackestones constitute the main part of this facies zone with thin layers of rhodolitic rudstones and floatstones and a few m-scale pockets of undefined branching coral floatstones with a microbioclastic wackestones matrix. These facies are characterized by a high- to medium-diversity faunal assemblage containing less encrusting organisms and a higher proportion of mud than FB1.

Facies belt 3 (FB3): Mollusk floatstones and foraminiferal packstones-wackestones to microbioclastic wackestones dominate this facies belt. The mud fraction is higher than in FB2 and contains a medium to low faunal diversity. The foraminiferal assemblage is dominated by both large and small porcelaneous foraminifera (Archaiasinidae, Soritidae and Miliolidae).

Facies belt 4 (FB4): This facies belt is dominated by foraminiferal packestones and microbioclastic wackestones-mudstones. The faunal diversity is low with abundant ostracods, rare sponges and the foraminiferal assemblage is dominated by Miliolidae and Textulariidae.

These facies belts have been attributed to four paleoenvironments, from a distal marginal reef setting to a proximal restricted lagoonal setting.

FB1: The very high faunal diversity, the coarseness of the grains, the low mud fraction, and the dominance of stenohaline organisms (e.g. corals, serpulids) suggest a moderate energy, open marine condition. Therefore we attribute this facies belt to, or close to, a marginal reef setting.

FB2: Similarly to FB1, the faunal assemblage indicates open marine conditions, but the higher mud fraction argues for a lower energetic setting. Thus, we assign this facies zone to a back reef/open lagoon environment containing small coralgal build-ups attributed to patch reefs.

FB3: The low faunal diversity, dominated by porcelaneous foraminifera and the high proportion of mud indicate a low energetic, sheltered lagoonal setting.

FB4: These facies contain a high proportion of mud and are dominated by euryhaline organisms (e.g. Miliolidae, ostracods, sponges), which suggests a very low energy, restricted lagoonal setting.

Microfacies analysis reveals a clear zonation pattern from the marginal reefs to the internal lagoon on Mayagana Bank, with FB1 restricted to its northern and southern margins and evolving to FB2, FB3 and FB4 towards the platform interior. The spatial distribution of these facies belts displays a reef-rimed platform during the Miocene, with moderate-energy reefs on the margins and shallow-water sediments with small coral bioherms in the lagoon. Furthermore, the vertical arrangement of the facies zones in the cores shows that this trend persisted during the Miocene with minor fluctuations towards more open conditions in the internal cores and accordingly in the previously sheltered and restricted lagoons. These fluctuations could either be linked to sea-level variations, due to the expansion and contraction of the East Antarctic Ice Sheet in the Miocene (Pekar and DeConto, 2006), or to periodic breaches in the marginal reefs leading to important influx of normal marine waters into the lagoon. These findings are in agreement with the assumption that many of the Bahamian Platforms evolved from Neogene coral atolls (Sealey, 1991).

Fig. 1: Core locations (in red) on Mayaguana Island.

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New insights into the paleogeographic relationship of the Antimonio-, Vizcaino terranes, and the North American craton

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The western margin of the North American continent consists from Alaska towards Mexico of several terranes. After some decades of extensive research on the Upper Triassic, conducted mainly on the Tethyan realm, the paleogeography and paleoenvironments of the Panthalassa Ocean remain widely unknown. Many of these terranes are still of unidentified origin and the paths they took persist mysterious.

The REEFCADE-project addresses these issues, by investigating individual terranes, reconstructing their respective geologic history in a multi-disciplinary approach, and in a final comparison to unravel the respective paleotectonic evolution.

For this part of the project two potential terranes in Mexico have been chosen: the Animonio Terrane (Sonora), and the Vizcaíno 'composite' Terrane (Baja California Sur). The outcrop situation for the time interval of Upper Triassic is difficult. Scarcity, and discontinuity of the outcrop localities, prevents a simple paleoenvironmental reconstruction.

The sedimentary succession of the Antimonio Terrane consists of shallow water sediments including carbonates with variable amounts of siliciclastic content, and calcareous silt- to fine sandstones. In the limestone-intervals sponge-dominated biostromal build-ups can be observed. Near the village of San Hipólito a succession of deeper marine to slope-environment sediments were deposited. Inside the clasts of the Breccia member of the San Hipólito Formation, shallow water faunal assemblages have been identified.

Through comparison of the two localities, we try to proof/disproof the proximity of the investigated terranes. From both terranes samples for thin-section preparation, and from the localities in Sonora additional samples for zircon separation, were taken. Due to the advanced grades of recrystallization, fossil-derived information needs to be complemented with petrographic data.

The siliciclastic components represent remains of an arkosic sandstone, which certainly are derived from granitoid intrusions. These components give us an insight into the climatic conditions in the accumulation area. Some of the samples yield a high amount of heavy-minerals. By LA-ICP-MS-dating of U/Pb-ratios, and the comparison of known ages of granitoid intrusions in the North American craton, we expect to grab new insights into the paleolatitude, and ultimately also the sense of movement of the investigated terranes. The preservation of the included feldspars points to a semi-arid to arid environment, potentially in the latitude of the subtropical-belts.

The sediments of Lake Aegeri - an archive of environmental/climate change, natural hazards and human impact

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Subaquatic landslides, floods and lake-level changes are important factors influencing the depositional processes in lakes. Lake-sediment investigations utilizing seismic data and sedimentological information from sediment piston cores make it possible to study underwater mass movements, which are similar to the marine environment, but under more accessible and confined conditions. In addition, lake sediments sensitively record environmental and climatic changes, as well as geological events, such as earthquakes. Previous studies have also linked subaquatic landslide deposits and flood layers in marine and in terrestrial, lacustrine sediment sequences to historic events (e.g. Schnellmann et. al., 2002).

