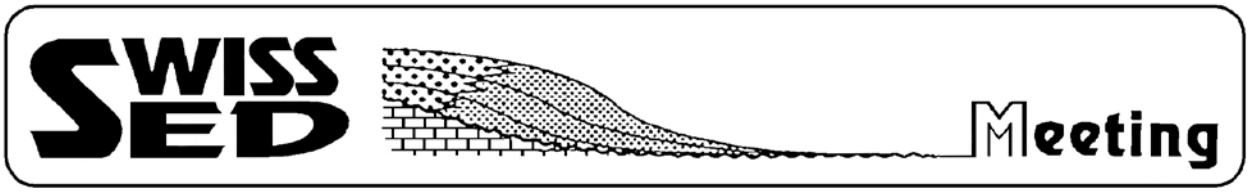


Twenty-second Meeting of Swiss Sedimentologists

Saturday, 22 February 2014

Fribourg

Abstracts

PROGRAMME

09:25 ***Opening***

09:30–09:50 **Vogel, H., Russell, J.M., Bijaksana, S., Anselmetti, F., Aritztegui, D., Crowe, S., Fowle, D., Haffner, D., King, J., Marwoto, R., Melles, M., von Rintelen, T., Stevenson, J., & Watkinson, I.:** Paleoenvironments, Evolution, and Geomicrobiology in a Tropical Pacific Lake: The Lake Towuti Drilling Project (TOWUTI).

09:50–10:10 **Hamaekers, H., Foubert, A., De Muynck, W., Soete, J., Bauters, E., Boon, N., & Swennen, R.:** Defining controlling factors on microbial-induced and physico-chemical precipitation of Mg-Carbonates: A large-scale laboratory experiment.

10:10–11:10 ***Coffee and posters***

11:10–11:30 **Peybernes, C., Martini, R., & Chablais, J.:** Upper Triassic reefs from Sambosan Accretionary Complex, Southwestern Japan: biostratigraphy and paleoecology.

11:30–11:50 **Pérez-Asensio, J.N., Aguirre, J., & Schmiedl, G.:** Paleoenvironmental and paleoclimatic evolution of the lower Guadalquivir Basin (SW Spain) during the Late Miocene: implications for northeastern Atlantic paleoceanography and the onset and termination of the Messinian salinity crisis.

11:50–12:10 **Slootman, A., & Moscariello, A.:** Catastrophic events on a cool-water carbonate ramp – the Favignana Calcarenite (Sicily, Italy).

12:10–14:00 ***Lunch***

14:00–14:30 **Keynote: della Porta, G.:** Depositional geometry, fabric types and geochemical signature of precipitated carbonates in continental settings.

14:30–14:50 **Reusch, A., Moernaut, J., Hilbe, M., Loher, M., Bouffard, D., Wüest, A.J., Mosar, J., Meinecke, G., Anselmetti, F.S., & Strasser, M.:** Subaquatic landslides and fluid-expulsion features within the sedimentary archive of Lake Neuchâtel.

14:50–15:10 **Blattmann, T., Wessels, M., Plötze, M., Mcintayre, C., & Eglinton, T.:** Quantitative Provenance Analysis of Organic Carbon using stable and Radiocarbon isotopes.

15:10–15:30 **Usman, M.O., Masago, H., Winkler, W., & Strasser, M.:** Mid Quaternary decoupling of sediment routing in the Nankai Forearc revealed by provenance analysis of turbiditic sands.

15:30–16:20 ***Tea and posters***

16:20–16:40 **Adolf, C., Wunderle, S., & Willy Tinner, T.:** Implementing cylinder sediment traps and satellite data for the construction of a microscopic charcoal deposition transfer function for lakes to quantitatively reconstruct past regional fire activity in Europe.

16:40–17:00 **Diot, X., El-Maarry, M.R. , Schlunegger, F., Norton, K.P., & Thomas, N.:** Banded Terrain in Hellas Basin, Mars: Results from Geomorphological Investigations and Morphometry.

17:00–17:20 **Benvenuti, A., & Moscariello, A.:** Genesis of the largest Tunnel Valley of the Southern North Sea and its infill dominated by northward dipping clinoforms – a 3D seismic and borehole data study.

17:20 ***Closure and apéro***

Posters

Baldessin, E., Fischer, G., Godefroid, F., & Kindler, P.: The dolomitic Timber Bay Formation (Pliocene, Mayaguana, Bahamas): a lateral equivalent of the Hope Gate Formation (Jamaica)?

Kiefer, L.: Permeable shell beds in the Upper Muschelkalk of the Swiss Plateau (Mittelland) – Is a geothermal use possible?

Loher, M., Reusch, A., Lilley, M., Bernasconi, S.M., & Strasser M.: The Pockmarks of Lake Neuchâtel: Sedimentological and geochemical studies on crater-shaped morphologic depressions on the lake floor of Lake Neuchâtel

Marchegiano, M., Gliozzi, E., Buratti, N., Ariztegui, D., & Cirilli, S.: Detailed analysis of Middle Pleistocene ostracod assemblages from Lake Trasimeno, Perugia, (Italy)

Morard, A., Strasky, S., & Swiss Committee for Stratigraphy: A harmonised lithostratigraphic scheme for the Geological Atlas of Switzerland 1:25 000 – preliminary synthesis.

Rüggeberg, A, Flögel, S., & Wolf-Christian Dullo: Cold-water coral reef health in a changing World

Thomas, C., Ariztegui, D., & the DSDDP Scientific Team: Subsurface biosphere specificity and distribution in the Dead Sea deep sediments: climate as game changer in extreme environments microbial communities

Fischer, G., Godefroid, F., Kindler, P., & Baldessin, E.: Evolution of the Mayaguana Bank (SE Bahamas) during the Neogene: Constructional windward margin *versus* erosional leeward margin.

Gilli, A.: Putting rockslide events into an environmental context: The search for the dust layer of the Flims rockslide, Graubünden, Switzerland

Slootman, A., & Cartigny, M.J.B.: The supercritical deposits of Favignana (Pleistocene of Sicily, Italy)

Vuillemin, A., Ariztegui, D., Leavitt, P.R., Bunting, L., & the PASADO Science Team: Environmental DNA comparison from the Holocene and Last Glacial Maximum records at Laguna Potrok Aike, Argentina.

De Boever, E., Foubert, A., Fouke, B., Swennen, R., Özkul, M., & Virgone, A.: Controls on the 3D distribution of microporosity and its connectivity within recent to ancient travertine deposits

Jaramillo-Vogel, D., Foubert, A., Atnafu, B., Kidane, T., & Henriet, J.-P.: Pleistocene coralgal- and microbial reef deposits in the Danakil Depression (Afar, Ethiopia): Preliminary results from a first reconnaissance

Alvarez, M., Hernández, M.A., & Ariztegui, D.: Geomorphological and sedimentological influences in groundwater hydrodynamics: An example from Península Valdés, Patagonia, Argentina – poster or talk?

Bilmes, A., & Ariztegui, D.: Linking mid-scale Distributive Fluvial Systems with drainage areas: Geomorphic evidence from the Gastre Basin, Argentina.

Camozzi, O., Stalder, C., Rüggeberg, A., & Spezzaferri, S.: Benthic Foraminifera reveal ecological requirements of the cold-water corals (*Madrepora oculata* and *Lophelia pertusa)*

ESPP SwissSed Meeting 2014 - List of participants

Adolf, Carole	Bern	Kiefer, Lea	Wettingen
Alvarez, Maria del Pilar	Geneva	Kindler, Pascal	Geneva
Anselmetti, Flavio	Bern	Lauper, Bruno	Fribourg
Ariztegui, Daniel	Geneva	Lefort, Apolline	Porrentruy
Baldessin, Erika	Geneva	Loher, Marcus	Zurich
Benvenuti, Antonio	Geneva	Love, Råman Vinnå	Lausanne
Bernoulli, Daniel	Basel	Marcheggiano, Marta	Geneva
Bilmes, Andrés	Geneva	Martini, Rossana	Geneva
Bläsi, Hansruedi	Bern	McKenzie, Judy	Zurich
Blattman, Thomas	Zurich	Morard, Alain	Waben
Camozzi Osvaldo	Fribourg	Morlock, Marina	Bern
Celestino, Ricardo	Zurich	Pérez-Asensio, José Noel	Geneva
Chesnel, Valentin	Geneva	Peyberne, Camille	Geneva
Constandache, Monica	Fribourg	Ramseyer, Karl	Bern
De Boever, Eva	Leuven, BEL	Reusch, Anna	Zurich
Della Porta, Giovanna	Milan, ITA	Rüggeberg, Andres	Fribourg
Diot, Xavier	Bern	Rusillon, Elme	Geneva
El Kateb, Akram	Fribourg	Samankassou, Elias	Geneva
Fisher, Jennifer	Geneva	Schlunegger, Fritz	Bern
Föllmi, Karl	Lausanne	Slootman, Arnoud	Geneva
Foubert, Anneleen	Fribourg	Spezzaferri, Silvia	Fribourg
Funk, Hanspeter	Baden	Stalder, Claudio	Fribourg
Hosseini, Seyedabolfazl	Geneva	Strasser, Andre	Fribourg
Geyer, Matthias	Freiburg, GER	Strasser, Michael	Zurich
Giesche, Alena	Bern	Thomas, Camille	Geneva
Gilli, Adrian	Zurich	Usman, Muhammad	Zurich
Hamaekers, Helen	Fribourg	Vogel, Hendrich	Bern
Hug, Wolfgang	Porrentruy	Weidmann, Marc	Jongny
Jaramillo-Vogel, David	Fribourg	Weissert, Helmut	Zurich

Implementing cylinder sediment traps and satellite data for the construction of a microscopic charcoal deposition transfer function for lakes to quantitatively reconstruct past regional fire activity in Europe

Carole Adolf[1], Stefan Wunderle[2] & Willy Tinner[1]

[1] *Institute of Plant Sciences and Oeschger Centre for Climate Change Research, University of Bern, Switzerland*
[2] *Institute of Geography and Oeschger Centre for Climate Change Research, University of Bern, Switzerland*

Only little is known about the transport ways of charcoal and other particles into lake sediments. In our project, the main aim is to create the first European calibration dataset for charcoal deposition (particles/cm^2/yr) in lake sediments. We aim at building a transfer function ("calibration in space"-approach) to quantitatively reconstruct past regional fire activity (e.g. fire frequency, burned areas). Such information can significantly contribute to a better assessment of future ecosystem dynamics by e.g. placing future risk of extreme fire events (IPCC, 2007) in a Late Glacial and Holocene context with highly variable climates. In building this calibration set we are also gaining important information into how far small particles can fly and the time it takes them to be transported firstly through the air and afterwards through the water column to reach the sediment of lakes. This understanding is crucial for the interpretation of our results and depositional processes in general.

We look into the relationship between large fires detected by satellites and the amount of charcoal particles found in the sediments of lakes within a flexible range. We start with collecting satellite data within a 100 km radius around the study sites. 40 cylinder sediment traps (75 cm tall, 9 cm opening diameter) were installed across Europe (Figure 1). Special emphasis was placed on small (ideally between 10 and 20 ha), ca. 10 m deep lakes (although bigger and deeper lakes were also included) covering most ecosystems in Europe (mediterranean, temperate, steppic, boreal and arctic). The sediment traps implemented were developed from devices used by the EAWAG and taking into account sediment trap literature, especially the review by Bloesch and Burns (1980), which highlights the importance of an appropriate aspect ratio (height/diameter of trap > 5), to avoid turbulence affecting the sediments collected inside the trap. Effects of vegetation cover and climate unto the transport and deposition of these small particles is also of interest. We empty the sediment traps once annually for tentatively three years and analyze their content in the laboratory with stereo- and light microscopes.

Our methods include the use of the MODIS fire products (Justice et al., 2002; Giglio, 2013) derived from satellite data from NASA's Terra and Aqua satellite platforms. This allows for uniform fire data from a very large area, which is available with daily and weekly time resolutions.

First results include a highly significant correlation between the amount of detected fire pixels by MODIS and microscopic charcoal influx in the year of burning. To explore the possibility of a time-lag between charcoal emission and the actual deposition into the sediments of the lakes, fires of the year previous to the sediment trap placements were analyzed and compared with the sediment trap microcharcoal. These correlations are also significant, suggesting the presence of time-lags and/or pronounced spatio-temporal persistences of fires across Europe. Further time steps and pooling of yearly fire data will be explored and compared to the contents of the sediment traps to study the temporal extent of these time-lags and improve the available statistical correlations and the already calculated regression models. The link between macroscopic charcoal and fires will also be explored.

REFERENCES

Bloesch, J. and Burns, N.M. (1980). A critical review of sedimentation trap technique. *Schweiz. Z. Hydrol*. 42 (1): 15-55.

Giglio, L. (2013). MODIS Collection 5 Active Fire Product User's Guide Version 2.5. *Department of Geographical Sciences, University of Maryland*. http://modis-fire.umd.edu/AF_usermanual.html (31 March 2013).

IPCC (2007). Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the IPCC. *Cambridge Univ. Press*, Cambridge.

Justice, C.O., Giglio, L., Korontzi, S., Owens, J., Morisette, J.T., Roy, D., Descloitres, J., Alleaume, S., Petitcolin, F., Kaufman, Y. (2002). The MODIS fire products. *Remote Sensing of Environment*. 83 (1-2): 244-262.

Fig. 1: Study lakes with sediment traps.

Geomorphological and sedimentological influences in groundwater hydrodynamics: An example from Península Valdés, Patagonia, Argentina

Maria del Pilar Alvarez[1,2] , Mario A. Hernández[2] & Daniel Ariztegui[1]

[1]Section of Earth & Environmental Sciences, University of Geneva,
13 rue des Maraîchers, 1205 Geneva, Switzerland
[2]Cátedra de hidrogeología, University of La Plata, calle 122 y 60, 1900 La Plata, Argentina

Geomorphology, geology, and climate are first-order determinants of hydrogeological phenomena, not just hydrodynamic but also hydrochemical ones. A study case is presented to assess the relationship between geomorphology and hydrodynamics and its relevance in studies in arid regions, where there is a closer correspondence between hydrogeological units and the geoforms containing them (Alvarez et al. 2010). The area has an average rainfall of 232 mm/year and a soil moisture deficit of about 472 mm/year. The main geomorphic units were identified by interpreting Landsat 7 satellite images and then surveyed in the field, as well as by sedimentological characterization. The forms analyzed were grouped into four major units according to Súnico (1996): Terrace-like plains (Tp), Endorheic depressions (Ed), Sand dunes and sandy layers (SdSl) and Coastal area (Ca). The local hydrogeological system was identified on the base of the hydrolithological and stratigraphic characteristics emerging from the geological map (Haller et al. 2001) and the field observations. The system is formed by an unsaturated zone corresponding to the Quaternary deposits (mainly sand, gravel and silt) and partly to the Tertiary sediments (mainly marine deposits formed by sands, coquinas, silts and clays with abundant volcanic ash) of the Puerto Madryn and Gaiman Formations. A phreatic aquifer is contained within these same deposits or in the sands of the Puerto Madryn Formation, which is exploited mainly in the region. Below it there are one or more semiconfined or confined aquifers, limited by clayey or siltyclay strata in the same Puerto Madryn Formation or in the underlying Gaiman Formation. All the aquifers are unconsolidated and porous. The hydrodynamic analysis was based on a survey of 89 monitoring wells, the construction of equipotential maps, and the interpretation of pumping-test results by a nonequilibrium method. The combination of geomorphological, sedimentological and hydrodynamic elements allowed the definition of hydromorphological units. The SdSl unit corresponds to major recharge areas (highly permeable aeolian sands), where the phreatic surface has a radial morphology with a tendency towards a divergent cylindrical one, the Tp unit has the most extensive groundwater circulation areas, with the lowest hydraulic gradients in the region (<0.1%), the Ed unit presents the most relevant inland discharge areas (Salina Grande, Salina Chica, and Gran Salitral salt pans) showing a radial phreatic morphology with a tendency towards a convergent cylindrical pattern and high hydraulic gradients of the order of 3%. Discharge also occurs through stratigraphic and talweg springs as groundwater runs towards salt bodies (Alvarez et al. 2006). The Ca unit is a local recharge area and it is independent from the regional hydrogeomorphological behavior.

These units and the criteria used for their definition allow immediate recognition of hydrogeological phenomena in arid regions with near-optimal satellite imaging of landforms due to the lack of vegetation cover. Therefore the geomorphological and sedimentological analysis may be an extremely useful tool for the hydrogeomorphological interpretation in areas where very little groundwater information such as the extra-Andean Patagonia.