In this study, we investigate the traces of natural hazards and environmental and climate change in the sediments of Lake Aegeri, located between Lake Zug and Lake Zurich, in Central Switzerland. Lake Aegeri is a 7.2 km² large lake at 724 m a. s. l., its basin was created during the last glaciations. The lake consists of two basins: a larger and deeper one in the north, and a smaller and slightly shallower one in the south. Its main tributary today is the Hüribach while the Lorze River drains the lake. The Hüribach bypassed the lake and flowed prior to 1665 in the village of Unterägeri directly in the Lorze river. During historic floods, it delivered large volumes of sediment potentially damming the lake outflow, which became a problem due to frequent inundations. In 1665, the Hüribach was diverted directly into Lake Aegeri successively forming a delta until today. This not only affects the lake level, but also depositional processes and sedimentation rates in the lake. In 2007, a seismic study was carried out (Müller, 2007), which showed that several subaquatic landslides have occurred in Lake Aegeri. Several seismic stratigraphic horizons were mapped on the seismic data; some of them are characterized by occurrence of multiple, isochronal subaquatic landslides, suggesting earthquakes as a trigger mechanism.

We present results from newly acquired sediment core of 9 and 10 m subbottom depth, which were retrieved at two different locations. The coring sites were selected based on reflection seismic data collected previously (Müller, 2007). We present results from newly acquired sediment core data. Sediment cores and geochemical analyses indicate that the sediment fill consists of two different sequences of lacustrine background sediment distinguished by the organic contents and amounts of siliciclatica. Together with elevated density values in the upper part of the cores, this datasets reveal strong evidence for the diversion of the Hüribach as the main driver exerting control on this change in lithology. Occurrence of intercalated thin turbidites and mass-transport deposits reflect the flood and slide history. Thicker deposits were correlated to the seismic data, so that our cores now provide data to groundtruth the paleoseismic interpretation of these features (Müller, 2007). The age model was constructed by $^{210}Pb/^{137}Cs$ and ^{14}C age chronologies resulting in an average sedimentation rates of 1.66 mm/yr for the upper 2.5 meters and 0.46 mm/yr for depths >2.5 m. The oldest ^{14}C dating amounts to 15,325 cal yr BP at a depth of ~10 meters.

Geochemical – as well as flood- and landslide-layer analyzes of the sediments of Lake Aegeri are ongoing and will eventually show in more detail how environmental and climate changes as well as natural hazards in the last few thousand years have affected the lake and the surrounding area.

This project is related to the 700th anniversary of the Battle of Morgarten, which (probably) took place near the shores of Lake Aegeri

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Land to sea correlation of clastic series in the Eocene pyrenean foreland basin: new data from field mapping, stable isotopes, and whole rock geochemistry

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Cyclicities in the sedimentary record have long been documented in a broad spectrum of sedimentary environments and through a wide range of time and space scales; the longstanding debate is about the various origins that have been put forward to explain them. Among these explanations, two are standing out: eustastic sea level changes and sediment supply variations. In the deep water system of the lower-middle Eocene Ainsa basin - Southern Pyrenees (Spain) - as well as in its fluvial counterparts in the Tremp-Graus basin, stratigraphic cyclicity in the form of repetitive packages of sands and marls of intermediate timescales (10e4 to 10e6 years) have long been recognized and are typically imputed to eustatic changes. So far most of the studies have focused either on the deep water systems or on their fluvial counterparts without a detailed effort concerning the correlation between the two at the scale of individual packages. While eustatic variations are well known to have taken place during the Eocene and are thus plausible causes of the observed cyclicities, our aim is to evaluate the possible role of sediment supply variations in generating or modifying such cyclicities by accurately linking the distal and proximal environment. This is particularly important in order to understand how sediment supply variations are tied to climate and tectonics in the source area over multi-millennial timescales and how the deep-sea sediments are recording these variations to reconstruct the Earth's history of surface response to climate change. To address these issues a stratigraphical and multi-proxy approach was undertaken in both basins where we focus on the middle Eocene Castissent formation, a major fluvial excursion and its deep marine time-equivalent: the Arro-Gerbe section. Through a detailed mapping of the major unconformities, calibrating four increasingly distal cross-sections with the global isotope record and combining newly acquired and existing geochemical data, we try to trace environmental signals across the whole source-to-sink system.

These analyses allow us to suggest a precise correlation between land and sea and to discuss hypotheses of climatic and eustatic controls on landscape dynamics at that time.

Sedimentary Responses to Tectonic and Climatic Forcing: a High-Resolution, Integrated Sedimentological-Geochemical Study in Terrestrial Foreland Deposits (Mendoza, Argentina)

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Numerous studies relate foreland-basin infill to allogenic forcing, but to date only a few have been able to clearly disentangle the relative roles of tectonics and climate on long-term deposition. Here we present preliminary observations on the continental sedimentology and stratigraphy of the Central Argentinian Foreland. The basin infill records local environmental changes from the late Oligocene to the Quaternary, during active Andean orogeny.

The Mariño Formation comprises a large part of the basin infill, dating from ~15.7 to 12.0 Ma and extending over almost 1100 m in stratigraphy. The basal part is characterized by the intercalation of aeolian and fluvial deposits, followed vertically by the stacking of fluvial deposits with highly differentiated facies associations and architectures. This stratigraphic picture developed during the uplift of the Principal Cordillera suggests the interaction of different allogenic controls in the region.

This project aims to provide a detailed reconstruction of paleoenvironmental dynamics and to unravel the relative roles of climate and tectonics through a high-resolution, integrated compositional and sedimentological analysis of the Mariño Formation. The main objectives are: to detect geochemical signatures of allogenic controls; to track changes in sediment provenance and relative information on magmatism and exhumation in the uplifting Andes; and to recognize the effects of different allogenic drives on sedimentary processes and local environmental changes.

Our approach consists of high-resolution mineralogical and petrographical study using both conventional approach and automated QEMSCAN technology, heavy-minerals analysis, geochemistry, radiogenic isotope analysis, U-Pb and fission-track dating of detrital zircons. A first field campaign provided a detailed stratigraphic and facies architectural framework; sampling was conducted along multiple transects (logged as continuous vertical sections).

The exceptional lateral exposure and the possibility to develop stratigraphic correlations calibrated with quantitative analytical approaches will constrain the relative role of different allogenic processes and offer insights for understanding similar sedimentary complexes in the subsurface.