REFERENCES

Alvarez, M. d. P., Weiler, N. E., & Hernández, M. A. 2010. Linking geomorphology and hydrodynamics: a case study from Península Valdés, Patagonia, Argentina. Hydrogeol J 18:473–486. doi:10.1007/s10040-009-0528-x

Alvarez MP, Weiler NE, Hernández MA (2006) Geohidrología de humedales cercanos a la costa con cota bajo nivel del mar, Península Valdés, Argentina [Geohydrology of below sea level nearshore wetlands, Península Valdés, Argentina] Latinoam Hidrogeologia [in Spanish] 6(1):35‑42

Haller M, Monti A, Meister C (2001) Hoja Geológica 4363-I, Península Valdés [Geological Sheet 4363-I, Península Valdés] SEGEMAR Buenos Aires, Argentina [in Spanish]

Súnico A (1996) Geología del Cuaternario y ciencia del suelo: relaciones geomórficas-estratigráficas con suelos y paleosuelos [Quaternary geology and soil science: geomorphic/stratigraphic relationships with soils and paleosoils] PhD Thesis, Universidad Nacional de Buenos Aires, Argentina [in Spanish]

The dolomitic Timber Bay Formation (Pliocene, Mayaguana, Bahamas): a lateral equivalent of the Hope Gate Formation (Jamaica)?

Erika Baldessin[1], Gyöngyvér Fischer[1], Fabienne Godefroid[1] & Pascal Kindler[1]

[1]Section of Earth and Environmental Sciences, University of Geneva, 13 rue des Maraîchers, CH-1205 Geneva
Email: Erika.Baldessin@unige.ch

Petrological and geochemical study of the Pliocene Timber Bay dolostone exposed along the north coast of Mayaguana Island (Bahamas) reveals a striking resemblance with the well-known Hope Gate Formation (HGF) described by Land (1973, 1991) from the Pliocene of North Jamaica suggesting these two lithostratigraphic units might be lateral equivalents.

The Timber Bay Formation (TBF) is unique in the Bahamas. While it crops out at the surface of Mayaguana, a small carbonate island nestled in the southeastern part of the archipelago, equivalents of this Pliocene unit are only found at depth on all other Bahamian banks. Discovered by Godefroid (2012), the TBF consists of a low-elevation reefal terrace (Fig.1) made of partially to completely dolomitized coral-algal boundstone with a bioclastic grainstone matrix. Similary, the HGF forms a 30 to 40 m-high reefal terrace that crops out on the north coast of Jamaica as a dolomitized coralline biolithite with a molluscan-algal grainstone matrix (Land, 1973, 1991; Austin et al., 2007).

The petrography and the geochemistry of both formations are very similar. Petrographically, both units exhibit two contrasting types of dolomite: (a) a fine-crystalline dolomite mimically replacing micrite and allochems (mainly red algae, echinoderms and foraminifera), and (b) a coarse-crystalline, limpid dolomite cement forming isopachous rims and/or blocky fillings in both inter- and intragranular pores (Land 1973; Godefroid, 2012). A late phase of low-Mg calcite (LMC) sparry cement occurs in both formations. As for the geochemistry, stable isotopic compositions are similar. Oxygen isotopic data are consistent with precipitation in a marine diagenetic environment with $\delta^{18}O$ = +3.1‰ for the HGF (Land, 1991) and $\delta^{18}O$ = +1.28‰ for the TBF (Godefroid, 2012). Although, minor differences appear in the carbon isotopic composition, the values are close enough to be considered as similar. The slightly negative value of the TBF ($\delta^{13}C$ = -0.33‰) was attributed to the occurrence of late LMC cement (Godefroid, 2012) while the $\delta^{13}C$ value (= +0.9‰) of the HGF was interpreted as resulting from the modification of seawater (the dolomitizing fluid) by oxidation (Land, 1991). More significant differences are observed in the $^{87}Sr/^{86}Sr$ ratios of both formations. The $^{87}Sr/^{86}Sr$ ratios of the TBF average at 0.709067±0.000011 (Godefroid, 2012), giving a Pliocene age (2.12-4.09 Ma). The HGF has a mean $^{87}Sr/^{86}Sr$ ratio of about 0.70897 (Land, 1991) which translates to a Late Miocene age (ca. 6.5 Ma). However, according to Land (1991), the HGF is of Pliocene age, and the low Sr-isotope values are explained by contamination of the dolomitizing fluid by underlying Miocene chalks.

The difference in Sr-isotope composition between the TBF and the HGF, which contrasts with their overall similarities, could be explained in three ways:

- $^{87}Sr/^{86}Sr$ values obtained from both units are correct indicating that, despite their petrographic and geochemical resemblance, the HGF and the TBF are not contemporaneous.
- $^{87}Sr/^{86}Sr$ values obtained from the TBF are correct, whereas those measured from the HGF have been contaminated by old Sr during dolomitization (Land, 1991). Both units are thus Pliocene in age and can be considered as lateral equivalents.

- $^{87}Sr/^{86}Sr$ values obtained from the HGF are correct, whereas those measured from the TBF have been altered by young Sr during a dolomitization event post-dating deposition. Both units are thus Miocene in age and can be considered as lateral equivalents.

We prefer the second hypothesis because similar dolostones of Pliocene age have been also recognized in other Caribbean islands (Sibley, 1982), suggesting a possible climatic control on dolomitization. This example further emphasizes both the limitations in dating dolomitic units with the Sr-isotope method, due to the possible diverse origins of Sr, and the sometimes forgotten importance of biostratigraphic age determinations.

REFERENCES

Austin, S.E., and Pigott, J.D., 2007. Eustatic sea level-influenced heterogeneous dolomitization of the Hope Gate Formation, Discovery Bay, Jamaica. *Geological Society of America*, Abstracts with Programs, Vol. 39, No. 6, p. 145.

Godefroid, F., 2012. Géologie de Mayaguana, SE de l'archipel des Bahamas. Terre et Environnement, Vol. 108, 230 pp.

Land, L.S., 1973. Contemporaneous dolomitization of middle Pleistocene reefs by meteoric water, North Jamaica. *Bulletin of Marine Sciences*, Vol. 23, pp. 64-92.

Land, L.S., 1991. Dolomitization of the Hope Gate Formation (north Jamaica) by seawater: Reassessment of mixing-zone dolomite. In: Stable Isotope Geochemistry: A Tribute to Samuel Epstein. *The Geochemical Society, Special Publication*, No. 3, pp. 121-134.

Sibley, D.F., 1982. The origin of common dolomite fabrics: clues from the Pliocene. *Journal of Sedimentary Petrology*, Vol. 52, No. 4, pp. 1087-1100.

Fig. 1: Reefal terrace of the Timber Bay Formation at Timber Bay (north coast of Mayaguana)

Genesis of the largest Tunnel Valley of the Southern North Sea and its infill dominated by northward dipping clinoforms – a 3D seismic and borehole data study.

A. Benvenuti & A. Moscariello

Earth and Environmental Sciences, University of Geneva,
Rue des Maraichers, 13, CH-1205 Geneva, Switzerland.
Email: antonio.benvenuti@unige.ch

Tunnel Valleys (TVs) are the most typical landforms created by conspicuous erosion of the substrata by glacial-related processes. Their genesis is still debated and generally associated with 1) catastrophic jökulhlaup-like outbursts, 2) a steady state overpressured condition or 3) a time transgressive formation following the retreating ice margin. TVs can be left completely unfilled or partly/ totally filled with sediments. Sediments could be laid down by glacial-related processes during or shortly after the ice-retreat (e.g. subglacial to proglacial range of processes…) or/and by different post-glacial processes in several depositional environments.

The main aim of this study is to clarify the genesis of the incision, the sediment provenance (i.e. glacially reworked Tertiary/Quaternary bedrock vs. southerly sourced fluvial deposits), the chronostratigraphy of the sediment succession and, subsequently, the process which driven the sediment deposition.

Here, we present the results of an architectural and compositional study of a buried TV in the Dutch sector of the Southern North Sea (SNS) focusing on the terminal sector (last 40 km) of the largest TV of the SNS (width: 5 km, thickness: 400 m, length: 100 km ca.). For this study a high-resolution 3D seismic database is used to define and map the TV and its infill geometries in detail. The seismic interpretation is constrained by compositional data from cutting samples and a gamma ray log from a gas exploration well (K14-12) entering the TV in the study area.

The TV has a strikingly straight north-south orientation with the exception of its southernmost part in which it exhibits a more curvy geometry. The valley base is flat in its southernmost sector, while it is incised by a narrow channel (686 m wide and 65 m deep in average) more towards the north. Tributary valleys are present on both sides of the TV; their depth is considerably lower than the TV floor. The overall infill geometry is dominated by northward-dipping seismic stratigraphic units that diverge in shape and seismic facies, varying from transparent to high-amplitude reflectors in parallel to more complex to chaotic reflector geometries.

Such dominant infill architecture is partly consistent with other TVs described in the SNS area (e.g. the backstepping clinoforms of Praeg 1996; 2003; Moreau et al., 2012); however, it is clearly more complex than simple prograding clinoforms: 1) the size of seismic bodies changes considerably along and perpendicular to the valley axis, 2) very differently and shaped seismic bodies constitute the TV infill, 3) channel-like geometries are present towards the top of seismic bodies and 4) the infill of tributary valleys consistently shows specific shapes where they connect with the TV.

Results from seismic stratigraphy and geomorphology, grain size, biostratigraphy and palynology on sediment cutting samples are contrasting but still provide insights both on TV formation and on infill depositional process. TV is supposed to have formed during an ice-retreat phase with a both meltwater and ice erosion on the subsurface. The presence of a narrow incision at the bottom of the valley especially highlights the meltwater action importance. A steady state formation is more plausible than a catastrophic one due to the

evidence of reshaping by ice. The TV infill is dominated by a fining-up sequence, which, together with the clinoform architecture, suggests that sediments were provided from North. Therefore, a glaciogenic infill is more plausible than a post-glacial deltaic filling process from South. However, the presence of lacustrine proxies of non-glacial origin within the deposits makes the interpretation difficult and requires further analysis.

Acknowledgements: This study is part of the Glaciogenic Reservoirs Analogue Studies Project (GRASP). The authors would like to thank Nederlandse Aardolie Maatschappij for the material offered and Prof. Roland Wernli and Prof. Timme Donders for their precious help with biostratigraphy and palynology determinations.

Linking mid-scale Distributive Fluvial Systems with drainage areas: Geomorphic evidence from the Gastre Basin, Argentina

Andrés Bilmes[1,2] & Daniel Ariztegui[1]

[1]Section of Earth & Environmental Sciences, University of Geneva, 13 rue des Maraîchers, 1205 Geneva, Switzerland
[2]Centro de Investigaciones Geológicas CONICET - Universidad Nacional de La Plata, Calle 1 Nº 664, La Plata, Argentina.

Distributive Fluvial Systems (DFS) have been recently identified as dominant Quaternary geomorphic features in many modern, aggradational continental sedimentary basins (Moscariello, 2005; Weissmann et al., 2011). For all the complete range in scale of DFS — represented by alluvial fans, fluvial fans and megafans — previous studies have demonstrated relationships between the DFS area and the catchment basin (Al-Farraj & Harvey, 2005; Davidson & Hartley, 2013). Thus the idea of that DFS area can be used to predict the magnitude of fluvially- transported sediment deposited in a sedimentary basin was considered.

Mid-scale DFS are well-preserved in the endorheic Gastre Basin, central Patagonia, Argentina. They are part of the Quaternary record of this basin together with small-scale distributive fluvial systems, lake shorelines and lacustrine deposits that interplay with a volcanic field 0.3-1 Ma old. The drainage network of the feeding DFS is transitory and extends over an area, which has arid climate conditions. Hence, the study of these mid-scale DFS provides an excellent opportunity to analyse fluvial depositional patterns in sedimentary basins including relationships between DFS properties and feeder catchment properties.

Detailed geological, geomorphological and hydrological mapping, together with trial pits and sedimentary cores were performed in order to analyze the sedimentological and geomorphological characterization of the Quaternary record from the Gastre Basin with focus in the mid-scale DFS. The piedemont zone of the basin is characterized by remnant fans and bajadas (lower to middle Pleistocene) which are incised by modern drainage systems, connected to younger small–mid scale DFS (upper Pleistocene-Holocene). Four mid-scale DFS are observed, all of them related to mountain-fed transitory rivers developed in the NE bounding mountains. They have a semiconical shape, slopes from apex to toe ranging from 0.23° to 0.82° and cover areas of 49 to 151km^2.Catchment areas of the feeding rivers range from 400 km^{2}to 1.500 km^2. The dominant channel planform of the mid-scale DFS is a single braided channel that bifurcates downstream into braided /or more rarely meandering channels that terminate in playa lakes or salinas. The sedimentological characterization exhibits pebble to cobble-grade conglomerates with fine-to coarse-grained sandy matrix. The four examples have the same source and thus the same bedrock lithology. Clast and matrix-supported textures are registered with planar cross-bedding, horizontal stratification and clast imbrication as the most common sedimentary structures. Lenses of coarse-grained and pebbly sandstones with planar cross-bedding are also recorded. All the mid-scale DFS exhibit evidences of streamflow processes typical of fluvial fans.

The present work indicates that the relationships between DFS area and catchment basin only agree in one case of the four DFS with the existing regression equations models (Al-Farraj & Harvey, 2005; Davidson & Hartley, 2013). Thus, others variables such as available horizontal accommodation space and drainage basin slope need to be included to predict mid-scale DFS length.

REFERENCES

Al-Farraj, a., Harvey, a. M., 2005. Morphometry and depositional style of Late Pleistocene alluvial fans: Wadi Al-Bih, northern UAE and Oman. Geological Society, London, Special Publications 251, 85–94.

Davidson, S.K., Hartley, A.J., 2013. A quantitative approach to linking drainage area with distributive fluvial system area in dryland, endorheic basin settings. 10th International Conference on Fluvial Sedimentology, Leeds, UK 2–3.

Moscariello, A., 2005. Exploration potential of the mature Southern North Sea basin margins: some unconventional plays based on alluvial and fluvial fan sedimentation models, in: Dore, A.G., Vining, B.A. (Eds.), Petroleum Geology: North-West Europe and Global Perspectives-Proceedings of the 6th Petroleum Geology Conference. Geological Society of London, London, pp. 595–605.

Weissmann, G.S., Hartley, a. J., Nichols, G.J., Scuderi, L. a., Olson, M., Buehler, H., Banteah, R., 2010. Fluvial form in modern continental sedimentary basins: Distributive fluvial systems. Geology 38, 39–42.

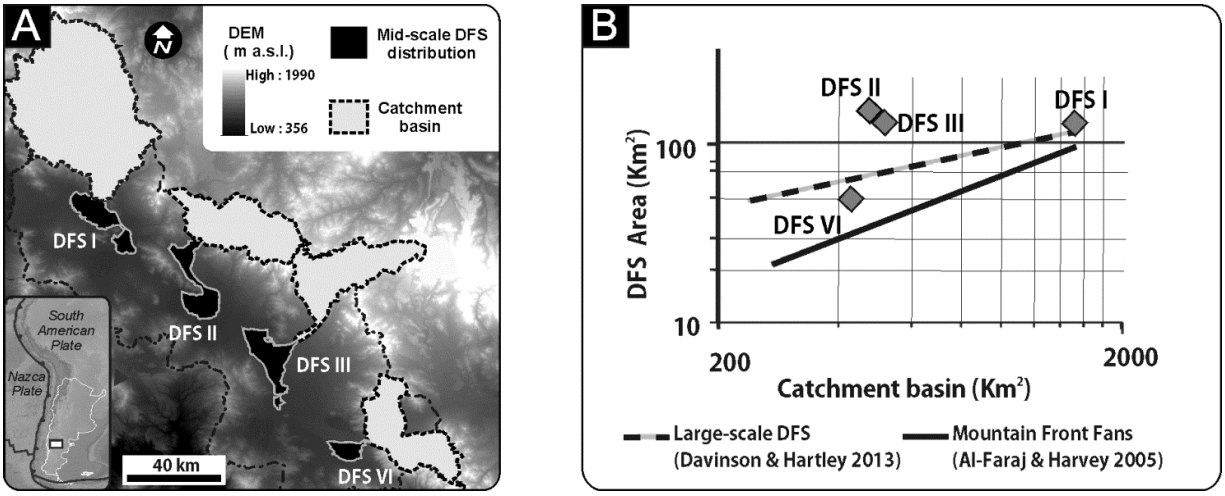


Fig.1: A: Location map and Digital Elevation Model (DEM) of the Gastre Basin. The four mid-scale DFS distribution and their catchment basins are highlighted. **B:** Regression relationship between DFS area and catchment basin of the mid-scale DFS studied. The dash line and solid line indicates regression lines of previous studies.

Quantitative Provenance Analysis of Organic Carbon using stable and Radiocarbon isotopes

Thomas Blattmann[1], Martin Wessels[2], Michael Plötze[1], Cameron Mcintyre[1] & Timothy Eglinton[1]

[1]ETH Zürich. Email: thomas.blattmann@erdw.ethz.ch
[2]ISF Langenargen.

This study investigated source-to-sink processes influencing organic matter in the Lake Constance drainage basin emphasizing research on mineralogical overlays on organic matter transfer and preservation. Using coupled stable and radiocarbon isotopes, results from spatiotemporal provenance analysis of organic carbon from lacustrine, soil, and rock-derived pools were generated. Relative contributions from these pools are seasonally mediated and event driven in locations proximal to the Rhine and exhibit strong seasonality in lake primary productivity over an annual cycle in locations distal from river influence. Recalcitrant fossil organic carbon, associated with quartz and mica, makes a significant contribution to the organic carbon budget of Lake Constance. The presence of this significant fossil organic carbon component calls for consideration of this organic carbon source in future studies, especially in perialpine lakes.

Benthic foraminifera reveal ecological requirements of the cold-water corals (*Madrepora oculata* and *Lophelia pertusa*)

Osvaldo Camozzi[1], Claudio Stalder[1], Andres Rüggeberg[1,2,3] & Silvia Spezzaferri[1]

[1]Department of Geosciences, University of Fribourg, Chemin du Musée 6, 1700 CH-Fribourg, Switzerland
[2]Renard Centre of Marine Geology (RCMG), Ghent University, Belgium
[3]GEOMAR-Helmoltz Centre for Ocean Research Kiel, Germany

The Melilla Carbonate Mounds Field is a cluster of Holocene to Recent mounds located in the southeastern margin of the Alboran Sea. They are elongated and dome-shaped biogenic buildups, 100–250 m wide, 2–6 km long and up to 100 m high above the seafloor, in a water depth from 250 to 400 m. During TTR-17 cruise in 2008, this area was surveyed with the purpose to discover the climatic, tectonic and oceanographic factors that influenced the formation of the carbonate mounds. Sediment cores 399G (340 cm core length) and 401G (560 cm) recovered at a water depth of 258 m and 251 m respectively were examined for their benthic, planktonic foraminifera and ostracod content. Distribution of macrofauna component (bryozoans, cold-water corals (CWC) *Madrepora oculata* and *Lophelia pertusa*) and analysis of TOC (Total Organic Carbon) were also carried out at a resolution of 20 cm.

The two cores were correlated based on benthic foraminifera and on a major turnover of the planktonic foraminifera fauna from an interval dominated by *Neogloboquadrina incompta* to an interval dominated by *Globorotalia inflata* (dated at ca. 8 kyr BC after Rohling et al., 1995).

Particularly, a detailed cluster analysis on core 401G revealed the occurrence of three major benthic foraminifera assemblages corresponding to intervals dominated by different macrofaunal components: from 440–560 cm corresponding to assemblage BFA1 (*B. dilatata* and *N. turgida*) and to high abundance of bryozoans, from 260–440 cm by BFA2 (*Cassidulina laevigata*, *Cibicides* spp., *Discanomalina coronata*) associated to CWC *L. pertusa*, from 0–260 cm by BFA3 (*B. dilatata*, *Bulimina* spp.) related to CWC *Madrepora oculata*.

The benthic and planktonic foraminifera assemblages show evidence for large-scale paleoceanographic variations in the western Mediterranean Sea and indicate that *M. oculata* may thrive in a more stressed environment compared to *L. pertusa*.

REFERENCES

Rohling et al., 1995. Deep-Sea Research I, 42 (9), 1609–1619.

Controls on the 3D distribution of microporosity and its connectivity within recent to ancient travertine deposits

E. De Boever[1], A. Foubert[2], B. Fouke[3], R. Swennen[1], M. Özkul[4], A. Virgone[5]

[1]Department of Earth and Environmental Sciences, KU Leuven, Leuven, Belgium,
E-mail: eva.deboever@ees.kuleuven.be
[2]Department of Geosciences – Geology, University of Fribourg, Switzerland
[3]Institute of Genomic Biology and Department of Geology,
University of Illinois at Urbana-Champaign, IL, USA.
[4]Department of Geological Engineering, Pamukkale University, Denizli, Turkey.
[5]TOTAL E&P Recherche Développement, Paris, France.

Continental microbial carbonates host important new hydrocarbon reservoir targets, but the origin and role of microporosity in these heterogeneous carbonate deposits are poorly understood. The goal of this project is to determine how depositional, diagenetic and microbiological processes control the three-dimensional (3D) development of (micro)-porosity and permeability within travertine reservoir analogues. Emphasis will be placed on the role of microbial-induced $CaCO_3$ cement precipitation versus physical-chemical controls in developing reservoir pore networks through geological time. Holocene-Pleistocene travertine examples in Yellowstone (Wyoming, US) and Gardiner (Montana, US) (0–31 ka) are compared to equivalent more ancient deposits from the Denizli Basin in Turkey (700–900 ka). Focus is on three key fabrics that characterize the downstream succession of apron & channel, pond and proximal slope facies (Fouke, 2011) that were identified and mapped at meter-scale in both case studies. Standard petrographical techniques (transmitted light, cold cathodoluminescence, autofluorescence) are integrated with high-resolution confocal laser microscopy, SEM and EPMA to investigate the crystal fabrics and distribution of biomolecules. Microfocus computed tomography (µ-CT) of miniplugs permits to quantify the pore structure and connectivity at a micrometer-scale resolution and is linked to petrophysical analyses of the core samples. The combination with molecular (DNA, RNA) and lipid biomarker analyses could provide crucial information on the role of microbial diversity and activity in producing specific pore networks and facies fabrics. This will then serve as the contextual framework for tracking the interaction between microbial metabolic activity and pore network evolution.

Fig. 1. Left: Field image of layered pond facies in Cakmak (Denizli Basin, Turkey). **Centre:** Reconstructed µ-CT image of proximal slope plug (2.5 cm diameter, resolution 11.7 μm^3, Turkey). **Right:** Confocal laser microscopy image of thin section from pond facies (Cakmak, Turkey). The thin section was selectively stained for DNA (red) and plasma membrane (green).

Depositional geometry, fabric types and geochemical signature of precipitated carbonates in continental settings

Giovanna della Porta

University of Milan, Earth Sciences Department, Milan 20133, Italy
E-mail: giovanna.dellaporta@unimi.it

Geometry, spatial distribution and fabric type of carbonate build-ups in continental subaerial and sub-lacustrine depositional environments vary largely at the macro- to micro-scale. These precipitated carbonates, however, also show similarities across different depositional settings and water physico-chemical properties. Sub-lacustrine build-ups include: a) decimetre to metre scale, lake margin microbial and algal bioherms precipitated from supersaturated lake water in hypersaline to alkaline endorheic lakes, which can form continuous belts for hundreds of metres to kilometres, subparallel to the shoreline; they are affected by hydrodynamic energy, water depth, stability of the substrate, sediment input disturbance and faults; and b) sub-lacustrine spring mounds and pinnacles related to the mixing of bicarbonate-rich lake water and Ca-rich groundwater and/or hydrothermal water are centimetres to tens of metres thick and spaced hundreds of metres to kilometres from each other, either as individual mounds or clusters of mounds, in correspondence of single spring orifices or aligned along faults. Decimetre to tens of metres scale, subaerial carbonates precipitated from flowing and CO_2 degassing water, emerging from hydrothermal vents, form decimetre to tens of metres thick mounds, aprons, wedges, fissure ridges and waterfalls with planar to sigmoidal clinoforms or terraced slopes. Their geometry is controlled by faults, which act as conduits for hydrothermal water and determine the location and alignment of springs, rate of water discharge (influenced by climate and tectonic activity), and substrate topographic gradient. Fluvial carbonates consist of decimetre to tens of metres thick dams, wedges, terraced slopes and cascades associated with common encrusted macrophytes, bryophytes and cyanobacterial biofilms..

The wide spectrum of carbonate microfabrics ranges from irregular clotted peloidal micrite framework, coated vegetation and filamentous microbes, to various forms of crystalline dendrites and fans, and coated grains. When observed individually, at the thin section scale, non-marine carbonate microfabrics cannot be linked to a specific depositional architecture and environment, resulting uncertain proxies of spatial information. Nevertheless, specific association of carbonate microfabrics at the centimetre to metre scale can be indicative, but not exclusive, of specific depositional settings. Stable isotope geochemistry is a useful tool to distinguish between hydrothermal, meteoric freshwater and evaporative closed lake settings.

Carbonate precipitation seems to result from a continuum of abiotic and biologically influenced and induced processes in settings where water is supersaturated with respect to carbonate minerals and microbial biofilms, even if acting as passive low-energy surface sites for nucleation, are widely present.

Banded Terrain in Hellas Basin, Mars: Results from Geomorphological Investigations and Morphometry

X. Diot[1,4], M.R. El-Maarry[2], F. Schlunegger[1], K.P Norton[3]& N. Thomas[2, 4]

[1]Institut für Geologie Universität Bern, Switzerland
[2]Physikalisches Institut, Universität Bern, Switzerland,
[3]School for Geography, Environment and Earth Science, Victoria University of Wellington, New Zealand
[4]Center for Space and Habitability, Universität Bern, Sidlerstrasse.

Hellas basin is a large impact basin situated in the southern highland of Mars [1, 2 and 3]. The north-western part of the basin has the lowest elevation (-7.5 km) on the planet and contains a unique terrain type, which we informally call "banded terrain" [4, 5]. The banded terrain is composed of smooth-looking banded deposits that display signs of fluid behavior and a paucity of superimposed impact craters. In this study, we use newly acquired high spatial resolution images from the High Resolution Imaging Science Experiment (HiRISE) in addition to existing datasets to characterize the architecture of the banded terrain using a geomorphological and morphometric approach. The banded terrain is generally confined to the NW scarp of the Alpheus Colle region. The individual band-like features are ~5–15 km-long and are separated by narrows inter-band depressions, which are on average ~60 m–wide and at least 10 m–deep. The bands display several morphologies that can vary from linear to concentric forms [6] (Fig. 1). Morphometric analysis reveals that the banded terrain is present on relatively steep slopes of ~7° and in a pro-scarp trough. Crater-size frequency analysis yields a late Amazonian age for the terrain (~1.02 Gyr ± 0.09), which along with the presence of very few degraded craters; either implies a recent emplacement or a resurfacing. The apparent sensitivity to local topography and preference for concentrating in localized depressions are compatible with deformation as a viscous fluid. In addition, the bands display clear signs of degradation and slumping in its margins along with a suite of other features that include fractured mounds, polygonal cracking at many size-scales, and knobby/hummocky textures (Fig. 2). Together, these features suggest an ice-rich composition for at least the upper layers of the terrain, which is currently being heavily modified through loss of ice and intense weathering.

Acknowledgements: XD would like to thank the University of Bern for funding his PhD work. MR-EM, NT, and FS are supported by funds from the Swiss National Science Foundation (SNSF)

REFERENCES

[1] Tanaka K. L. and Leonard G.J, Journal of Geophysical Research, Vol. 100, 5407–5432, 1995.
[2] Smith et al., Science, 284, 1495–1503, 1999.
[3] Moore, J.M. and Wilhelms D.E., Icarus, 154, 258-276, 2001.
[4] Thomas N. et al., EPSC Abstracts, Vol.5 EPSC2010-338, 2010.
[5] El Maarry M.R. et al., 43rd LPSC, n°2653, 2012.
[6] Diot, X. et al., EPSC Abstract #100, 2013.

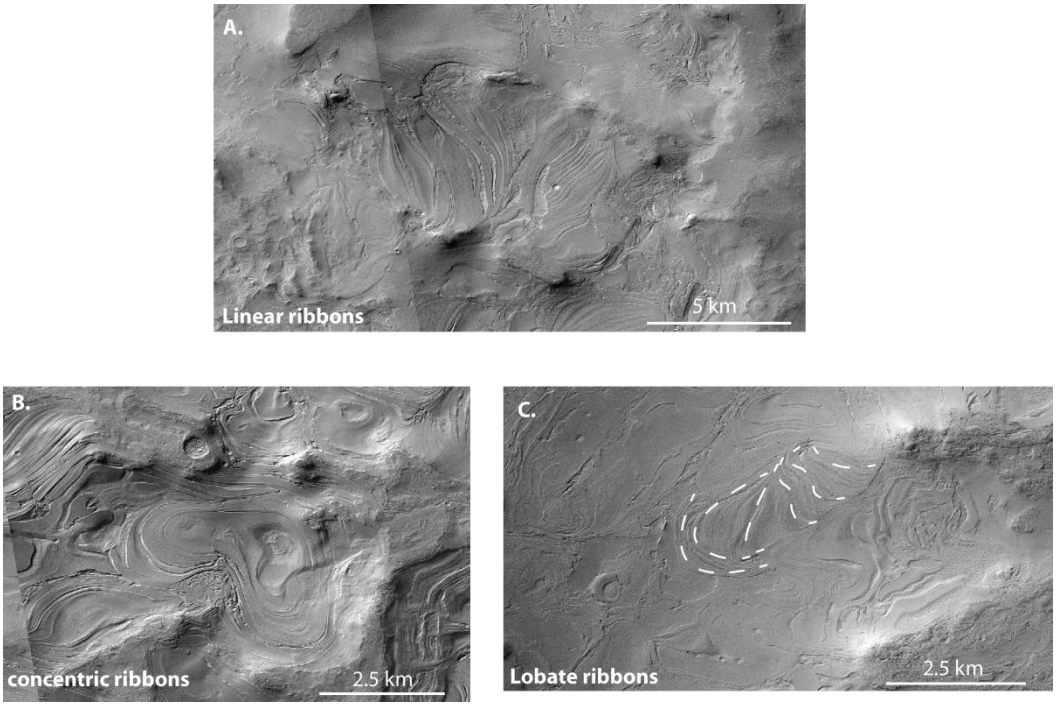


Fig. 1: The different morphologies of the banded terrain.

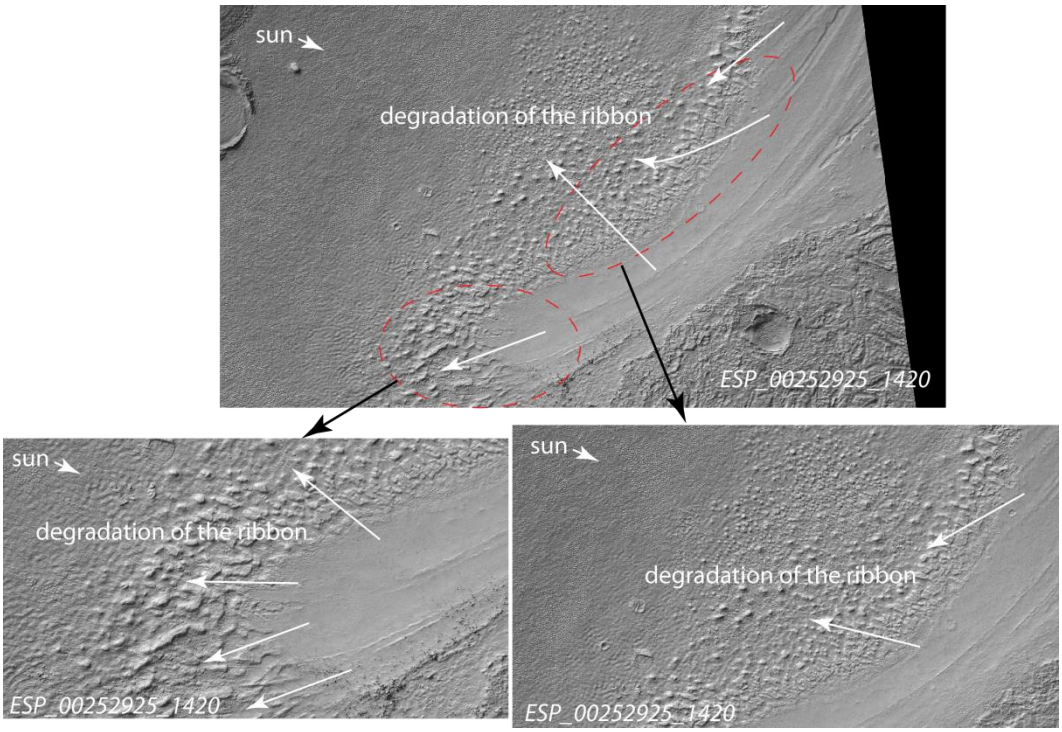


Fig. 2: Illustration of the degradation of the ribbon.

Evolution of the Mayaguana Bank (SE Bahamas) during the Neogene: Constructional windward margin *versus* erosional leeward margin

Gyöngyvér Fischer, Fabienne Godefroid, Pascal Kindler & Erika Baldessin

Section of Earth and Environmental Sciences, University of Geneva, 13 rue des Maraîchers, CH-1205 Geneva
Email: Gyongyver.Fischer@unige.ch

The petrographic study of four drill cores, in average 32 meters in length, from which two were retrieved from the north and two from the south coasts of Mayaguana Island, reveals distinct margin morphologies for this platform in Neogene times. Until the Early Pleistocene, only the northern windward margin was characterized by major reef build-ups with minor peri-reefal to peritidal carbonates, while the southern leeward margin was distinguished by backreef to lagoonal lithologies. The Middle Pleistocene eolian deposits show a patchy distribution, which is mainly restricted to the center of the island and have consequently not been recovered, or recognized, in our cores. The Late Pleistocene sediments blanket the entire platform forming its present day landscape. Reefs of this age were encountered in two cores (one from the south and one from the north coast), showing that they developed on both coasts. Thus, using Read's classification of carbonate platforms (1982), we interpret the Neogene northern margin of the Mayaguana Bank as aggradational, and its southern margin as erosional.