Exploration and extraction of energy resources is increasingly reliant in the detailed characterization of sedimentary reservoirs. Besides providing an extensive outcrop analogue for the characterization and prediction of subsurface reservoirs, this project represents an important, ground-based test of mineralogical and geochemical methods for reservoir correlation and evaluation.

The nature and significance of botryoidal and fibrous aragonite microbialites deposited in the Danakil depression

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The Danakil Depression, situated in the northern part of the Afar triple junction (up to 120 m below sea level), is a tectonic depression associated to the rifting of the Afro-Arabian plateau, which is active since the Oligocene. Although, nowadays this depression is dry, there is evidence that it has been flooded by the Red Sea at least twice during the Middle and Late Pleistocene (marine isotope stage 7: MIS 7 and marine isotope stage 5: MIS 5). The resulting marine incursions led to the deposition of a series of fringing coralgal-reefs surrounding the Danakil depression (geographic extension of approximate 240 km x 70 km).

Sixteen marine carbonate outcrops, situated at the western margin of the depression, are presently being studied in order to reconstruct the young flooding history of the Danakil depression. The complete sedimentary succession of MIS 7 is composed of at least 4 reefal units separated by erosional unconformities, which are laterally interfingered with bioclastic and ooid calcarenites. Marine deposition during MIS 5 is mainly restricted to the occurrence of scattered corals and small coralgal bioherms (less than 2 m high). Laterally, the youngest reef deposits are interfingered with bioclastic calcarenites with abundant sea urchin remains of *laganum depressum* and ooid beaches. Both marine sequences are overlain by evaporites probably deposited in a salina environment.

The transition from normal marine to hypersaline settings as a result of the closure of the connection to the Red Sea is characterized by the deposition of stromatolitic and thrombolitic fibrous and botryoidal aragonite, as well as fibrous aragonite crusts and oncoids. On top of the oldest reef units (MIS 7), these crusts are covering and filling cavities (up to 30 cm thick) within red algal bioherms and bivalve coquinas. The sediment below is not affected by crust formation. At the end of MIS 5 the formation of crusts directly follow the deposition of coralgal bioherms. Bivalves as well as serpulids seem to have been actively involved in the formation of the crusts. SEM-images and EDS analyses have revealed the presence of Mg-silicates closely associated to the aragonite fibers. Spectacular preservation of microbial filaments due to the early precipitation of Mg-silicates suggests that the formation of the crusts was strongly influenced by microbial activity. These filaments occur in thin laminae ("dust lines") within aragonite botryoids and stromatolitic fabrics, as well as replacing the original mineralogy of serpulid worm-tubes. Scattered calcite and dolomite crystals are found embedded in the Mg-silicate matrix.

These microbialites appear in a variety of preservation states, from well preserved to completely recrystallized. Thus, different diagenetic steps can be reconstructed and characterized. The further study of these exceptionally well preserved microbialites will give insights into the diagenesis and preservation potential of this type of fabrics and the interaction between carbonates and Mg-silicates during microbial-mediated precipitation.

Heavy metal distribution in the sediments of Lake Walen

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The increase of human activities associated to industrialization led to the release of many trace elements in the environment, especially heavy metals that potentially threaten fresh water resources and living organisms through accumulation in the food chain. Natural archives, such as lacustrine sediments offer a valuable tool to assess the distribution of heavy metals in the past. Lake Walen, situated in the Eastern Swiss Alps, is located in the Glarnerland region where the first textile industries were established in Switzerland. The Linth, a debris loaded river flowing through these industrial sites, was diverted into Lake Walen in the beginning of the 19th century, potentially carrying industrial legacies to the lake depository ever since.

The main objective of this study is to evaluate the heavy metal deposition with respect to natural and industrial sources based on sedimentary records from Lake Walen. The temporal and spatial variations of trace metals are determined using a continuous and high-resolution X-ray fluorescence (XRF) core scanner and discrete Inductively Coupled Plasma Mass Spectrometry (ICP-MS) measurements following sediment digestion. Density and magnetic susceptibility measurements, as well as radionuclide dating (^{137}Cs) and grain size analyses provide further insights into sedimentological processes.

Sediments of Lake Walen consist mostly of detrital origin. The finely laminated background sediment reveals maximum concentrations of zinc (Zn) and lead (Pb) in the early 1960s and elevated Pb values in the beginning of the 20th century for both methods applied here. Calibration between XRF core scanner and ICP-MS data show significant correlation coefficients of 0.74 for Zn and 0.87 for Pb. ICP-MS measurements of the heavy metals Cu, Cd, Cr, Ni, As reveal maximum concentrations in the 1960s as well but do not show high correlation coefficients with XRF data, probably due to high background noise in the latter measurements.

The ongoing investigation provides insights into the heavy metal sources for the distinct peaks in the 1960s and the beginning of the 20th century in the area adjacent to Lake Walen.

Paleohydraulic reconstruction of a 40 kyr-old terrace sequence implies that water discharge was 10 times larger than today

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The Pisco valley in the Peruvian Andes hosts a Quaternary cut-and-fill succession that can be used, in combination with existing datasets, to quantitatively assess past sediment and water discharge values in relation to present-day conditions. This knowledge would shed some light about the potential role of climate as the driver of sediment transport in the past. Using sedimentological and morphometric data we calculate the water discharge associated with the river system at 40 ka, within the Minchin pluvial period (48–36 ka). We compare these discharge values to the discharge regime of the modern Pisco River and find that the mean water discharge of the paleo-Pisco River, during the Minchin pluvial period, was c. 10 times greater than the modern Pisco River if considering the mean water discharge, and approximately 4 times greater if considering the maximum water discharge. The calculated differences in water discharge between the modern and the paleo-Pisco River thus suggests that the Minchin pluvial period was characterized by a wetter climate and more powerful flood events.

Disentangling the relationship between environmental conditions and ostracod assemblages in modern Lake Trasimeno, Italy

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One of the major advances in paleoclimate research during the last decades has been the development of proxies. However, the lack of well-calibrated indicators in modern environments is often preventing the establishment of transfer functions for quantitative palaeoenvironmental reconstruction. Fossil ostracods are widely used in paleoclimatic research but not often calibrated against living species in the same system (Mezquita et al. 2005; Mischke et al. 2007). Multiproxy paleoenvironmental investigations of Lake Trasimeno in the province of Perugia (Umbria, Italy; 43°09' N and 12°06' E) include for the first time the study of living ostracod assemblages in order to further improve ongoing paleoclimatic reconstructions covering the Late Pleistocene and Holocene. Thus, the aim of this work is to learn more about the ecological preferences of the modern ostracod species and assemblages in each area of the lake, for their application, as indicator taxa, in the fossil record.