Schlager and Ginsburg (1981) recognized accretionary, bypass and erosional margins throughout the Bahamas, with a dominance of bypass slopes, expressing the evolutionary stages of the platforms. As the platform builds up, the slope steepens and the margin evolves from a depositional to a bypass and finally to an erosional margin in its mature stage. These different margin morphologies are characterized by different sedimentary packages and evolutionary trends of the platforms. Accretionary margins show upbuilding and outbuilding of the banks resulting in thick reefal carbonate units (Read, 1982, 1985). Bypass margins are characterized by the collapse (or erosion by turbidity currents) of the upper slope of the platform edge, exposing reefs on top of a very steep escarpment (Read, 1982, 1985). Erosional margins are characterized by backreef lithologies due to the collapse of the reef crest.

Mayaguana Bank is a small (57 x 13 km) elongated carbonate platform located in the SE Bahamas between latitudes 22°15' N and 22°30' N and longitudes 12°40' W and 73°10' W. A low-elevation island covers nearly the entire platform. The margins of the bank are particularly steep on the northern and western edges rising from depths of over 2.5 km (Pierson, 1982). Peritidal carbonates ranging in age from the Early Miocene to the Holocene constitute the stratigraphic record of the island (Kindler et al., 2011; Godefroid, 2012).

The exploration of Mayaguana Island by a mining company in 2011 resulted in the recovery of fifteen drill cores, four of which concern the present study. These cores have been drilled with a CME 750X rubber-tired core drill retrieving cores of either 6.3 cm or 5 cm in diameter. From south to north, cores C-32, C-31, C-BWP and C-LB reached depths of 30.5 m below the surface (mbs), 36.6 mbs, 16.75 mbs and 44.2 mbs, respectively, with a core recovery averaging 88%. 150 thin sections have been made and analyzed with a petrographic microscope. Strontium analyses were made on whole-rock samples but individual well-preserved bioclasts are currently being processed to refine the previously obtained strontium ages. The cores have been described and correlated based on macrofacies, discontinuity surfaces, faunal assemblages, geochemical ages and petrographic studies.

Five main lithostratigraphic units have been distinguished in the cores and are summarized below, ranging from the youngest to the oldest:

- **Unit 1:** Pedogenised, soft coralgal floatstones to framestones of Late Pleistocene age recovered in cores C-32, C-31 and C-BWP reaching depths of, respectively, 12.5 mbs, 6.6 mbs and 4.1 mbs. The framestones are dominated by *Montastrea annularis* in the south and *Acropora palmata* in the north.
- **Unit 2:** Hard pedogenised rudstones to floatstones present in the southern cores down to 17 mbs and 16.5 mbs. This unit is dolomitized in the southernmost core, C-32, and corresponds to a heavily altered pedogenised limestone with thick calcite veins in C-31. $^{87}Sr/^{86}Sr$ ratios yield Early Pleistocene ages between ~1.31 Ma and ~1.61 Ma. The coral assemblage is dominated by poorly preserved, undetermined, branching corals, but *Porites porites* and *M. annularis* are also present.
- **Unit 3:** Porcelain-white, laminated dolomicrite forms the uppermost 20 cm of the northernmost core, C-LB, and is present in many karstic cavities throughout all four cores. This unit has been described in outcrops and dated from the Late Miocene, between ~5.59 Ma and ~6.81 Ma (Godefroid, 2012).
- **Unit 4:** Marble-hard, altered, locally dolomitized, foraminiferal packstones to coralgal floatstones, reach down, from south to north, to 30.5 mbs, 31.4 mbs, 16.75 mbs and 32 mbs. This unit is rich in larger hyaline foraminifers (Miogypsinidae), which are particularly abundant in the northern cores, encrusting foraminifers (e.g. Acervulinidae and Rupertinidae) and contain a few porcelaneous foraminifers (e.g. *Praerhapydionina delicata*). Reefal facies dominate in the northern cores, with *Pocillopora*, *Porites porites*, *P. asteroides*, *M. cavernosa* and rare *Siderastrea*, while lagoonal lithologies dominate in the south. $^{87}Sr/^{86}Sr$ ratios give an Early Miocene age, between ~15.18 Ma and ~17.84 Ma.
- **Unit 5:** Dolomitized mollusc floatstones, containing a few coral molds, to pedogenised foraminiferal packstones, in the south, are mainly dominated by porcelaneous foraminifers (e.g. *Archaias*, *Soritidae*, *Amphisorus* and *Praerhapydionina delicata*). The same foraminiferal assemblage is observed in C-LB associated with coralgal rudstones to floatstones. This unit is missing in C-BWP and has not been recognized, or reached, in C-32. Unit 5 is present between 30.5 and 36.6 mbs in core C-31 and between 32.0 and 44.2 mbs in core C-LB. $^{87}Sr/^{86}Sr$ ratios from the bottom of C-LB yield a Burdigalian-Aquitanian age, between ~20.79 Ma and ~21.30 Ma. Strontium-isotope data from the bottom of core C-31 gave a Pliocene age of ~2.63 Ma. This could be due to the heavy alteration of the rock or could also be the result of a karst infill.

Our results show that, in the Neogene, the northern lithologies were dominated by reefal to peri-reefal deposits rich in Miogypsinidae, characteristic of high-energy forereef to reef environments, while the southern cores recovered mainly backreef lithologies dominated by porcelaneous foraminifers, diagnostic of low-energy lagoonal environments. The Quaternary-Neogene boundary is reached, from south to north, at depths of 17 mbs. 16.5 mbs and 4.1 mbs and is exposed along the north coast between present-day sea level and +4 m, defining the gently southward-dipping ramp profile of the platform. The Late Pleistocene reefs developed on both margins of the Mayaguana Platform, while skeletal sands filled the inner platform lagoon forming the present-day, flat-topped morphology of the island. Thus, we suggest that the northern windward margin of the Mayaguana Bank was aggradational during the Neogene, while the southern leeward margin was mainly erosional.

This research is supported by the Swiss National Science Foundation (grant n^{o} 200020-124608).

REFERENCES

Godefroid, F. (2012) Géologie de Mayaguana, SE de l'archipel des Bahamas. *Terre et Environnement*, 108, 230 pp.

Kindler, P., Godefroid, F., Chiaradia, M., Ehlert, C., Eisenhauer, A., Frank, M., Hasler, C.-A., and Samankassou, E. (2011) Discovery of Miocene to early Pleistocene deposits on Mayaguana, Bahamas: evidence for recent active tectonism on the North American margin. *Geology*, 39, 523-526.

Pierson, B.J. (1982) Cyclic sedimentation, limestone diagenesis and dolomitisation in upper Cenozoic carbonates of the southeastern Bahamas. *Unpublished PhD thesis*, University of Miami, Florida, USA: p. 286.

Read, J.F. (1982) Carbonate platforms of passive (extensional) continental margins: types, characteristics and evolution. In: A.L. Hales (Editor), Geodynamics Final Symposium. *Tectonophysics*, 81, 195-212.

Read, J.F. (1985) Carbonate platform facies models. *American Association of Petroleum Geologists Bulletin*, 69, 1-21.

Schlager, W. and Ginsburg, R.N. (1981) Bahama carbonate platforms – the deep and the past. In: M. B. Cita and W. B. F. Ryan (Editors), Carbonate platforms of the passive-type continental margins, present and past. *Marine Geology*, 44, 1-24.

Putting rockslide events into an environmental context: The search for the dust layer of the Flims rockslide, Graubünden, Switzerland

Adrian Gilli

Geological Institute, ETH Zurich, Zurich, Switzerland

Rockslides are the result of gravitational collapses of mountain flanks posing a major natural hazard in the alpine realm. Therefore, it is crucial to know the temporal occurrence of this natural hazard in order to understand the trigger mechanism. In the last decade, there was a great effort in dating numerous rockslides using different techniques. The two most common approaches are radiocarbon dating of organic material found below, within or atop the rockslide deposit and surface exposure dating of rockslide bolder or the sliding surface.

In case of the Flims rockslide, which was the largest one in the Alps, several newer dating approaches were conducted. Poschinger and Haas (1997) used tree trunks found within the rockslide deposit for dating, Deplazes et al. (2007) dated the oldest sediments in lakes on top of the rockslide and Ivy-Ochs et al. (2009) did exposure dating. All of them revealed an early Holocene age of 9.4 ka revising the classical view that the age of the Flims rockslide is Late Glacial.

However, dating rockslides is one thing, but understanding the environmental conditions leading to the rockslide occurrence is another important issue, which is often neglected. It would be extremely interesting to investigate paleoenvironmental archives like lakes or peat bogs in the close vicinity of rockslides, where the rockslide event can be directly linked to the environmental record by the occurrence of its dust layer. Only in this way it would be possible to link unequivocal the rockslide event with a environmental record und understand the preconditions for the occurrence of a slope instability.

For the Flims rockslide, there were attempts to find its dust layer in small lakes (Augenstein, 2007; Grischott, 2010). Augenstein claimed to have identified remnants of the dust layer in Lake Dachli/Obersaxen, although the sedimentological evidence is not particularly convincing. Now, several peat bogs and ponds in the close vicinity of rockslide area of Flims were cored in order to find clear evidence for the presence of a dust layer. Currently, several layers have been identified as potential dust layers, which will be closer investigated to confirm an atmospheric origin of these sedimentary features. Combined with radiocarbon dating below and above the dust layer, an unequivocal link to the rockslide event should be possible.

REFERENCES

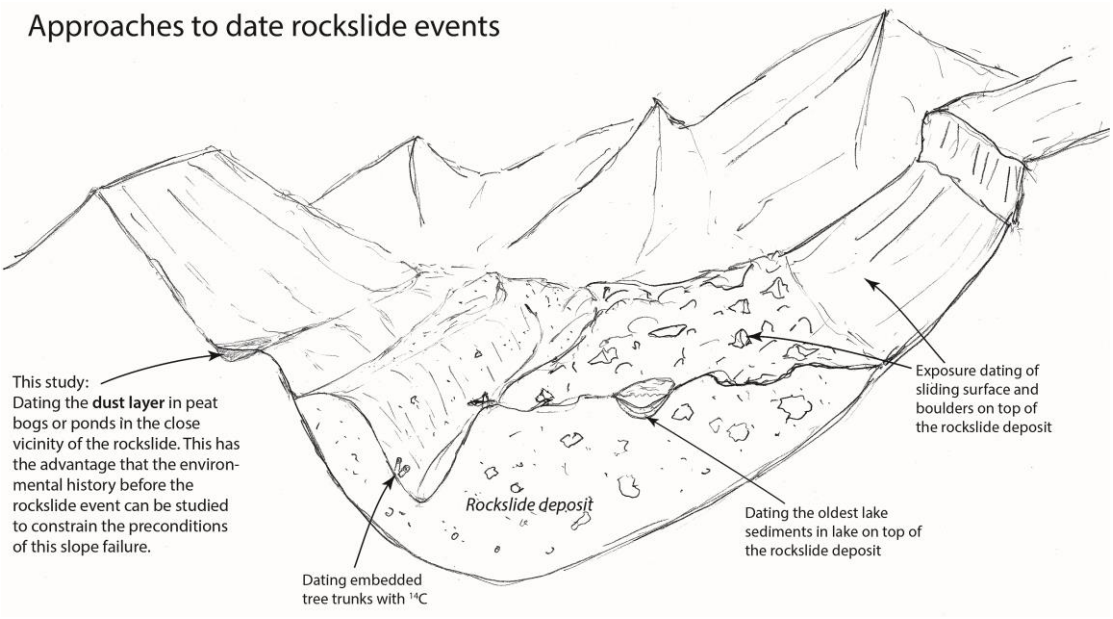
Augenstein, C., 2007, Spuren des Flimser Bergsturzes im Dachlisee (Obersaxen), Jber. Natf. Ges. Graubünden, 114, 43-57.

Deplazes, G., Anselmetti, F.S. and Hajdas, I., 2007, Lake sediments deposited on the Flims rockslide mass: the key to date the largest mass movement in the Alps. Terra Nova, 19, 252–258.

Grischott, R., 2010, Environmental history of Lake Canova, unpubl. Masterthesis, Dept. Earth Sciences, ETH Zurich.

Ivy-Ochs, S., Poschinger, A.v., Synal, H.-A., and Maisch, M., 2007, Surface exposure dating of the Flims landslide, Graubünden, Switzerland, Geomorphology, 103(1), 104-112.

Poschinger, A.v. and Haas, U., 1997, Der Flimser Bergsturz, doch ein warmzeitliches Ereignis? Bull. Angew. Geol., 2, 35–46.


Approaches to date rockslide events
This study:
Dating the **dust layer** in peat bogs or ponds in the close vicinity of the rockslide. This has the advantage that the environmental history before the rockslide event can be studied to constrain the preconditions of this slope failure.
Rockslide deposit
Dating embedded tree trunks with ^{14}C
Dating the oldest lake sediments in lake on top of the rockslide deposit
Exposure dating of sliding surface and boulders on top of the rockslide deposit

Defining controlling factors on microbial-induced and physico-chemical precipitation of Mg carbonates: A large-scale laboratory experiment

H. Hamaekers[1,2], A. Foubert[2], W. De Muynck,[3], J. Soete[1], E. Bauters[4], N. Boon[3] & R. Swennen[1]

[1]Department of Earth and Environmental Sciences, KU Leuven, Celestijnenlaan 200E, 3001 Heverlee, Belgium
Email: helen.hamaekers@ees.kuleuven.be
[2]Department of Geosciences, University of Fribourg, Chemin du musée 6, 1700 Fribourg, Switzerland
Email: helen.hamaekers@unifr.ch
[3]LabMET, Ghent University, Coupure Links 653, 9000 Ghent, Belgium
[4]FLAMAC, Technologiepark 903, 9052 Zwijnaarde, Belgium

Carbonate rocks are an important component of the earth's surface. Although the formation processes of most of these rocks are well known, there is still a lot of debate concerning the origin of dolomite ($CaMg(CO_3)_2$). The last decades, much research has been carried out to reveal the influence of bacteria on the precipitation of dolomite (Vasconcelos et al., 1995; Sánchez-Román et al., 2009, 2011; Bontognali et al., 2008, 2010, 2012).

This research project focuses on the microbial induced precipitation of Mg carbonates in a monitored laboratory environment. A large-scale experiment (250 samples) under aerobic conditions was set up to unravel the impact of the Ca/Mg ratio of the fluidum, urea ($CO(NH_2)_2$) concentrations and incubation temperatures. The impact of the drying temperature on the precipitates has been verified after cessation of the microbial activity through removal of the urea. The pH was measured at the start, after one day and at the end of the incubation period. A strain of *Bacillus sphaericus* was used because it has a high urease activity, which increases the amount of Mg-carbonate precipitation in a short time period (De Muynck et al. 2010). The precipitates have been analysed with (Environmental) Scanning Electron Microscopy (ESEM), X-Ray Diffraction (XRD) and micro-Computed Tomography (µCT). Raman spectroscopy will be envisaged to characterize further the crystalline and amorphous phases. ESEM and SEM images show the presence of spheres, comprising a large variety of shapes (half – full – flower-like) and of sizes (10 – 100 µm) (see Fig. 1B), dumbbells, needle crystals and rosettes (see resp. Fig.1 A, C ,D). Point analyses at the surface of some of these structures reveal a Ca:Mg ratio (1:1) which is typical for dolomite, however, other ratios (e.g. 2:1) were also encountered, implying the importance of other Ca-Mg carbonates. Therefore, XRD measurements were carried out on all samples (with Cu-Kα radiation, 5-70 2θ, stepsize 0.02° and a scan speed of 2s counting time per step) and the obtained diffraction patterns were analysed with DIFFRAC^{plus} EVA software (Bruker AXS) and quantified by the Rietveld method, with JEdit (TOPAS® Academic (TA) Software, Coelho Software). The main mineralogical components are dolomite, nesquehonite, chlorartinite, hydromagnesite, dypingite, monohydrocalcite, calcite, aragonite and vaterite. The 250 samples could be divided into 10 groups with matching diffractograms and consequently similar mineralogies. The groups which do contain only minor quantities of dolomite (2% or less), hold a higher amount (up to 50%) of nesquehonite ($Mg(HCO_3)(OH)•2(H_2O)$). However, when higher quantities (± 20%) of dolomite are present, nesquehonite is absent and the amount of hydromagnesite ($Mg_5(CO_3)4(OH)_2•4(H_2O)$) has increased to ± 15%.

3D µCT reconstructions confirm the presence of dolomite as sphaerical structures (see Fig. 2 A, B). The density range for dolomite was defined by simultanously scanning dolomite standards (GBW 7114 and JDo). The next step would be to mark similar zones for other Ca-Mg rich minerals, to visualize the interactions and characteristics of the different mineralogical phases.

REFERENCES

Bontognali, T., Vasconcelos, C., Warthmann, R., Dupraz, C., Bernasconi, S., McKenzie, J., 2008. Microbes produce nanobacteria-like structures, avoiding cell entombment. ***Geology,*** **36**, 663 – 666.

Bontognali, T., Vasconcelos, C., Warthmann, R., Bernasconi, S., Dupraz, C., Strohmenger, C., McKenzie, J., 2010. Dolomite formation within microbial mats in the coastal sabkha of Abu Dhabi (United Arab Emirates). *Sedimentology*, **57**, 824 – 844.

Bontognali, T., Vasconcelos, C., Warthmann, R., Lundberg, R., McKenzie, J., 2012. Dolomite-mediating bacterium isolated from the sabkha of Abu Dhabi (UAE). *Terra Nova*, **24**, 248 – 254.

De Muynck, W., Verbeken, K., De Belie, N., Verstraete, W., 2010. Influence of urea and calcium dosage on the effectiveness of bacterially induced carbonate precipitation on limestone. *Ecological Engineering*, **36**, 99 – 111.

Sánchez-Román, M., Mc.Kenzie, J., de Luca Rebello Wagener, A., Rivadeneyra, M., Vasconcelos, C., 2009. Presence of sulfate does not inhibit low-temperature dolomite precipitation. *Earth and Planetary Science Letters*, **285**, 131 – 139.

Sánchez-Román, M., Romanek, C., Fernández-Remolar, D., Sánchez-Navas, A., McKenzie, J., Amils Pibernat, R., Vasconcelos, C., 2011. *Chemical Geology*, **281**, 143 – 150.

Vasconcelos, C., McKenzie, J., Bernasconi, S., Grujic, D., Tien, A., 1995. Microbial mediation as a possible mechanism for natural dolomite formation at low temperatures. *Nature*, **377**, 220 – 222.

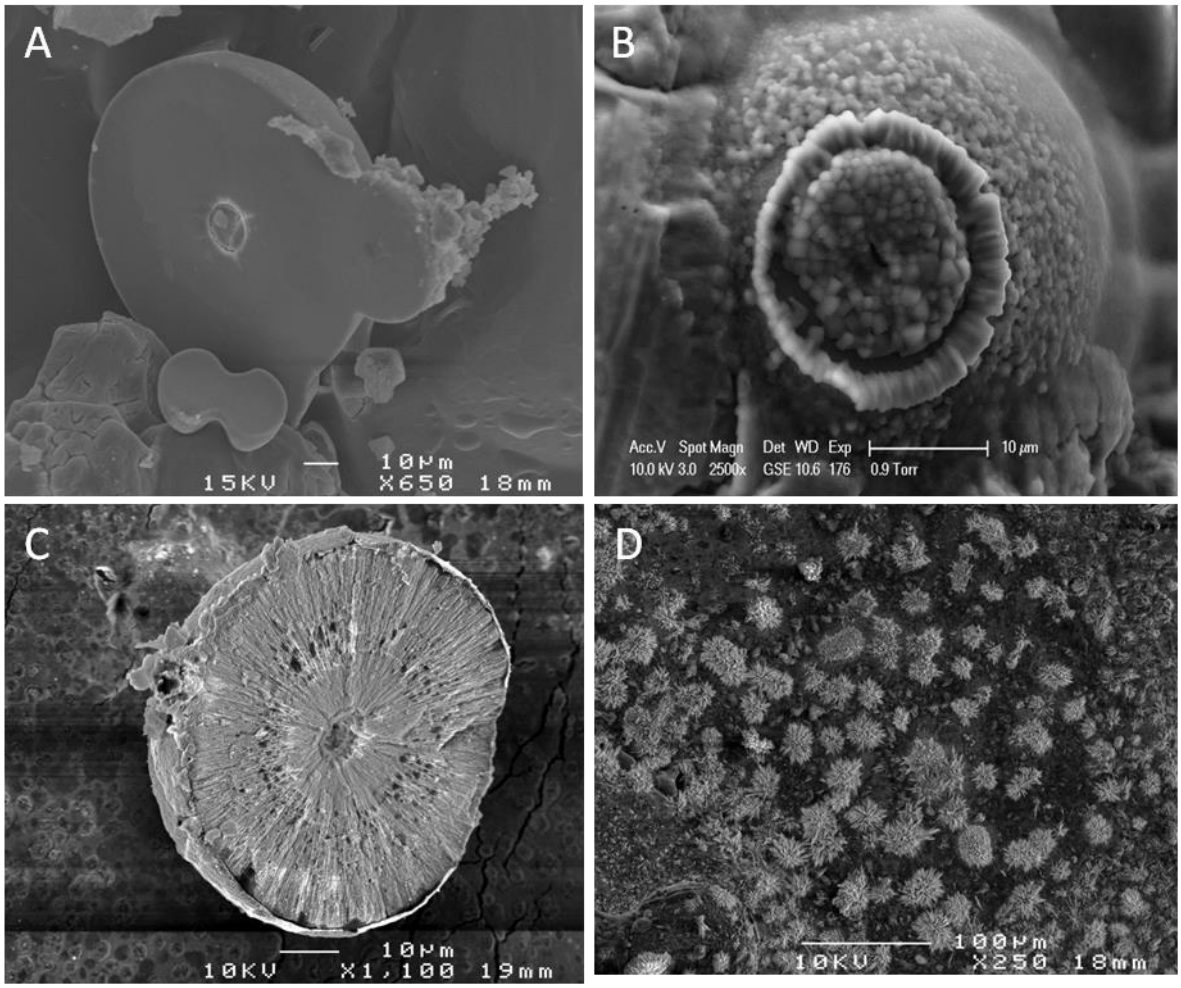


Fig. 1: Different morphologies of Mg-carbonate precipitates. (A) Half spheres and dumbbells, (B) Full sphere composed of small crystals. (C) Half sphere composed of needles, in several concentric circles. (D) Rosette morphology.

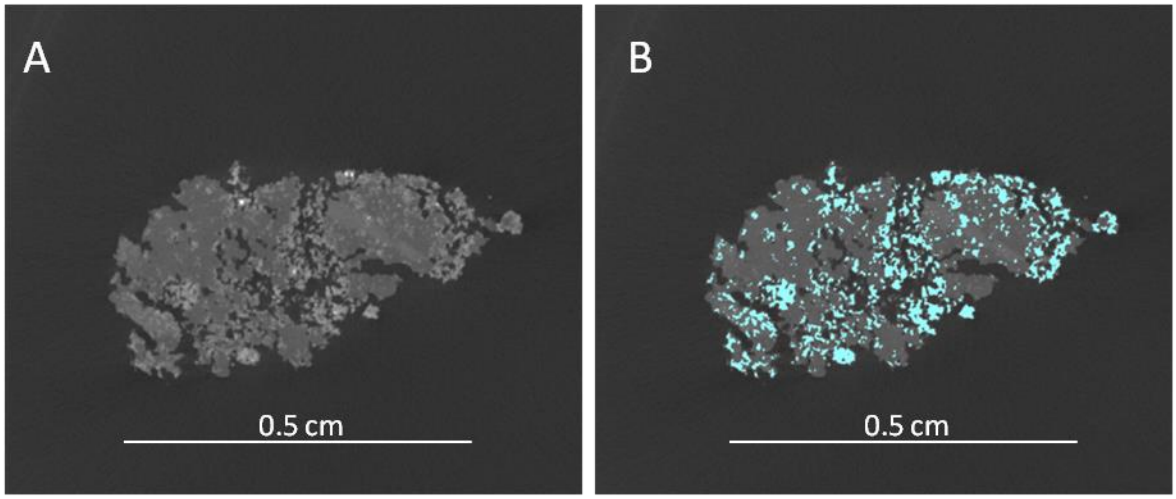


Fig. 2: 3D visualization of dolomite. (A) Original sample, (B) Original sample with density range of dolomite indicated in blue.

Pleistocene coralgal- and microbial reef deposits in the Danakil Depression (Afar, Ethiopia): Preliminary results from a first reconnaissance survey

D. Jaramillo-Vogel[1], A. Foubert[1], B. Atnafu[2], T. Kidane[2] & J.-P. Henriet[3]

[1]Department of Geosciences, University of Fribourg, Ch. Du Musée 6, 1700 Fribourg
[2]School of Earth Sciences, Addis Ababa University, Ethiopia
[3]Renard Centre of Marine Geology, Ghent University, Krijgslaan 281, S8, B-9000 Ghent, Belgium

The Danakil Depression, situated in the northern part of the Afar tectonic triple junction (up to 120 m below sea level), was connected to the Red Sea during the Middle and Late Pleistocene. Episodes of marine flooding and desiccation led to the deposition of diverse reefal carbonates, ranging from open marine coralgal reefs to hypersaline microbial reefs deposited in lacustrine environments. During a first field campaign in October 2013 a detailed sedimentological and stratigraphic study was performed on six marine and two lacustrine localities on the western and southern side of the Danakil Depression. Samples of specific intervals were collected in order to date carbonate units and to characterize sedimentary facies.

The studied marine deposits consist of at least three superimposed coralgal units evidencing successive episodes of fringing reef formation around the Danakil depression (geographic extension of approximate 190 km x 70 km). These coralgal units are separated by erosional unconformities suggesting long episodes of non-deposition and/or subaerial exposure. Monospecific bivalve- and gastropod shell accumulations occur between the coralgal units, evidencing alternating periods of restricted and open marine conditions. The carbonate succession is overlain by extensive evaporite deposits. For earlier studies $^{230}Th/^{234}U$ and ^{14}C datings have been performed on corals and bivalves, suggesting ages between 230 kyr and 32 kyr (Lalou et al. 1970; Bonatti et al. 1971). In these studies, however, no detailed stratigraphic context was presented making it impossible to differentiate between single coralgal units and their relation to eustatic sea-level changes. Moreover, older units have been probably undersampled due to scarceness and/or poor preservation of corals. Our observations confirm that younger units are dominated by corals, while older units are more lithified and dominated by red algae.

Microbial reefs are found in (1) coralgal reef cavities, (2) as small stromatolites in reef slope environments and in (3) hypersaline lakes commonly associated to hydrothermal springs. The study of these well exposed microbial deposits will allow the better understanding of processes leading to microbial mediated carbonate precipitation in diverse marine and continental settings.

The primary goal of this long-term project is to establish a well-constrained stratigraphic framework supported by radiometric datings. This framework will form the base for detailed sedimentological, palaeoecological and biogeochemical studies of these exceptionally well exposed deposits, and so the thorough understanding of the flooding history, the timing of final closure of the connection to the Red Sea, and the development of microbial carbonates in open and closed systems.

REFERENCES

Enrico Bonatti, Cesare Emiliani, Göte Ostlund & Harold Rydell (1971). Final Desiccation of the Afar Rift, Ethiopia**.** *Science* **172**, 468-469.

Claude Lalou, Huu Van Nguyen, Huggues Faure & Lycia Moreira (1970). Datation par la méthode uranium-thorium des hauts niveaux de coraux de la dépression de l'Afar (Éthiopie). Revue de géographie physique et de géologie dynamique (2), **12**, fasc. 1. 3-8.

Permeable shell beds in the Upper Muschelkalk of the Swiss Plateau (Mittelland) – Is a geothermal use possible?

L. Kiefer

In the deep underground of the Swiss Plateau (Mittelland) one of the most promising horizons for deep geothermal energy is the Upper Muschelkalk because this unit is often porous and jointed can be found in exploitable depths. Furthermore, permeable formations could be suited for CO_2 sequestration.

Due to the inhomogeneous character and thickness of the Upper Muschelkalk in the Swiss Plat- eau, detailed information and descriptions from existing deep boreholes are essential.

This master thesis contributes to our understanding of the spread and the characteristics of per- meable zones and facies in the Muschelkalk unit.

Core sections and cuttings of the boreholes Pfaffnau (LU), Schafisheim (AG) and Triemli (ZH) were described in detail with particular focus on porosity properties. To draw a comparison to the for- mations from further north, in a shallower depth, a drill core from Bözberg (AG) was consulted. The pore characterisations as well as the diagenesis reconstruction were conducted by means of different microscopy techniques (reflected light, transmitted light, fluorescence, ESEM) and addi- tionally, cathodoluminescence measurements were realized. Serving as a formation specific corre- lation tool, sulfur isotope values were measured.

Another aspect of this thesis was to evaluate the potential of cutting analysis focused on different facies and associated porosity.

Tempestites (‘Schill- und Trochitenbänke’) are often highly permeable and were therefore de- scribed in great detail and correlated over the different locations. However are such units seldom or not existing, e.g. in Triemli, or moldic pores are secondarily cemented with mainly anhydrite, like this thesis showed.

It was determined that higher porosity and permeability values often are connected to dissolved anhydrite nodules. It was found out during this thesis that in the underground of the southern Swiss Plateau no dissolved anhydrite nodules can be expected; only in parts which were uplifted in the course of the folding of the Jura Mountains or in areas with local fault zones.

In Pfaffnau, Schafisheim and Triemli intercrystalline pores (generated through dolomitisation) dom- inate followed by secondary moldic pores. The highest porosity and permeability values are reached in sections with oomoldic pores, mostly above the base of the ‘Lettenkohle’. These layers are correlatable.

The upper Muschelkalk formation can be described as rather tight; however a basic porosity is existent. An expansion of this pore space would enable the use of the unit for geothermal energy and CO_2 sequestration.

The Pockmarks of Lake Neuchâtel: Sedimentological and geochemical studies on crater-shaped morphologic depressions on the lake floor of Lake Neuchâtel

Markus Loher[1], Anna Reusch[1], Marvin Lilley[2], Stefano M. Bernasconi[1]& Michael Strasser[1]

[1]Geological Institute, ETH Zürich
[2]University of Washington, USA

We present unprecedented insight into three pockmarks, discovered during a multibeam bathymetric survey of Lake Neuchâtel (Western Switzerland) in 2012. High resolution seismic data from the pockmarks show distinct seismic reflections interrupting the background sedimentation. These signals are interpreted as overflow deposits, documenting phases of active fluid flow from inside the pockmarks, causing sediment to be spilled over the rims and deposited on the outside of the craters.

A detailed sedimentological description of Kullenberg type long cores and gravity short cores aims at a characterisation of the pockmarks in terms of sedimentary composition and activity phases. Geochemical analyses of sedimentary pore fluids are being carried out to investigate the presence and isotopic signal of fluids (methane and / or water) escaping through the pockmarks.

In the marine environment where pockmarks have been studied in great detail, it has been found that they are often the surface expression of focussed fluid flow. However, due to the fact that most pockmarks are not active today this paradigm stands yet to be more thoroughly verified (Hovland & Judd, 2007; Paull et al., 2002). The main motivation to carry out this study is to gain knowledge of the processes governing the activity of the craters in order to understand the relations between the overflow events and their potential triggers in the past and present.

The pockmark named Chez-le-Bart (diameter ≈ 160 m, depth ≈ 10 m), is partially filled with unconsolidated calcareous mud which produces a yet enigmatic high impedance reflection layer in seismic images. It is believed that this strongly fluidised sediment results from actively outflowing fluid. In addition, the Chez-le-Bart crater as well as a second crater (Treytel: diameter ≈ 100 m, depth ≈ 4 m) show seismic evidence of activity in the form of sediment expulsion several times during their evolutionary past. A third pockmark (La Lance: diameter ≈ 95 m, depth ≈ 13 m) seems to be associated with a tectonic fault zone and the evidence of sediment expulsion is less clear.

This work is part of project DYNAMITE funded by the Swiss National Science Foundation (Project number: PP00P2-133481), which among other aims, investigates seismically induced geohazards such as tremors, landslides and tsunamis in the Swiss Molasse Basin.

REFERENCES

Hovland, M., & Judd, A. G. (2007). Seabed fluid flow. The impact on geology, biology and marine environment. 475.

Paull, C., Ussler, W., Maher, N., Greene, H. G., Rehder, G., Lorenson, T., & Lee, H. (2002). Pockmarks off Big Sur, California. *Marine Geology, 181*(4), 323-335. doi: 10.1016/S0025-3227(01)00247-X

Detailed analysis of Middle Pleistocene ostracod assemblages from Lake Trasimeno, Perugia, (Italy)

Marta Marchegiano[1], Elsa Gliozzi[2], Nicoletta Buratti[3], Daniel Ariztegui[1] & Simonetta Cirilli[3]

[1]Earth & Environmental Sciences, University of Geneva, 13 rue de Maraîchers, 1205 Geneva, Switzerland
Email: marta.marchegiano@unige.ch, daniel.ariztegui@unige.ch
[2]Department of Science, University Roma Tre, Largo S. Leonardo Murialdo, 1, 00146 Roma, Italy
Email: elsa.gliozzi@uniroma3.it
[3]Department of Geological Sciences, University of Perugia, Piazza Università 1, 06100 Perugia, Italy
Email: stradott@unipg.it, simocir@unipg.it

Lake Trasimeno is a meso-eutrophic, shallow (<6 m deep) and large lake (~120km^2) located in central Italy, at 259 m above sea level. As it is common in shallow-water ecosystems, climate change plays a fundamental role in the Lake Trasimeno evolution and its history is signed by a strong dependence of the water balance on meteorological conditions (Dragoni, 2004; Ludovisi & Gaino, 2010). Recent geophysical data reveals that the Lake Trasimeno evolution was accompanied by a constant subsidence rate driven by normal faults. The extensional tectonic regime does not show substantial changes since the lake formation and it is probably responsible for its long-term preservation against sediment infill (Gasperini et al., 2010).

A 175 m long sedimentary core was retrieved by the Geological Survey of the Umbria Region along the present southern shore of the lake (north of the Panicarola town). A multidisciplinary study of the core (i.e. palynology, paleontology, geochemical analyses, magnetic susceptibility, paleomagnetism) is now in progress and a preliminary age model based on pollen data suggests that the record may be as old as Middle Pleistocene. The investigation of the first 30 meters of the Panicarola core revealed its great potential as archive of palaeoclimatic/palaeoenvironmental changes in the region.