Today, the meso-eutrophic Trasimeno Lake has a maximum depth of about 6 meters and extends over a surface of 120 sq km, encompassing a large variety of ecological niches. Thirty-eight samples of the uppermost 4 cm of bottom sediments and one water surface sample among free floating macrophytes were collected for ostracods analysis. Several environmental variable were measured at each site during sampling: water temperature (T, °C), dissolved oxygen content (DO, mg/L), conductivity (C, mS/cm) and pH. The sediment grain size as well as the presence and type of aquatic macrophytes were recorded. A multivariate statistical analysis has been applied to the entire dataset to characterize the ecology of the different ostracod associations.

The samples carried 19 different species of ostracods referable to 15 genera: *Candona angulata, Candona candida, Fabaeformiscandona fabaeformis, Fabaeformiscandona harmsworthi, Cypridopsis vidua, Cyprideis torosa, Ilyocypris gibba, Ilyocypris salebrosa, Ilyocypris getica, Darwinula stevensoni, Pseudocandona marchica, Limnocythere inopinata, Cypria ophtalmica, Herpetocypris helenae, Heterocypris salina, Heterocypris incongruens, Isocypris baucampi*, *Eucypris virens, Trajancypris clavata.* Few valves of *Limnocythere stationis* and *Potamocypris zschokkei* have also been collected but without soft parts and are thus considered not living species. *C. angulata, C. vidua, C.torosa* and *L. inopinata* are the most abundant species.

Our first results show that freshwater ostracods are very sensitive to the dominant physico-chemical conditions of the lake environment as well as to the prevailing subaquatic vegetation. Two main different assemblages have been recognized. In the central part of the lake, an oligotypic assemblage with high equitability, is dominated by *C. angulata* and *C. torosa*. This is the deepest part of the lake (from 320 to 520 cm) with very fine substrate sediment, without vegetation and a slightly alcaline pH (7,7-8,7). The other assemblage characterizes the coastal area (80-270 cm), with a coarser substrate inhabited by different ostracod associations. These are dominated by *C. vidua*, *C. torosa* and *I. inopinata* or only by

C. torosa that are closely linked, respectively, to the presence/absence of aquatic macrophytes, mainly represented by *Phragmites*, *Ceratophyllum*, *Vallisneria*, *Potamogeton* and *Naias*.

Ongoing analysis along with multivariate statistical techniques will be used to analyse the influence of selected environmental variables on the distributions of surface sediment ostracod assemblages. The results will be further applied to the fossil analogues.

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Alkaline-earth metal micropearls in meso-oligotrophic Lake Geneva (Switzerland): Tracking the origin and understanding the role of microbes in carbonate precipitation

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It is now widely accepted that microorganisms such as cyanobacteria play an important role in carbonate precipitation, in both freshwater and marine environments. However, their exact function is not yet clearly defined and whether they induce mineral precipitation or trap abiotic mineral precipitates remain open questions.

During a water-quality survey in meso-oligotrophic Lake Geneva (Switzerland), suspended matter was collected by filtration between July 2012 and spring 2014 at various depths in the water column. In most of the samples, scanning electron microscopy revealed the presence of numerous dark and gelatinous patches occluding the pores of the filters, often containing clusters of smooth micropearls of 0.2 - 2 micrometers in diameter (Fig. 1). These are embedded in a mucilage-looking extracellular polymeric substance (EPS). Systematic observation of the monthly samples showed their presence all year-round and at very different water depths, with clear periods of "bloom" in summer, which may point to microorganisms, e.g., prokaryotes or algae. A range finding chemical composition of the micropearls by energy dispersive X-ray spectroscopy (EDS) shows Mg, Ca, Sr and Ba (alkaline earth metals) as the dominant cations. Carbon (as carbonate) and phosphorus (probably as phosphate) are the dominant anions. Different chemical types of micropearls have been identified (Ba-rich and Sr-rich). The composition of the Ba-rich micropearls resembles that of benstonite, a Group IIA carbonate that has been previously described as intracellular granules in a cyanobacterium from alkaline Lake Alchichica (Mexico) (Couradeau et al., 2012). Further morphological and geochemical analyses have been carried out on different micropearls. TEM images in diffraction mode indicate that they are amorphous whereas NanoSIMs analyses in selected specimens have shown that organic matter is also included inside the amorphous carbonate micropearls.

Lake water analyses in summer 2012 show that the prevailing physico-chemical conditions in Lake Geneva epilimnion were suitable to calcite precipitation but not for strontium and barium carbonates formation. The appropriate conditions to precipitate these two carbonates might have been reached in the microenvironment created by phytoplankton and/or bacterial activity within the EPS. The exact nature of the organisms providing this EPS envelope as well as the favorable microenvironment for the alkaline-earth metal precipitation have not yet been identified. Several hypotheses are currently under consideration.

This ongoing research aims to gain a proper understanding of the process behind alkaline-earth metals sequestration in lakes. In addition to the role of phytoplankton and microbes in the precipitation of these alkaline-earth micropearls, this study also addresses several questions such as their spatio-temporal distribution and a plausible classification based on their shape and chemical composition.

Understanding the processes of incorporation of alkaline-earth metal precipitates in lacustrine carbonates and their possible dependence on the nature of the phylogenetic lineage involved may shed new light on the actual function of phytoplankton and/or microbes in carbonate precipitation.

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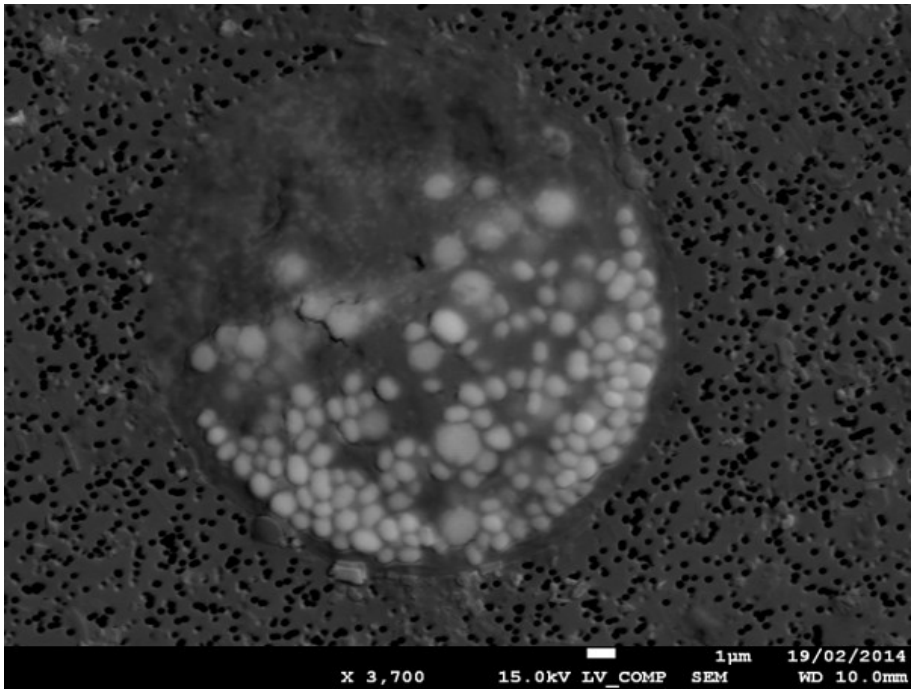

Fig. 1: micropearls of different composition embedded within an EPS envelope

How does seasonality affect the $\delta^{13}C$ values of cladoceran and bryozoan remains in lake sediments?

Investigating a new approach in aquatic palaeoecology to reconstruct past methane abundance in lakes.

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Methane (CH_4) is an important greenhouse gas, but our knowledge about methane cycling in lakes, especially at decadal time scales is still insufficient. In order to extend the time series back in time, a good palaeoecological indicator for methane is urgently required.

Biogenic methane in lakes is characterised by a distinctly negative stable carbon isotopic composition ($\delta^{13}C$ value) of < -50‰, which is more negative than the $\delta^{13}C$ values of the organic matter the CH_4 was produced from. In contrast, algae typically have $\delta^{13}C$ values in the range of -35 to -25‰. This large difference in $\delta^{13}C$ values allows differentiation between photosynthetically produced organic matter and methane oxidizing bacteria (MOB) as carbon sources for benthic and planktonic invertebrates. It has been shown that *Daphnia* (Cladocera) can incorporate methanogenic carbon. Furthermore, their chitinous resting eggs (*Daphnia* ephippia) are preserved in sediments and little or no fractionation of ^{13}C was observed between *Daphnia* and their ephippia. Therefore, $\delta^{13}C$ values of *Daphnia* ephippia have been suggested as a palaeoecological indicator for reconstructing changes in lake water CH_4 concentrations and the importance of CH_4 in lake food webs. However, little attention has so far been dedicated to connecting present-day seasonal variation in the $\delta^{13}C$ values of *Daphnia* and their ephippia to the $\delta^{13}C$ values measured in the sedimented remains.

We measured seasonal variation in the $\delta^{13}C$ values of *Daphnia* and *Daphnia* ephippia in Lake Gerzensee, a small dimictic lake in the northern foreland of the Alps. Moreover, we examined whether variations in these variables were related to changes in CH_4 concentrations in the lake. To track seasonal variation, $\delta^{13}C$ values of *Daphnia*, dissolved inorganic carbon (DIC), and particulate organic matter (POM) were measured at bimonthly intervals throughout 2012/2013 and at biweekly intervals during autumn and spring 2013/2014. In addition, we measured the $\delta^{13}C$ values of invertebrate resting stages, which were regularly and abundantly found floating on the lake surface. These included ephippia of two cladoceran genera (*Daphnia* and *Ceriodaphnia*) and statoblasts of one bryozoan genus (*Plumatella*). All three are chitinous structures that may also be found as fossils in the sediment. In a second step, fossil remains of these three taxa were analysed from a sediment core covering the past 150 years. Ours is the first study to analyse the seasonal variation in $\delta^{13}C$ values of cladoceran and bryozoan resting stages in a temperate European lake at high temporal resolution and relate this variation to a sedimentary record.

Results show that throughout the year *Daphnia* $\delta^{13}C$ values closely followed the $\delta^{13}C$ values of POM, but $\delta^{13}C$ values were on average 3.3‰ more negative than POM (ranging from 6.6‰ more negative to 4.2‰ more positive), indicating that *Daphnia* utilize a more ^{13}C-depleted carbon source than POM in the lake. Moreover, *Daphnia* $\delta^{13}C$ values were positively correlated with lake water CH_4 concentrations in the bottom waters (log-transformed, Pearson correlation $r = 0.86$, $p < 0.01$, $n = 13$). This suggests that *Daphnia* incorporate less ^{13}C-depleted carbon during lake stratification when CH_4 concentrations are high. In contrast, during winter, when CH_4 and algal concentrations are low, methane-derived carbon may supplement the diet of *Daphnia*.

In Gerzensee, *Daphnia* ephippia $\delta^{13}C$ values did not show any seasonal variation. This suggests that the resting eggs are produced batch-wise in autumn and / or spring and float on the lake for several months. This implies that seasonal changes in *Daphnia* $\delta^{13}C$ and hence potential seasonal changes in the diet of *Daphnia* are not recorded in the $\delta^{13}C$ values of *Daphnia* ephippia in Gerzensee. Because the seasonal variability of *Daphnia* $\delta^{13}C$ is high, the timing of ephippia production may have an important influence on the $\delta^{13}C$ signal preserved in the sediment. This may, however, be different in other lakes. Nonetheless, this is valuable information when interpreting changes in *Daphnia* ephippia $\delta^{13}C$ values from the sediment core. Average *Daphnia* and *Ceriodaphnia* ephippia $\delta^{13}C$ values in the flotsam agreed very well with the $\delta^{13}C$ values of the ephippia retrieved from Gerzensee surface sediments. This shows that, in Gerzensee, the $\delta^{13}C$ values of the two types of cladoceran ephippia found in the surface sediment, and potentially in general at a certain sediment depth, are an integration of the ephippia floating on the lake during a particular time span, for example one year.