The present work focussed on the palaeoenvironmental and palaeoclimatic reconstruction of the topmost 30 m of the sediment core based on ostracods. As it is known, ostracod assemblages in lacustrine sediments represent a main tool for palaeoenvironmental reconstructions (von Grafenstein, 2002; Decrouy et al., 2012).

A total of 245 samples have been taken at a 13 cm sampling interval. The first presence of ostracods was recorded at 13 m, but the specimens are badly preserved until15 m in the core. In the subsequent metres, ostracods are constantly present, generally represented by mature communities composed of adults and instars.

On the whole, 13 species referable to 10 genera were collected (*Ilyocypris gibba, Candona neglecta, Candona angulata, Cypridopsis vidua, Heterocypris salina*, *Limnocythere* sp.1, *Limnocythere stationis, Darwinula stevensoni, Cyprideis* sp., *Leptocythere* spp., *Fabaeformiscandona fabaeformis, Cyclocypris ovum*). Abrupt changes in the abundance of the assemblages were found along the studied core alternating sections with very abundant ostracod remains with others with scant (or even null) individuals. Moreover, some changes in the composition of the ostracod assemblages have been detected, which are interpreted as recording environmental variations. In particular, two intervals are significant for the palaeoenvironmental reconstruction of the sedimentary successions: 1) the section from 25.60 m to 23.50 m is characterized by a rich ostracod fauna (dominated by *Cyprideis* sp., *Candona angulata* and *Leptocythere* spp.). These assemblages possibly indicate an increase in salinity or alkalinity of the waterbody; 2) the interval from 21.05 m to 17.60 m contains *Ilyocypris gibba, Candona neglecta, Cypridopsis vidua, Heterocypris salina, Limnocythere* sp. 1, *Limnocythere stationis* and *Darwinula stevensoni*. *Limnocythere stationis* is a central

European species, until now signalled only in Italy in the Panicarola core (this study) and in the Holocene of Sicily (Curry et al., 2013) probably suggesting a period of cool waters. Further ostracod identifications as well as geochemical analyses on their valves will provide a more detailed reconstruction of the timing and magnitude of palaeoclimate changes in the Lake Trasimeno area.

REFERENCES

Curry, B., Mesquita-Joanes, F., Fanta, S., Sterner, D., Calò C. & Tinner W., 2013 : Two coastal sinkhole lakes in SW Sicily (Italy) reveal low-salinity excursion during Greek and Roman occupation. 17th International Symposium on Ostracoda, Rome July 23-26, 2013, Il Naturalista Siciliano, Abstract Book, 93-95.

Decrouy, L., Vennemann, T. & Ariztegui, D., 2012: Sediment penetration depths of epi- and infaunal ostracods from Lake Geneva (Switzerland). Hydrobiologia 688/1, 5-23

Dragoni W. 2004 : Il Lago Trasimeno e le Variazioni Climatiche. Progetto informativo dell'assessorato all'Ambiente della Provincia di Perugia, Servizio Gestione e Difesa Idraulica, 1-60, Perugia

Gasperini L., Barchi M.R., Bellucci L.G., Bortoluzzi G., Ligi M. & Pauselli C. 2010 : Tectonostratigraphy of Lake Trasimeno (Italy) and the geological evolution of the Northern Apennines. Tectonophysics 492, 164-174.

Ludovisi A. & Gaino E. 2010 : Meteorological and water quality changes in Lake Trasimeno (Umbria, Italy) during the last fifty years. J. Limnol. 69 (1), 174-188.

von Grafenstein, U., 2002 : Oxygen-isotope studies of ostracods from deep lakes. In Holmes, J. A. & A. R. Chivas (Eds.),The Ostracoda: Applications in Quaternary Research, AGU Geophysical Monograph, 131, 249–266

A harmonised lithostratigraphic scheme for the Geological Atlas of Switzerland 1:25 000 – preliminary synthesis.

Alain Morard[1], Stefan Strasky[1] & Swiss Committee for Stratigraphy

[1]Swiss Geological Survey, Federal Office of Topography swisstopo, Seftigenstrasse 264, 3084 Wabern
Email: alain.morard@swisstopo.ch

With the achievement of the HARMOS project (Morard et al. 2012), a revised and up-to-date lithostratigraphic scheme is now available for the Geological Atlas of Switzerland 1:25 000. A first attempt at a graphic synthesis of the results of this project is presented here at the formation level.

In order to get a synoptic view of the lithostratigraphy of Switzerland through space and time, the succession of units for the main tectonic domains is fitted within a broad chronostratigraphic frame (Series). Lateral variations, such as platform to basin transitions are represented schematically, as well as the most prominent stratigraphic gaps.

The valid units will be progressively integrated into the Lithostratigraphic Lexicon of Switzerland (www.stratigraphie.ch), together with a short description and bibliographic references.

We would like to acknowledge most gratefully the contribution of more than 40 experts to the setting up of this new landmark for geological mapping in Switzerland and are confident this harmonised lithostratigraphic scheme will prove useful and fertile for future GIS analysis and field research as well.

REFERENCES

MORARD, A., BURKHALTER, R., MÖRI, A., & STRASKY, S. 2012: Lithostratigraphy of Switzerland: options and challenges for a harmonisation, Abstract Volume 10th Swiss Geosciences Meeting, p.173. http://geoscience-meeting.scnatweb.ch/sgm2012/abstracts_2012/SGM_2012_Symposium_07.pdf

Paleoenvironmental and paleoclimatic evolution of the lower Guadalquivir Basin (SW Spain) during the Late Miocene: implications for northeastern Atlantic paleoceanography and the onset and termination of the Messinian salinity crisis

José N. Pérez-Asensio[1], Julio Aguirre[2] & Gerhard Schmiedl[3]

[1]Earth and Environmental Science Section, University of Geneva,
Rue des Maraîchers 13, 1205, Geneva, Switzerland
E-mail: Noel.PerezAsensio@unige.ch
[2]Department of Stratigraphy and Paleontology, Faculty of Science, University of Granada,
Avenida de Fuentenueva s.n., 18002 Granada, Spain
[3]Center for Earth System Research and Sustainability, University of Hamburg,
Bundesstraße 55, 20146 Hamburg, Germany

In this study, Messinian marine deposits from the Montemayor-1 core, located at the northwestern margin of the lower Guadalquivir Basin (SW Spain), have been analysed. This core ranges from the latest Tortonian (late Miocene) to the early Zanclean (early Pliocene), and includes a sedimentary record of the coetaneous deposits of the Mediterranean Messinian salinity crisis (MSC). The location of the core in the Atlantic-linked lower Guadalquivir Basin, where neither desiccation nor evaporite deposition took place during the Messinian, allows us to obtain a more precise view of the global geological processes that affected the Mediterranean before, during and after the MSC. Furthermore, the impact of the Mediterranean outflow water (MOW) on northeastern Atlantic paleoceanography was recorded due to the location of the core close to the last active Betic Atlantic-Mediterranean gateway, the Guadalhorce Corridor. The age model of the core was established combining magnetobiostratigraphy and oxygen stable isotopic stratigraphy, which allowed the identification of the Messinian glacial-interglacial cycles. The analysis of benthic foraminiferal assemblages and oxygen and carbon stable isotopes was performed to characterise the paleoenvironmental and paleoclimatic evolution of these Messinian sediments, as well as changes in paleoceanographic circulation and paleoproductivity in the NE Atlantic.

A transgressive-regressive sea-level cycle along the core is shown by changes in the benthic foraminiferal assemblages. During the latest Tortonian-earliest Messinian, the sea level sharply rose from inner-middle shelf to middle slope. Then, a sea-level drop from middle slope to inner-middle shelf is recorded during the early Messinian-early Pliocene.

The distribution of the benthic foraminifera is also controlled by the quantity and the quality of the organic matter at the sea floor, which, in turn, is affected by glacioeustatic fluctuations. The inner-middle shelf setting was eutrophic, low-oxygenated and influenced by high supply of degraded continental organic matter related to riverine discharge that is higher during interglacial periods. The outer shelf and the shelf edge were high-oxygenated oligotrophic settings. In the outer shelf, the input of organic matter was mostly associated with river run-off promoted by more humid interglacial conditions. Upper and middle slope environments were dominated by mesotrophic conditions with moderate oxygenation. In these settings, upwelling currents provided marine fresh organic matter to the sea floor. These conditions prevailed during glacial periods due to more intense upwelling promoted by strong winds. In addition, the presence of marine degraded organic matter in the upper slope after upwelling events characterise interglacial periods.

Upper Triassic reefs from Sambosan Accretionary Complex, Southwestern Japan: biostratigraphy and paleoecology

C. Peybernes[1], R. Martini[1]& J. Chablais[2]

[1]*University of Geneva, Department of Earth Sciences, Geneva CH-1205, Switzerland*
E-mail: Camille.Peybernes@unige.ch
[2]*Geneva Petroleum Consultants International, Geneva CH-1211, Switzerland*

The Upper Triassic was a time of important reef development. This development has been documented mostly in the Tethys realm. Conversely, mid oceanic reef evolution of the Panthalassa still need deeper investigation. In this contribution we aim to improve our understanding of the reef evolution of the western panthalassic domain.

In order to achieve this objective a biostratigraphical and paleoecological approach is applied to the Upper Triassic limestone of the Sambosan Accretionary Complex (SAC) in Southwestern Japan.

The Sambosan limestone consist of terrigenous-free atoll type shallow water carbonates that crop out, associated with intra oceanic seamount basalts, pelagic cherts and mudstones, in a subduction-generated accretionary complex.

First, we carried out a micropaleontological inventory of the Sambosan limestone in central and eastern Shikoku. In a second phase, quantitative analyses such as cluster analyses and point counting are being performed on reef limestone.

Cluster analyses permit hierarchical grouping of samples from different localities and allow to define different biotic associations in reef environment. In this study, they are based on presence/absence of reef components in thin sections. These analyses, associated with relative abundances data from point counting, will provide valuable information on the ecological structure of reef communities. These results would be compared with similar reef settings in others areas.

Nevertheless, such a comparison needs a better biostratigraphical frame for the Sambosan limestone. Indeed, according to former studies and our own data, reef facies of the Sambosan limestone range from Carnian to Norian/Rheatian. However the age attribution usually relies on biostratigraphically significant taxa which don't occur frequently. Cluster analysis, associated with a compilation of biostratigraphic data including taxa such as conodonts, foraminifera, sponges and corals, would lead to more accurate dating for each limestone units.

Through this integrate approach we will increase our understanding of reef environment evolution in western Panthalassa during the Upper Triassic. This evolution would be compared with coeval reef evolution in the Panthalassa domain and in the Tethys as well.

Acknowledgement: We thank Professor Hiroyoshi Sano, Professor Tetsuji Onoue and Daisuke Yamashita for their helps in the field and exciting discussion about the Sambosan Accretionary Complex.

Subaquatic landslides and fluid-expulsion features within the sedimentary archive of Lake Neuchâtel

A. Reusch[1], J. Moernaut[1,5], M. Hilbe[2], M. Loher[1], D. Bouffard[6], A.J. Wüest[6], J. Mosar[3], G. Meinecke[4], F.S. Anselmetti[2]& M. Strasser[1]

[1]Swiss Federal Institute of Technology (ETH Zürich), Geological Institute, CH-8092 Zürich
Email: Anna.Reusch@erdw.ethz.ch
[2]University of Bern, Institute of Geological Sciences and
Oeschger Centre for Climate Change Research, CH-3012 Bern
[3]University of Fribourg, Department of Geosciences, CH-1700 Fribourg
[4]Marum, Center for Marine Environmental Sciences, D-28359 Bremen
[5]Universidad Austral de Chile, Valdivia, Chile
[6]École Polytechnique Fédérale de Lausanne, Laboratoire de physique de systèmes aquatiques, CH-1015 Lausanne

Subaquatic landslide deposits are important components of the sedimentary infill of lakes. Lakes offer the possibility to study subaqueous mass-wasting phenomena, which are similar to the processes in marine environments, under more accessible and spatially confined conditions. Lake sediments are highly sensitive archives of environmental changes and geological events, such as earthquakes. Previous studies linked subaquatic landslide deposits to historic earthquakes, in the marine - as well as in the lacustrine realm (e.g. Schnellmann et al., 2002). Synchrony of multiple mass-transport deposits at different locations within a basin is the main criterion to postulate seismic triggering. Additionally, subaquatic landslide events are often accompanied by fluid-expulsion features. In this study, we investigate the event deposits in the sediments of Lake Neuchâtel, Western Switzerland. We show that sublacustrine slopes failed several times since Late Glacial times and that these multiple landslide events were partly accompanied by expulsion phases of large-scale pockmarks on the lake floor. Eventually, this project aims to investigate the potential link between sediment remobilization, fluid flow and neotectonic activity.

We present results from an extensive high-resolution reflection seismic and swath bathymetry survey - as well as newly acquired sediment-core data. Swath-bathymetry data (Kongsberg EM 2040 multibeam) provide precise high-resolution lake floor morphological data. Dense grids of high-resolution reflection seismic data (3.5 kHz pinger source) are used to image the sedimentary infill of the Lake Neuchâtel basin with decimeter-scale vertical resolution. Selected morphological features were investigated using ultra-high-resolution lake-floor surface and subsurface imaging tools (sub-bottom profiler [0.6 – 15 kHz Chirp System] and side-scan sonar) mounted on an autonomous underwater vehicle (AUV "MARUM SEAL"). Kullenberg-type sediment-core data are integrated with published sediment-core data by Schwalb et al. (1992). This allows a systematic mapping of mass-movement deposits, landslide scars and fluid-seepage structures.

Sediment cores and seismic data indicate that the sediment fill consists of sequences of interbedded lacustrine background sediment and thin turbiditic deposits, which are intercalated with mass-transport units. Seismic-stratigraphic correlation is used to determine the chronostratigraphic relations between the seismic-stratigraphic event horizons.

Our data reveal strong evidence for at least two distinct seismic-stratigraphic horizons with multiple, basin-wide subaquatic landslides in the sedimentary record of Lake Neuchâtel. These multiple landslide event-horizons are interpreted as the fingerprint of past earthquakes. Furthermore, seismic reflection and swath-bathymetry data image large pockmarks of up to 160 m in diameter and 30 m depth. Geochemical and hydrological analyses on the pockmarks are ongoing, and further analysis will hopefully reveal whether these features indicate active fluid-seepage structures, possibly related to karst features (e.g. sublacustrine karst springs)

and/or migration pathways along possibly active fault zones. The levees of these pockmarks are characterized by several distinct overflow deposits, clearly showing multiple phases of outflow events at discrete periods in the past. The reflection seismic data (3.5 kHz pinger data) show that at least one of the multiple landslide horizons correlates with outflow-events of several large-scale pockmarks, suggesting that the overflow deposits were emplaced immediately after the deposition of the landslides or within a very short time period. Correlation between the different event deposits within the reflection seismic data and the sediment core data is ongoing.

A causal link between multiple landsliding and fluid-expulsion activity, likely triggered by past earthquakes, is hypothesized. Future investigations, which include dating of the event horizons for correlation with independent paleoseismological archives, will reveal whether the observed event horizons relate to past seismic activity.

This project is financed by the Swiss National Foundation (Project Nr.: PP00P2-133481)

REFERENCES

Schnellmann, M., Anselmetti, F. S., Giardini, D., McKenzie, J., and Ward, S., 2002, Prehistoric earthquake history revealed by lacustrine slump deposits: Geology 30, 12, 1131-1134.

Schwalb, A., 1992, Die Sedimente des Lac de Neuchâtel (Schweiz): Rekonstruktion spät- und postglazialer Klima- und Umweltveränderungen: Université de Neuchâtel, Suisse.

Cold-water coral reef health in a changing World

Andres Rüggeberg[1,2,3], Sascha Flögel[1] & Wolf-Christian Dullo[1]

[1]GEOMAR Helmholtz Centre for Ocean Research Kiel, Wischhofstr. 1-3, D-24148 Kiel, Germany
[2]Renard Centre of Marine Geology, Dept. of Geology and Soil Science, Ghent University, Krijgslaan 281, S8, B-9000 Gent, Belgium
[3]Present address: Dept. of Geosciences, University of Fribourg, Chemin du Musée 6, CH-1700 Fribourg, Switzerland, Email: andres.rueggeberg@unifr.ch

Cold-water coral communities cover a wide range of possible habitats in terms of latitude, ocean basins, and depth. On-going studies and exploration are discovering additional occurrences in various regions of the global ocean. Their possibility to create large reef structure shows their potential to contribute to the sedimentary record along the continental slope. However, to identify and interpret such sediments is difficult without knowledge on their recent distribution and development. In some areas, scleractinian corals form elongated reef-like structures some kilometres in length, e.g. off Norway (Mortensen et al., 1995) or they occur in patches on elevated bathymetric structures such as mounds of smaller dimensions (Mortensen et al. 2001) or sills (Freiwald et al., 1997; Rüggeberg et al., 2011). South of the Bay of Biscay, living CWCs decrease in number. There, the CWCs seemed to flourish during glacial times (e.g., Wienberg et al., 2009).