In the sediment core, $\delta^{13}C$ values of the two cladocerans remained relatively low throughout the record (down to -39.8 and -43.3‰ for *Daphnia* ephippia and *Ceriodaphnia* ephippia, respectively). These values are comparable to those measured in the flotsam and suggest that in Gerzensee, *Daphnia* and *Ceriodaphnia* included a ^{13}C-depleted carbon source in their diet throughout the past 150 years. In contrast, *Plumatella* had distinctly less negative $\delta^{13}C$ values (average -32.0‰, minimum -33.3‰) and showed different changes over time. These changes could not, however, be linked to changes in lake productivity of Gerzensee as has been suggested for other lakes. The difference between $\delta^{13}C$ values of cladocerans and bryozoans can be explained by a different feeding behaviour and habitat occupancy of *Plumatella*, which are sessile filter feeders and do not, for example, have access to deeper water food sources. In contrast, the two cladoceran taxa are mobile filter feeders and can filter smaller particles from the water than *Plumatella*. This potentially provides the cladoceran taxa access to ^{13}C-depleted carbon sources, e.g. by feeding on MOB, which are typically found around the oxycline.

The results of this study suggest that the $\delta^{13}C$ value analysis of the resting stages of *Daphnia* and *Ceriodaphnia* has the potential to provide insights into past methane availability in lakes during the time of year when ephippia are produced. This property may, however, vary between lakes and possibly over time. Bryozoan remains have been suggested to reflect past changes in $\delta^{13}C$ values of the biomass of photosynthetic primary production, but more research is needed to confirm this.

Sachsler Seefeld: A high-resolution alpine lake-sediment record from the center of Switzerland

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Sachsler Seefeld (46°47'24" N 8°13'46"E) is a small lake in the geographical center of Switzerland and the target for a high-resolution sediment study that will reconstruct local change and events (e.g., land use, earthquakes, floods, and rockslides) and larger-scale climatic changes in the Alps. Above the treeline at an altitude of 1,819 m, the lake has a small catchment area composed of carbonate and marl sediments from the Helvetic Axen-Decke and till deposits from Quaternary moraines. Aside from precipitation and snowmelt, the lake receives water from a small nival stream. These features, along with a steep west bank, make the lake susceptible to changes in the catchment area and in climate.

Initial analyses on sediments from two short cores confirm that the sediment is carbonate-rich, has a high water content, a low sedimentation rate (~0.5-1 mm/yr), and low concentrations of siliciclastic grains. The top 54-56 cm of both short cores are faintly laminated with several distinct layers that include red redox laminations, turbidites, and weakly graded flood layers. In contrast, the bottom halves of both cores appear to be thinly laminated, i.e. potentially varved, have a higher diversity and abundance of diatoms, contain vivianite, and several distinct turbidite and flood layers. Overall, magnetic susceptibility and density measurements appear to be anti-correlated showing a slight decrease and increase, respectively, between the top, non-varved and bottom, varved halves of the cores and at distinct clay layers. Average total inorganic carbon increases in the varved sections of both cores relative to the non-varved sections. Both cores will be dated using Pb-210 and Cs-137, and then compared to historical archives, instrumental data, and other paleolimnological and paleoclimate studies. This will be used to distinguish local catchment changes and events from larger-scale shifts in the region and the Alps.

Long cores will be retrieved from Sachsler Seefeld in spring to conduct further analyses spanning the entire Holocene. A more extensive record will be developed of major events, ecological shifts, and climatic changes in the local catchment area and the Greater Alpine Region based on changes in the lithological composition, isotopic record, diatom productivity, and elemental geochemistry in the sediments and pore water.

Tristacher See: Lacustrine sediments as an archive for mass movements and paleoclimate (Eastern Tyrol, Austria)

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Due to their temporal and spatial continuity, lake sediments provide an important archive to reconstruct environmental change. Situated just west of a landslide deposit with a volume of ~20 Mio m^3 (Reitner 2003), Tristacher See offers ideal conditions to study its environmental history and to shed light on the so far little-known paleoclimate in Eastern Tyrol, Austria (Davis et al. 2003 and references therein). The sediment fill of Tristacher See was imaged with a dense grid of high-resolution seismic profiles. Furthermore two long piston cores (~6.5 and 8 m long), one from the deepest part of the basin, and the other from near the landslide deposit, were collected using an UWITEC percussion piston-coring system. Here we present first results, which reveal evidence for a changing paleoenvironment from the deglaciation to the Holocene and significant control on depositional processes as a result of the landslide deposit.

The two long gravity cores, and the one from the deepest part of the basin in particular, are characterised by abruptly changing lithologies that are emblematic for rapidly changing climatic and environmental conditions in the area. At the base of the almost 8 m long deep basin core, siliciclastic dense clays and silts are interpreted as Late Glacial deposits from a nearby glacial source in Pleistocene time. The overlying dark-brown organic-rich layer forms the transition between Late Pleistocene and Holocene. The interpretation of these two sedimentary facies is supported by the ^{14}C age model. Above the organic-rich layer, an abrupt change to sediments being primarily composed of detrital carbonate occurs. The sudden change in sediment composition is likely related to material being reworked and washed in from the landslide deposits that block the eastern end of the lake today. This interpretation is supported by the carbonate-rich landslide source area (Triassic Kössen-Formation and Oberrhätkalk).

The datasets presented here will be supported by additional highly-resolved geochemical analyses to allow more detailed reconstructions of the climatic and environmental history at Tristacher See.

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Fig. 1: Landslide deposits (white bordered) at the eastern end of Tristacher See, view to west (modified from Dolomitenstadt.at, 2014).