However, most of the morphology forming and living CWC frameworks of several tenths to several hundred meters height and with a large areal extent that form large biogenic structures on the sea floor seem to be restricted to the NE Atlantic margin. Obviously, distinct water mass characteristics on various scales, from small scale mixing processes to basin wide properties, in concert with nutrient supply seem to be a major controlling factor with respect to reef formation by *Lophelia pertusa* (e.g., Freiwald, 2002; Dullo et al., 2008). Only few studies made an attempt to characterize the hydro–biogeochemical and –physical constraints of cold-water coral reefs and to differentiate between pristine reef growths versus sites with reduced or no coral occurrences. Here, we concentrate on a compilation of new and existing data of physical and chemical properties in the NE Atlantic and the Mediterranean and explore the influence of ambient bottom waters and its characteristics on living cold-water reefs and mounds formed by *Lophelia pertusa*.

The following questions are addressed:

(1) What are the physical and geochemical boundary conditions of living cold-water corals?
(2) Do these geochemical parameters correlate with proposed physical prerequisites?
(3) Is there a general difference in the signature of living and dead coral sites?
(4) What is the future implication for CWC with changing controlling parameters such as temperature, salinity, density, dissolved inorganic carbon, pH, and total alkalinity?

REFERENCES

Dullo et al., 2008. Marine Ecology Progress Series 371:165–176.
Freiwald, 2002. In: Wefer et al. (Eds.), Ocean Margin Systems, Springer Verlag, Berlin, 365–385.
Freiwald et al., 1997. In: James & Clarke (Eds.), Cool-Water Carbonates, SEPM Spec. Publ. 56:141–162.
Mortensen et al. 2001. Journal of the Marine Biological Association of the UK 81:581–597.
Rüggeberg et al., 2011. Marine Geology 282:5–12.
Wienberg et al., 2009. Deep-Sea Research I 56:1873–1893.

The supercritical deposits of Favignana (Pleistocene of Sicily, Italy)

A. Slootman[1]& M.J.B. Cartigny[2]
[1]Earth and Environmental Sciences, University of Geneva,
Rue des Maraichers 13, CH-1205, Geneva, Switzerland
Email: Arnoud.Slootman@unige.ch
[2]National Oceanography Centre, European Way, SO14 3ZH, Southampton, Hampshire, United Kingdom

The most important property of a subaqueous, high-energy sediment gravity flow, such as a turbidity current, is described by the dimensionless Froude number (Fr'), which measures the ratio between inertia and gravitational forces:

$Fr' = U/\sqrt{g'h}$ where U is the flow velocity, h the flow thickness and g' the reduced gravity, with

$g' = g\left(\frac{\rho_{mix}-\rho}{\rho_{mix}}\right)$ where ρ_{mix} is the density of the flow, ρ the density of the ambient water and g the acceleration of gravity.

When gravitational forces dominate (Fr'<1), the flow is called subcritical. Contrastingly, when dominated by inertia the flow is said to be supercritical (Fr'>1). The most familiar bedforms such as ripples, dunes, and lower and upper plane beds are generated under subcritical conditions. Here, we explore the supercritical domain of the bedform stability diagram in analysing the sedimentary structures observed in the Pleistocene Favignana Calcarenite ramp deposits of Sicily, Italy. Inferred bedforms include antidunes, chute-and-pools, cyclic steps and transitional morphologies.

Over the past few years, supercritical flow conditions are increasingly invoked to explain bedforms and sedimentary structures observed in a multitude of depositional environments, including deep-marine, proglacial, fluvial and volcanic, and in experimental setups and numerical models. Related processes commonly involve the upstream migration of hydraulic jumps, which connect upstream supercritical to downstream subcritical flow. Hydraulic jumps embody the physical transition from kinetic into potential energy, characterised by an abrupt increase in flow depth and a decrease in flow velocity.

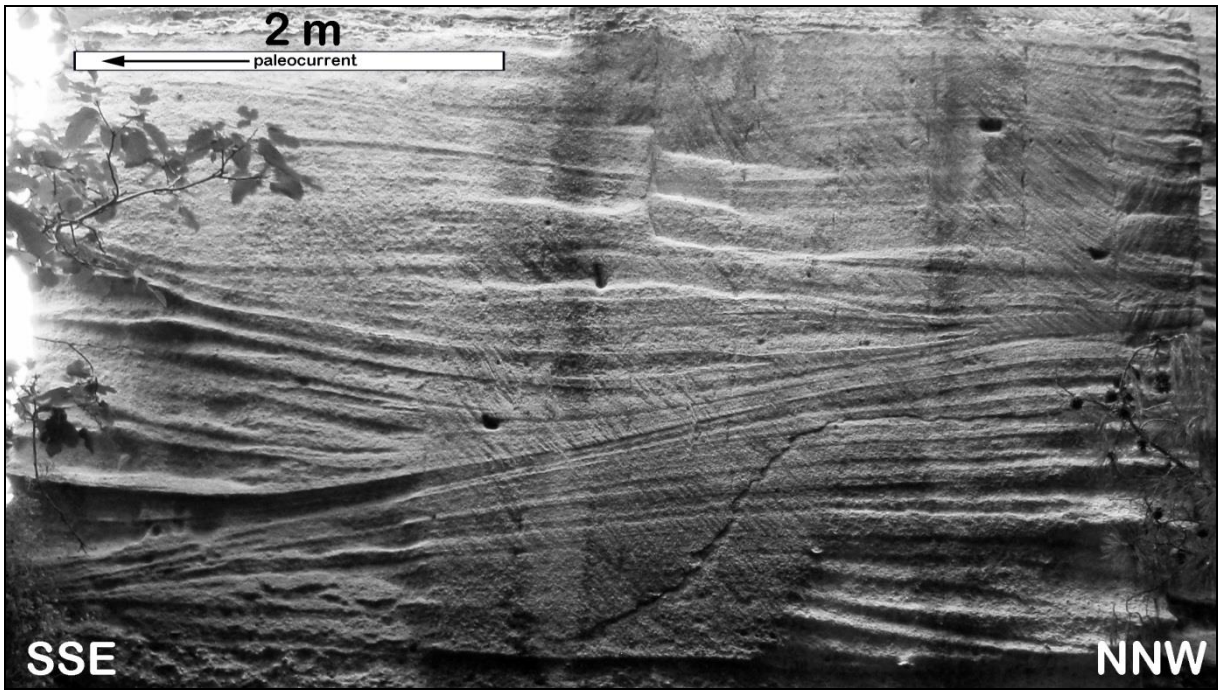
Such flows may result in the generation of a series of downslope asymmetrical cyclic steps, characterised by a train of hydraulic jumps, situated in the troughs between the bedforms' steep lee sides and gentle stoss sides. From the hydraulic jump the flow travels subcritically over the stoss side and reaches the critical Froude number (Fr'=1) at the crest of the step before its further acceleration to supercritical down the lee side, at the toe of which it plunges into the next hydraulic jump (*Cartigny et al*, 2013). On lee sides the lower flow depth and higher flow velocities lead to erosion or limited deposition. Contrastingly, on stoss sides flow depths are high and velocities low causing deposition and backset stratification (*Cartigny et al*., 2011).

Cyclic step bedforms are sensitive to variations in flow discharge, which will reconfigure morphologies in restoring equilibrium between flow and bedforms. Such reconfigurations involve vast amounts of erosion and deposition and may result in temporal conditions favouring the deposition of other supercritical bedforms such as antidunes and chute-and-pool morphologies. As a result, cyclic step deposits typically display complex interplays between low-angle backsets, foresets and convex-up structures, separated by erosional surfaces, frequently arranged in lenticular architectures.

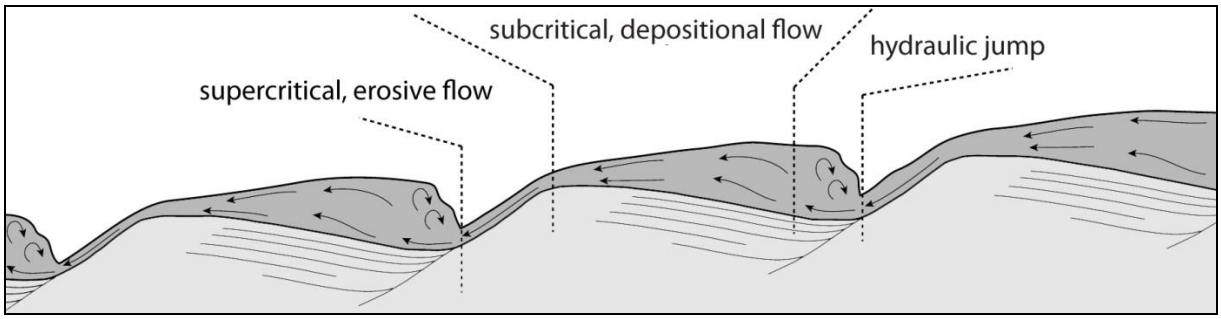
REFERENCES

Cartigny et al. (2011) A comparative study of sediment waves and cyclic steps based on geometries, internal structures and numerical modeling. *Marine Geology*.

Cartigny et al. (2013) Morphodynamics and sedimentary structures of bedforms under supercritical-flow conditions: New insights from flume experiments. *Sedimentology*.



Complex geometries in the Pleistocene Favignana Calcarenite ramp deposits of Sicily, Italy.



Schematic representation of cyclic step bedforms. Modified after *Cartigny et al.* (2011).

Catastrophic events on a cool-water carbonate ramp – the Favignana Calcarenite (Sicily, Italy)

A. Slootman[1]& A. Moscariello[1]

[1]Earth and Environmental Sciences, University of Geneva,
Rue des Maraichers 13, CH-1205, Geneva, Switzerland
Email: Arnoud.Slootman@unige.ch

Introduction

The eastern side of Favignana Island (19 km^2), western Sicily, consists of Pleistocene calcarenites with a maximum observed thickness of 50 metres. These are characterised by a wide range of prograding sediment bodies comprising mainly (very) coarse, (in places) very porous grainstones. Some results of ongoing PhD work are presented here.

Biological assemblages are composed of fragmented red algae, bryozoans, echinoids and (mainly benthic) foraminifera with, in places, rhodoliths and/or well-preserved mollusc shells. Microfacies are of heterozoan origin indicating relatively cool-water conditions. The deposits consist of prograding clinoforms, showing event beds alternating with intensely bioturbated cross-stratified beds.

Event beds

Observations – Event beds may reach up to >10 metres in thickness. In the proximal parts, they dip 5-10 degrees towards the southeast and can be traced in the field for hundreds of metres, until they finally pinch out. Event beds display internal stratification varying from crudely to spaced to more pronounced. Geometries within event beds consist of backsets, foresets, wavy geometries or planar stratification, and locally display scours (1-10 metres) with gravelly infills at the base. In more distal settings, where facies consist of upper plane bedding, event beds directly overlie non-bioturbated dunes (height 20-30 cm) of the underlying cross-stratified beds.

Interpretation – Event beds were interpreted to be deposited from short-lived supercritical flows travelling down a slope, with Froude numbers generally decreasing from proximal ($Fr>>1$) to distal ($Fr<1$). Hence, sedimentary structures were formed by bedforms such as cyclic steps, chute-and-pools, and antidunes. Rapid fluctuations in flow conditions are evident from numerous erosion surfaces and structures formed by transitional bedforms, reflecting attempts in restoring equilibrium conditions between flow and the mobile bed.

Cross-stratified beds

Observations – Cross-stratified beds are frequently organised in thick sets accommodating much of the progradation. Furthermore, the top of event beds is generally not flat, but contains depressions which were filled with (compound) cross-stratified beds and subsequently became intensely bioturbated. In proximal parts, cross-strata indicate a southeastward palaeoflow in the direction of the dips of event beds, whereas on the more horizontal toesets, cross-strata dip is more variable.

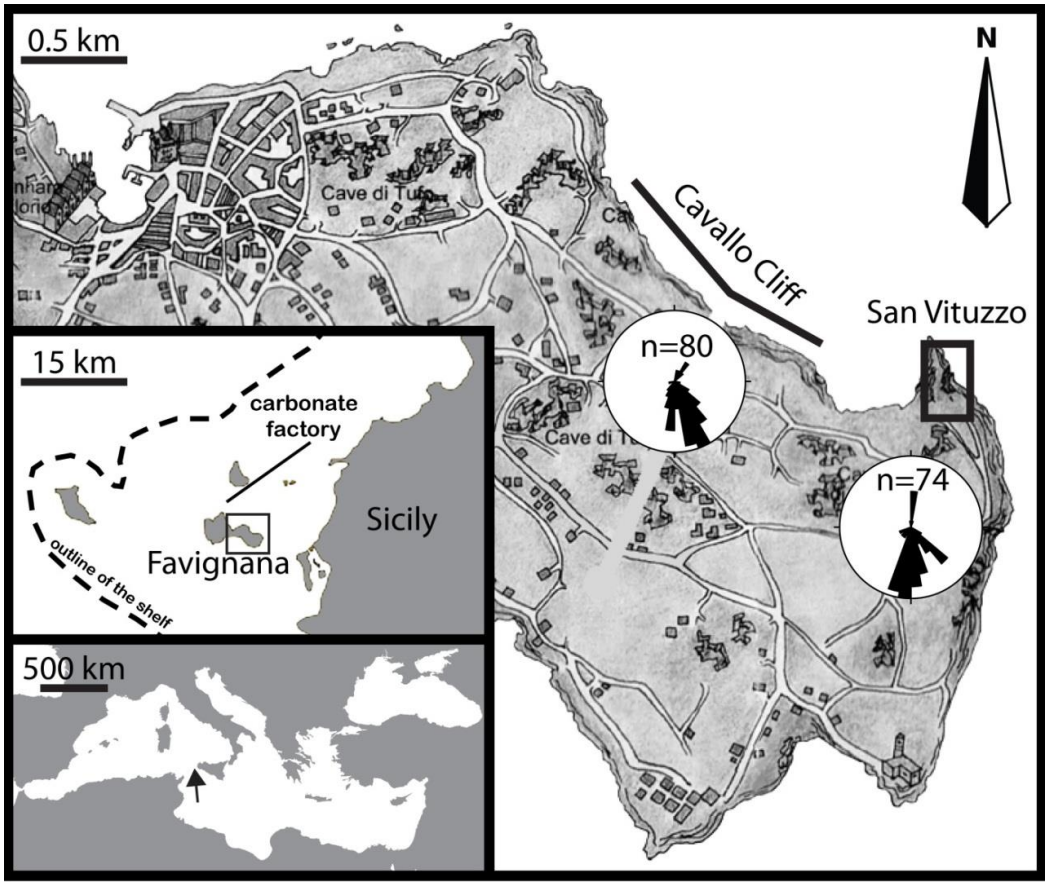
Interpretation – Cross-stratified beds were interpreted to result from deposition by migrating subaqueous (compound) dunes, which prevailed during periods of relative quiescence in between events. In proximal settings these low-energy bedforms migrated under the influence of wind-induced surface currents, where they were forced to migrate down the gentle slope of the clinoforms and hence display palaeotransport in the direction of progradation (southeastward). In distal settings, the more horizontal dip of the sea floor allowed dunes to migrate also in opposite directions.

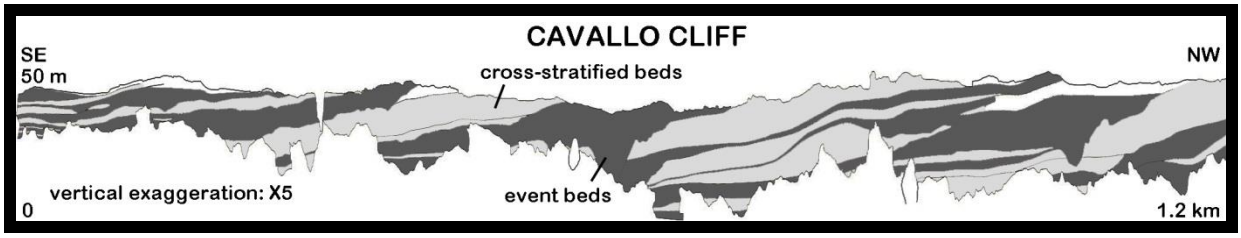
Depositional model

The combined observations reflect bi-modal deposition on a cool-water carbonate ramp characterised by either low-energy currents or supercritical currents. The carbonate factory is inferred to have been located on a submarine high in between Favignana and another island, situated four kilometres northward. The particular palaeoceanographic setting of the Aegadian Archipelago, with two islands located on the shelf separated by a shallow passage where skeletal debris is produced, had a funnelling effect on approaching currents.

The background sedimentation of subaqueous dune facies resulted from strong northwesterly winds, such as those dominantly observed today, creating a set-up of the water level on the windward side of the passage which generated currents in accord with the observed palaeotransport directions of low-energy bedforms, which were intensely bioturbated during following calm times.

Episodic catastrophic events, such as megastorms, hurricanes or tsunami waves, are thought of to have had a devastating effect on the carbonate factory. Such high-energy events swept the shallow passage, delivering vast amounts of material to the slope edge, which, upon gravitational acceleration, transformed into supercritical sediment-gravity flows resulting in the generation of high-energy bedforms. Between such events there was sufficient time for the factory to recover.