GEothermie 2020, an integrated project in the Greater Geneva Basin

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GEothermie 2020 is a multistage program aiming at developing deep geothermal energy in the Geneva area, taking into account the trans-border nature of the resource at the Greater Geneva Basin scale (Swiss-French). This focuses on studying the subsurface geology and the hydrothermal and burial evolution of the basin. In parallel, an exhaustive GIS database is developed to integrate all the available deep subsurface data and by-products in the catalogue of the geological survey of Geneva.

In detail we focus on (1) the structural framework of the basin, including the identification of faults and enhanced permeability zones resulting from fractures development and connectivity across the basin; (2) rock typing characterization of the potential reservoirs and conceptual model of facies distribution as well as thermal and petrophysical properties investigations; (3) stratigraphic analysis of sedimentary sequences ranging from Permo-Carboniferous to the Lower Cretaceous ages in order to homogenize and structure, at the basin scale, a century of geological research; (4) investigating the past and present temperature gradients on fracture mineralization to document hydrothermal influences on sedimentary and basement units across the basin; (5) developing a new comprehensive GIS database to structure all the data collected and supplied by this project that will complement the previous SITG[1] platform.

The basin structural analysis includes 3D geological modelling derived from 2D seismic, well data and field studies. Fracture properties will also be studied on wells and outcrop analogues. The reservoir characterization encompasses well logs and cores investigation for detailed petrophysical analysis, a micro-facies study using conventional petrography and automated QEMSCAN analysis, a diagenetic study by optical luminescence and a sediment provenance analysis (QEMSCAN combined with ICPMS). Bottom hole temperature data are used to produce a probabilistic model of the thermal state of the basin. In the framework of the cantonal geological survey, all the data will be integrated in 3D models and should be compatible with the platform developed by the Swiss geological survey (Swisstopo). The GST[2] software will then be used for data storage, visualization and management, in agreement with the federal harmonized stratigraphy (HARMOS).

This integrated study will allow characterizing the 3D geology of the Greater Geneva Basin, with emphasis on its geothermal potential (in collaboration with the GeoMol project[3]). Systematic data management is necessary to make the information durable and useful for all kind of territorial and scientific uses and issues. The development of the geothermal sustainable resource is pivotal for the Canton of Geneva energy policy.

[1]SITG: Système d'Information du Territoire Genevois (http://ge.ch/sitg/)

[2]GST: Geosciences in Space and Time (http://www.giga-infosystems.com)

[3]GeoMol project: assessing subsurface potentials of the Alpine Foreland Basins for sustainable planning and use of natural resources (www.geomol.eu/)

Recent and ancient continental carbonates in the Danakil basin (NE Afar, Ethiopia): Preliminary results.

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The Danakil basin is a rift valley that constitutes the northern part of the Afar triple junction, defined by the intersection of three extensive structural systems: the Red Sea, the Gulf of Aden and the main Ethiopian rift (Keir et al., 2012). During fieldwork in January and February 2015, different sedimentary units were described to understand the evolution of the depositional settings in the basin. Since the mid-Pleistocene, the Danakil basin has been connected at least two times to the Red Sea – during MIS 5 and MIS 7. Episodes of opening and successive closure led to the formation of rapid alternating depositional environments, which range from marine to hypersaline, as well as lacustrine and fluviatile.

A variety of continental carbonate deposits have been described all over the basin. The present study focuses on two areas:

(1) Recent hot spring carbonates appear under different forms along the hypersaline lake Afdera in the southern part of the basin. In close interaction with the recent hot springs, oncoid grainstones and boundstones with encrusted algal mats are formed on the lake shore. Within the recent lake, cone-shaped microbialites with hollow internal conduits have been found.

(2) Quaternary lacustrine carbonates have been described at the western margin of the basin. This outcrop shows a succession of fluviatile over lacustrine brackish to hypersaline deposits with microbialites and calcarenites. The microbial carbonates – characterized by conical buildups associated with rhyzolites – deposited directly on top of an evaporitic sequence. These deposits are witnessing the transition from fresh water lakes towards hypersaline conditions.

Comparing recent and ancient continental carbonates within the Danakil depression will allow understanding better the opening and closure of the basin with the Red Sea. Moreover, studying the nature of hot spring carbonates and hypersaline microbialites will give more insights in the environmental conditions and controlling biotic/abiotic parameters under which they formed.

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A sedimentological and geochemical analysis of Hettangian to Pliensbachian sediments from the Jura Mountains: phosphogenesis, paleoenvironment and paleoclimate

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The Early Jurassic period is a time of significant changes in continental configurations, oceanographic patterns and climate conditions, which led to several crises and perturbations in the biological, geochemical and depositional systems. In the frame of a Ph.D. project, we are studying these changes in sections and cores located in the Swiss Jura Mountains.

The outcrop of Frick (Aargau, Switzerland) records a fully marine section spanning from the Middle Hettangian to the Late Toarcian. A wide array of geochemical and sedimentary analyses and observations have been and will be made with the purpose to (a) create a complete and detailed model of deposition, (b) to reconstruct the impact of phosphorus on the environment, (c) to determine associated climatic, environmental and paleogeographic changes and (d) to link the model of deposition with local and global environmental and climatic change.

The lithology of this outcrop is composed of limestone-marl alternations, which are enriched in phosphate for the upper Hettangian – lower Sinemurian and Pliensbachian intervals. The phosphate-enriched sediments represent a complex and dynamic depositional history, as is seen from the presence of hiati, condensed and fossil-rich strata, erosional bases, etc. One interesting aspect of this section is the changings of sedimentation rate. Some intervals have very high sedimentation rates (*liasicus, obtusus* and *oxynotum* zone) while others are very condensed (*angulata, semicostatum, raricostatum, jamesoni, ibex, davoei, margaritatus* and *spinatum* zone). Moreover, at least three hiati have been recorded which date as the *bucklandi* zone (early Sinemurian), the *turneri* zone (early Sinemurian) and the *stokesi* zone (early late Pliensbachian). The presence of hiati associated with phosphates and condensation testifies to the important hydrodynamic conditions in this region, and likely also to tectonically induced submarine relief.