Subsurface biosphere specificity and distribution in the Dead Sea deep sediments: climate as game changer in extreme environments microbial communities

Camille Thomas[1], Daniel Ariztegui[1] & the DSDDP Scientific Team[2]

[1]Department of Earth Sciences, University of Geneva, Switzerland
[2]Complete list of DSDDP scientists at www.icdp-online.org

The ICDP Dead Sea Deep Drilling Project (DSDDP) is an internationally funded initiative aiming to reconstruct the paleoenvironmental and paleoseismicity histories of the Dead Sea Basin, in the Levantine region. Here we present results of the first geomicrobiological investigation in this extreme environment based on metagenomic data. We aim to obtain a comprehensive view of the Dead Sea sediment subsurface biosphere to identify and better understand the interaction between sediment and microbes and its imprint in the sedimentary record.

A 454m long sedimentary core retrieved from the center of the present Dead Sea displays distinctive facies that can be correlated with different lake regimes. The latter are induced by contrasting climatic conditions leading to the preferential precipitation of some evaporitic minerals. During rather dry periods as today in the Levant, the lake is holomictic and halite deposits as the main evaporitic phase. The lacustrine basin displays maximum salinities under such conditions. During more humid intervals, like those experienced in the late glacial period, or punctually during the Holocene, the lake becomes stratified, and aragonite precipitates forming varve-like laminae alternating with detritus laminae (aad facies) brought by incoming freshwater. Transitional periods of increasing aridity are further characterized by massive gypsum precipitation. We investigated the 16S rRNA gene sequences in several samples from key lithologies and completed the comparison using metagenomic data of two intervals characterizing the specificity of the Dead Sea sediments. Knowing the prevalent environmental conditions and the state of the lake when it happens we can propose some hypothesis to explain the presence of the identified microbial sequences down to 200m below today's lake floor.

We have attempted to characterize as largely and completely as possible the microbial subsurface biosphere using DNA extractions and amplifications. We present here libraries of bacterial and archaeal 16S rRNA sequences extending from the surface of the core down to 200m, covering a complete glacial-interglacial cycle.

In order to give a good insight into the specific assemblages of the Dead Sea, we also compare the identified microbial communities with those of a living microbial mat found in the saline shores of the present Dead Sea.

Our results show a microbial population largely dominated by obligate halophiles of the *Euryarcheota* family. Sequences retrieved from the halite and gypsum samples show very strong similarities with each other, with maximum richness found in the shallowest sediments. They also share their main phylotypes with those identified in the modern microbial mat, and previously described in the modern Dead Sea water column (Bodaker et al., 2010). While those populations show relatively little variation between each other, the aad sample displays a completely different population. It is almost exclusively composed of members of the MSBL1 and KB1 candidate divisions first described in the Mediterranean and Red Sea deep brine basins (Eder et al., 1999 ; Van der Wielen et al., 2005). The Dead Sea water during aragonite precipitation shares with these sites extremely high salinity and high divalent cation concentrations, forming sharp gradients against less saline water, together with anoxic

conditions. Metagenomics data indicate a tight link with the methane cycle for this assemblage.

In halite-gypsum sediments, the identified assemblages do not show major variations in the archaeal communities of the Dead Sea and lake ancestors sediments. The similarity between sequences found in the oldest and present day halite and gypsum point towards very low activity within the sediments. Thus, it is actually more likely that most of the microbial diversity and metabolic changes occur in the water column and the most recent sediments. Once buried, *Archaea* may have very low metabolic rates, and probably do not influence much their environments when deposited in halite and gypsum sediments of a holomictic lake.

On the other hand, the aad facies shows a unique microbial assemblage with very specific phylotypes. This specificity is sharpened by the fact that no or very few sequences could be retrieved from any other aragonitic sample along the core. The MSBL1 Candidate Division is here identified for the first time in a continental setting. Its unique recovery in this specific lithology advocates for the importance of specific sedimentary conditions and pore water chemistry for their development. It appears that the prevalence of sharp salinity gradients and anoxic conditions in the lake water at the moment of sedimentation are the prerequisites for their presence.

Finally, although primarily controlled by the salinity, it seems that physico-chemical conditions found in the (paleo)lake water, which are originally driven by climatic variations, are responsible for the development and preservation of specific microbial assemblages recovered in the Dead Sea Basin sediments.

REFERENCES

Bodaker, I., Sharon, I., Suzuki, M. T., Feingersch, R., Shmoish, M., Andreishcheva, E., Sogin, M. L., Rosenberg, M., Maguire, M. E., Belkin, S., Oren, A., Béjà, O. (2010). Comparative community genomics in the Dead Sea: an increasingly extreme environment. *The ISME journal*, *4*(3), 399–407.

Eder, W., Ludwig, W., & Huber, R. (1999). Novel 16S rRNA gene sequences retrieved from highly saline brine sediments of kebrit deep, red Sea. *Archives of microbiology*, *172*(4), 213–8.

Van der Wielen, P. W. J. J., Bolhuis, H., Borin, S., Daffonchio, D., Corselli, C., Giuliano, L., … Timmis, K. N. (2005). The enigma of prokaryotic life in deep hypersaline anoxic basins. *Science*, *307*(5706), 121–3.

Mid Quaternary decoupling of sediment routing in the Nankai Forearc revealed by provenance analysis of turbiditic sands.

Muhammed O. Usman[1], Hideki Masago[2], Wilfried Winkler[1] & Michael Strasser[1].

[1]Geological Institute, ETH Zurich, Switzerland.
[2]Centre for Deep Earth Exploration, Japan Agency for Marine-Earth Science and Technology, Yokohama, Kanagawa, Japan.

Actualistic provenance studies on a continental scale are a powerful tool for understanding the relationship between sedimentation and tectonics as such studies provide a fundamental insight to improve our understanding of the location and nature of sediment source areas, the pathways by which sediment is transferred from source to basin of deposition and the factors that influences the composition of sedimentary rocks such as relief, climate and tectonics. Recognition of diagnostic petrographic and mineralogical signatures of contrasting geodynamic settings by relating the composition of modern sands to the geologic evolution of wide and complex source areas helps in making predictions of detrital mode trends in space and time.

Coring during Integrated Ocean Drilling Program (IODP) Expeditions 315, 316, and 333 recovered turbiditic sands from the forearc Kumano Basin (Site C0002), a Quaternary slope basin (Site C0018), and an uplifted trench wedge (Site C0006) along the Kumano Transect of the Nankai Trough accretionary wedge offshore southwest Japan. The compositions of the submarine turbiditic sands here are investigated in terms of bulk and heavy mineral modal compositions to identify their provenance and dispersal mechanisms, as they may reflect changes in regional tectonics during the past ca. 1.5 Myrs. The results show a marked change in the detrital signature and heavy mineral composition in the forearc basin and slope basin facies around 1 Ma. This sudden change is interpreted to reflect a major change in the sand provenance, rather than heavy mineral dissolution and/or diagenetic effects, in response to changing tectonics and sedimentation patterns. In the trench-slope basin, the sand older than 1 Ma were probably eroded from the exposed Cretaceous-Tertiary accretionary complex of the Shimanto Belt and transported via the former course of Tenryu submarine canyon system, which today enters the Nankai Trough northeast of the study area. In contrast, the high volcanic lithics and volcanic heavy mineral suites of the sand younger than 1 Ma points to a strong volcanic component of sediment derived from the Izu-Honshu collision zones and probably funnelled to this site through the Suruga Canyon. However, sands in the forearc basin show persistent presence of blue sodic amphiboles across the 1 Ma boundary, indicating continuous flux of sediments from the Kumano/Kinokawa River. This implies that the sands in the older turbidites were transported by transverse flow down the slope. The slope basin facies then switched to reflect longitudinal flow around 1 Ma, when the turbiditic sand tapped a volcanic provenance in the Izu-Honshu collision zone, whilst the sediments transported transversely became confined in the Kumano Basin. Therefore, the change in the depositional systems around 1 Ma is a manifestation of the decoupling of the sediment routing pattern from transverse to long-distance axial flow in response to forearc high uplift along the megasplay fault.

Paleoenvironments, Evolution, and Geomicrobiology in a Tropical Pacific Lake: The Lake Towuti Drilling Project (TOWUTI)

H. Vogel, J.M. Russell, S. Bijaksana, F. Anselmetti, D. Aritztegui, S. Crowe, D. Fowle, D. Haffner, J. King, R. Marwoto, M. Melles, T. von Rintelen, J. Stevenson & I. Watkinson

Lake Towuti (2.5°S, 121°E) is a, 560 km^2, 200-m deep tectonic lake at the downstream end of the Malili lake system, a set of five, ancient (1-2 MYr) tectonic lakes in central Sulawesi, Indonesia. Lake Towuti's location in central Indonesia provides a unique opportunity to reconstruct long-term paleoclimate change in a crucially important yet understudied region- the Indo-Pacific warm pool (IPWP), heart of the El Niño-Southern Oscillation. The Malili Lakes have extraordinarily high rates of floral and faunal endemism, and the lakes are surrounded by one of the most diverse tropical forests on Earth. Drilling in Lake Towuti will identify the age and origin of the lake and the environmental and climatic context that shaped the evolution of this unique lacustrine and terrestrial ecosystem. The ultramafic (ophiolitic) rocks and lateritic soils surrounding Lake Towuti provide metal substrates that feed a diverse, exotic microbial community, analogous to the microbial ecosystems that operated in the Archean Oceans. Drill core will provide unique insight into long-term changes in this ecosystem, as well as microbial processes operating at depth in the sediment column.

High-resolution seismic reflection data (CHIRP and airgun) combined with numerous long sediment piston cores collected from 2007-2013 demonstrate the enormous promise of Lake Towuti for an ICDP drilling campaign. Well-stratified sequences of up to 150 m thickness, uninterrupted by unconformities or erosional truncation, are present in multiple sub-basins within Towuti, providing ideal sites for long-term environmental, climatic, and limnological reconstructions. Multiproxy analyses of our piston cores document a continuous and detailed record of moisture balance variations in Lake Towuti during the past 60 kyr BP. In detail our datasets show that wet conditions and rainforest ecosystems in central Indonesia persisted during Marine Isotope Stage 3 (MIS3) and the Holocene, and were interrupted by severe drying between ~33,000 and 16,000 yr BP when high-latitude ice sheets expanded and global temperatures cooled. This in combination with the observed little direct influence of precessional orbital forcing and exposure of the Sunda Shelf implies that central Indonesian hydroclimate varies strongly in response to high-latitude climate forcing: a hypothesis we aim to test across multiple glacial-interglacial cycles through scientific drilling. Indeed, numerous high-amplitude reflectors in the upper 150 m of lacustrine fill suggest repeated cycles of moisture-balance variations in the tropical Pacific.

In summary drilling in Lake Towuti will help to:

(1) Document the timing, frequency, and amplitude of orbital- to millennial-scale changes in surface hydrology and terrestrial temperature in the Indo-Pacific Warm Pool across multiple glacial-interglacial cycles;

(2) Understand how variations in terrestrial hydrology and temperature in central Indonesia respond to changes in the mean state of the ENSO system, the monsoons, high-latitude forcing, and insolation;

(3) Analyze the long-term stability and resilience of rainforest vegetation to changes in climate, greenhouse gases, and fire frequency;

(4) Study the extent, biogeography, and metabolism of microbial life in the sediments of a non-sulfidic, ferrginous basin, and their relationships to carbon cycling, redox metal deposition, and the concentration of metal ore minerals;

(5) Study the effects of climate-driven changes in the aquatic environment on both lacustrine microbial populations, and the geobiosphere within the lake's sediment;

(6) Determine the age of Lake Towuti, and the ensuing rates of speciation of Towuti's endemic fauna and flora;
(7) Identify the timing of past lake level fluctuations in Towuti, changes in hydrological connections among the Malili Lakes, and how these influenced biological colonization events, habitat stability, and modes of speciation (sympatric, allopatric).

Important milestones concerning the operational and logistical preparation of a deep drilling at Lake Towuti have been achieved by the PI team in close collaboration with DOSECC, local authorities and businesses in Indonesia, and ICDP. A drilling proposal has recently been funded through the ICDP and proposals for matching funds have been submitted to national funding agencies in 2013. Drilling operations are envisaged to commence in early 2015.

Environmental DNA comparison from the Holocene and Last Glacial Maximum records at Laguna Potrok Aike, Argentina.

A. Vuillemin[1], D. Ariztegui[2], P.R. Leavitt[3], L. Bunting[3]& the PASADO Science Team[4]

[1]GFZ German Research Centre for Geosciences,
Section 4.5 Geomicrobiology, Telegrafenberg, 14473 Potsdam, Germany.
[2]University of Geneva, Earth and Environmental Sciences,rue des Maraîchers 13, 1205 Geneva, Switzerland.
[3]Limnology Laboratory, Department of Biology, University of Regina, Regina, Saskatchewan, Canada.
http://www.pasado.uni-bremen.de.

All organisms living in aquatic systems leave DNA behind them. The study of such environmental DNA has led to a new approach to reconstruct past environments. Laguna Potrok Aike is an endorheic basin located in the southern hemisphere's mid-latitudes (52°S). Rainfall and geology of the catchment exert a dominant control on the lake inputs, resulting in different sedimentary sequences related to paleoenvironmental conditions. The interpretation of the limnogeological multiproxy record developed in the frame of the ICDP-PASADO project showed that lake-level variations recorded changes in the regional hydrological regime associated with the influence of Southern Westerly Winds and allowed the identification of contrasting time windows (Zolitschka et al. 2013). In addition, within the framework of this project a 100-m-long core was dedicated to a detailed geomicrobiological study in order to fill the existing gap in the knowledge of the lacustrine subsurface biosphere (Vuillemin et al. 2010).

Indeed, aquatic sediments do not only record past climatic conditions, but also provide a wide range of ecological niches for microbes. In this context, the influence of environmental features upon microbial development and survival remained still uncharted for the deep lacustrine realm (Vuillemin et al. 2013a). We investigated the presence of living microbes within sediments, combining a microbiological and geochemical approach to determine the sustainability of microbial activity (Vuillemin et al. 2014), while assessing the influence of microbial diagenesis on the sediment organic (Vuillemin et al. in press) and mineral fractions (Vuillemin et al. 2013b). Finally, 16S rRNA gene clone libraries were established for two sedimentary horizons corresponding to the Holocene and Last Glacial Maximum times, respectively both displaying *in situ* microbial activity. Sequences recovered from the productive Holocene record revealed a microbial community adapted to subsaline conditions with a high potential of organic matter degradation. In contrast, sediments rich in volcanic detritus from the Last Glacial Maximum showed a substantial presence of lithotrophic microorganisms and sulphate-reducing bacteria. Together, these patterns suggested that microbial communities developed in response to climatic control of lake and catchment productivity at the time of sediment deposition. Moreover, it demonstrates that environmental DNA can constitute sedimentary archives of phylogenetic diversity and diagenetic processes over tens of millennia.

REFERENCES

Vuillemin A, Ariztegui D, Vasconcelos C, and the PASADO Scientific drilling party (2010). Establishing sampling procedures in lake cores for subsurface studies: Assessing in situ microbial activity. Scientific Drilling 10, 35-39.

Vuillemin A, Ariztegui D, and the PASADO Science Team (2013a). Geomicrobiological investigations in subsaline maar lake sediments over the last 1500 years. Quaternary Science Reviews 71, 119-130.

Vuillemin A, Ariztegui D, De Coninck AS, Lücke A, Mayr C, Schubert CJ, and the PASADO Science Team (2013b). Origin and significance of diagenetic concretions in sediments of Laguna Potrok Aike, southern Argentina. Journal of Paleolimnology 50, 275-291.

Vuillemin A, Ariztegui D, Lücke A, Mayr C, and the PASADO Science Team (2014). Paleoenvironmental conditions define current sustainability of microbial populations in Laguna Potrok Aike sediments, Argentina. Aquatic Sciences 76, 101-114.

Vuillemin A, Ariztegui D, Nobbe G, Schubert CJ, and the PASADO Science Team (in press). Influence of methanogenic populations in Holocene lacustrine sediments revealed by clone libraries and fatty acid biogeochemistry. Geomicrobiology Journal.

Zolitschka B, Ariztegui D, Francus P, Maidana N, Wastegård S (eds.) (2013). The Potrok Aike Maar Lake Sediment Archive Drilling Project (PASADO). Quaternary Science Reviews 71, 1-228.

SwissSed is an informal group of (not only) Swiss sedimentologists. It promotes contacts, exchange of ideas, and information on current developments in sedimentology. Membership is free, but SwissSed lives by the interest and initiative of its members.

To become a member, please contact:

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

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

Pascal Kindler
Section des Sciences de la Terre et de l'environnement
Rue des Maraichers 13
1205 Genève **Tel +41 22/ 379 66 49**
Switzerland **E-mail: pascal.kindler@unige.ch**

Silvia Spezzaferri
Department of Geosciences – Geology
University of Fribourg
Chemin du Musée 6
1700 Fribourg **Tel +41 26/ 300 89 77**
Switzerland **E-mail: silvia.spezzaferri@unifr.ch**

SwissSed on the Web:
http://www.unifr.ch/geoscience/geology/en/research/swisssed