Low organic-carbon and trace-element contents, the continental origin of organic matter, the presence of benthic organisms and sedimentary figures indicate that almost all the sediments dating from the Hettangian to the Pliensbachian outcropping in Frick have been deposits under well oxygenated conditions. The slightly uranium enrichment and the higher organic-carbon content in the base of the Insektenmergel (lower *liasicus* zone: middle Hettangian) indicate deposition under possibly dysoxic conditions.

Neogene Cool-Water Carbonate Ramps in the Mediterranean: Gradualism versus Catastrophism – A Hydrodynamic Story

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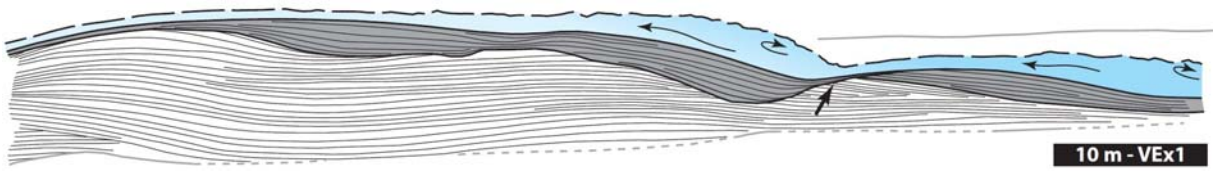
Following the Principle of Uniformitarianism/Actualism (James Hutton, 1785: "*the physical, chemical and biological processes that operate today have also operated in the geological past*") allows us sedimentologists to apply our understanding of modern processes to interpret the geological history through observations of sedimentary rocks and its sedimentary structures. But how well do the processes that created these rocks and structures represent the processes that operated on an every-day basis in their depositional environment?

The sedimentology of extreme events is based on the idea that extreme examples of natural processes have occurred in the past. The key to their recognition, however, is the correct identification of bedforms and resulting sedimentary structures. With our understanding of the morphodynamics of supercritical flow bedforms having advanced significantly over the past decade through laboratory experiments, numerical modelling, sea floor surveys and field observations, we are now equipped with an increased 'palette' when interpreting sedimentary structures in the field.

Here, we show that sedimentary structures in some Neogene cool-water carbonate ramp successions in the Mediterranean region, which in cases were previously interpreted as channels-fills, are in fact related to hydraulic jumps in dense underflows. For the Pleistocene deposits of Favignana Island (Italy), we present time-progressive morphodynamic reconstructions of flow and bed to explain the generation of the characteristic backset beds, consisting dominantly of upstream-dipping strata.

The backset beds of Favignana Island occur in alternation with packages of cross-stratified beds, created by the migration of subaqueous dunes. Examination of the fluid dynamics behind the origin and migration of bedforms in both types of deposit demonstrates that in terms of hydrodynamic conditions they represent two genetic populations. We reveal that with respect to every-day processes the studied carbonate ramp was an inactive depositional environment in terms of sediment transport and that sedimentation took place only during major storms (subaqueous dune deposits) and catastrophic tsunamis (backset beds).

The prograding sand wedge thus formed, recorded a very non-linear sedimentation history which is not in line with the gradual build-up commonly assumed for temperate carbonate ramps. We contend that beds with supercritical flow structures, which are frequently observed in the Neogene of the Mediterranean region, indeed indicate catastrophic evolution, which is a new way to interpret temperate carbonate ramps in the sedimentary record.



Reading the (paleo-)environmental message from living (stained) and dead benthic foraminifera assemblages from cold-water coral ecosystems of the Gulf of Cadiz and the Eastern Alboran Sea

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Although cold-water corals (CWC) are known since centuries, they have been extensively studied only in the last two decades with a special focus on the CWC ecosystems from the Mediterranean Sea and along the Northern European margin. Comprehensive publications on their ecology and associated fauna (e.g., Freiwald et al., 2004) demonstrated that living CWC thrive preferentially on elevated substrates in high water energy supplied by enhanced organic carbon fluxes. The present day distribution of living CWC along the European margin shows a clearly contrasting pattern between the North Atlantic (Norwegian shelf and Porcupine Seabight) characterized by well established and flourishing corals and the declining and buried structures in the Gulf of Cadiz and the Mediterranean Sea. Using living (stained) and dead benthic foraminifera, we aim to better constrain CWC evolution through time and space along the Atlantic-Mediterranean Gateway.

A 600 cm long gravity core (MD13-3443G) and 6 box-cores (BCs) have been recovered during the EC Eurofleets MD194 "Gateway" cruise from the Melilla Mounds Field (eastern Alboran Sea) and the Gulf of Cadiz from water depths ranging from 310 m to 530 m. The BCs were sampled for living benthic foraminifera following the FOBIMO protocol (Schönfeld et al., 2012). The gravity core and the uppermost centimetre of sediment of the BCs were then investigated for the micropaleontological content. At least 300 specimens per sample have been identified on the fraction >63 μm for the dead (fossil) benthic foraminifera and 300 specimens per sample, if possible, for the living (stained) foraminifera.
The surface sediments of each BC were characterized by measuring total organic carbon, sedimentary phosphorus and stable $\delta^{13}C$ and $\delta^{15}N$ isotopes of the organic fraction.

The distribution of stained foraminifera reveals major differences occurring between the sites and points to locally important variability in the current strength at the sea-floor and the export of organic carbon: the sampled CWC site in the Gulf of Cadiz contains only few stained specimens dominated by the opportunistic species *Epistominella exigua*. Samples from the Melilla Mounds field vary from samples barren of stained foraminifera to samples containing relatively high-diversified assemblages. The unique BC containing a living coral colony (*Dendrophillia cornigera*) is characterized by the highest stained benthic foraminifera diversity of all sampled sites including epibenthic species such as *Rosalina brady* and *Gavelinopsis praegeri* and abundant infaunal species e.g., *U. mediterranea*, *Nonionella iridea*. The fossil benthic foraminifera from core MD13-3443G reveal that 1) most of the Holocene record is missing or has never been deposited, 2) the coring site in the Gulf of Cadiz was strongly influenced by the North Atlantic Central Water (NACW) and, 3) intervals of enhanced organic carbon fluxes and increased bottom water energy characterize the sediment record.

REFERENCES

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Schönfeld et al., 2012. Marine Micropaleontology, vol. 94-95, p. 1-13.

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