COCARDE Workshop and Field Seminar 2012

Fluid flow-related carbonate build-ups: from lacustrine to (early) marine environments

– The Ries Impact Crater as a Natural Laboratory –

October 15-19, Nördlingen, Germany

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Sublacustrine spring mound of the Miocene Ries Crater Lake, Wallerstein (© G. Arp)

The COCARDE Workshop 2012 in Nördlingen, Germany, aims to bring together junior and senior scientists from industry and academia working on fluid-flow related carbonate build-ups in lacustrine and (early) marine environments. The workshop will evaluate well-preserved spring and seepage associated mounds in the Ries impact crater. Results from the 2011 Erbisberg Mound drilling will be compared and contrasted with other research efforts on fluid flow-related carbonate build-ups. The workshop will be combined with a hands-on field seminar focusing on the respective mound systems, microbial build-ups and associated Miocene carbonates in the Ries impact crater and the surrounding Franconian Jurassic reef systems.

Scientific Summary

Framework

COCARDE's second Workshop and Field Seminar in Rabat, Morocco, fall 2011, confirmed the variety in carbonate mound systems, stressing the need to distinguish between pure bioclastic mounds with typical framework builders (such as Challenger Mound, SW of Ireland and Puebla de Lillo Mounds, Spain) versus fluid-flow influenced or spring- and seepage related carbonate build-ups. This holistic vision of mound systems stressed the need to multiply the studies of small mounds (typically 15 to 30m high) especially in settings where fluid fluxes play a crucial role, both *marine* and *continental*.

Recent COCARDE research efforts focused on the drilling of recent small cold-water coral mounds in seepage associated settings off Morocco (Pen Duick Escarpment mounds on the Atlantic margin, Melilla mounds in the Alboran Sea). Both sites will be surveyed in 2013 by a COCARDE *EUROFLEETS* cruise with R/V Marion Dufresne: "GATEWAYS". However, the strength of continental drilling lies in the combination of 3D outcrop studies and targeted drilling, which allows to study pristine core sections of carbonate build-ups in their surrounding setting.

Suevite (impact-melt-bearing breccia) with basal graded unit upon Bunte Breccia, Aumühle, Miocene Ries Impact Crater (© G. Arp)

Sponge-microbialite-mounds of the lower "White Jurassic", Oxfordian, Sengenthal Quarry (© G. Arp)

In 2011, the Geological Survey of Bavaria carried out under the scientific direction of Gernot Arp the first scientific drilling of a spring carbonate mound in the Ries Impact Crater, Germany: the Erbisberg Mound drilling project. Preliminary results from the Erbisberg Mound suggest that impact-induced thermal springs were involved in the very early stage of mound formation, at least at this site. So, it should be stated that the Ries Impact Crater (Nördlingen, Germany) forms the perfect setting to discuss fluid-flow related carbonate build-ups and to exchange views and experience across disciplines and carbonate research fields. Moreover, the outstanding scientific value of the Ries lacustrine carbonate system and the proximity of a unique Jurassic reef domain add a significant and broadband field training component for young scientists and industrial trainees in carbonate systems.

The Ries carbonate system

The Nördlinger Ries is a circular basin separating the Jurassic limestone plateau's of the Swabian and Franconian Alb, the latter indeed famous for its vast coral reefs, sponge reefs, microbialites and the lagoonal "lithographic" limestone of Solnhofen, with its legendary fauna. The Ries crater was formed 15 Million years ago by the impact of an asteroid. Apart from its impact nature, the Ries basin offers a great opportunity to study post-impact Miocene lacustrine microbialites and algal build-ups in the light of changing hydrochemical conditions in the crater lake.

Prior to the sixties, when the Ries basin was considered to be of volcanic origin, the large calcitic mounds were regarded as hot spring travertines. In the late sixties, these mounds were compared with the Searles Lake tufa pinnacles and thus regarded as "cool" and "built by algae". Material from soda lake spring mounds from China evidence that the Ries mounds are indeed very similar to the soda lake mounds. Central parts of the mounds and pinnacles are composed of highly porous so-called sickle-cell limestones, with up to cm-sized voids. Marginal mound parts show thrombolites, planar non-skeletal stromatolites and rare green-algal frameworks.

Expected impact

The Ries Workshop will discuss in a **first session** the results of the Erbisberg Mound drilling and frame these in other research efforts on **lacustrine Recent spring carbonates** in Turkey, the USA, etc. During advanced discussion sessions controversial interpretations will be confronted.

Lithographic limestones (Plattenkalke) of the Tithonian Solnhofen Formation, Quarry Haardt near Solnhofen (© G. Arp)

The potential of those fluid-flow related carbonate deposits as potential analogues for non-marine carbonates in the South Atlantic subsalt will be discussed during a **second session**. Moreover, as **Industry** is recently confronted with such frontier carbonate systems, they are urgently in demand of both interpretation keys and skilled brainpower. Facies and pore-scale architecture of non-marine carbonates are strongly controlled by specific hydrological conditions in terms of catchment geology and its effect on water chemistry and the nature of solute supply. The COCARDE Ries Workshop and Field Seminar offers both a forum for reflecting on such questions and a training platform to expose young scientists and industrial trainees to new exploration concepts.

In a **third session**, the thematic topics discussed during the previous sessions will be opened to include **marine seepage associated carbonate mounds** such as encountered on- and offshore in Morocco.

The need for **drilling and new projects** will be discussed in a **final session**. The discussion of methodologies will encompass both data acquisition and analytical approaches to characterize palaeo-environments (e.g. palaeo-temperature) and to capture the signature of fluid flow – of

various, and often varying nature – from mound genesis to diagenesis. This session will be finished by an **hands-on writing session** where mixed senior and junior scientists will be working in smaller groups to launch potential **new drilling and research proposals**.

Additionally, this workshop and field seminar will contribute to the long-term objective of the ESF COCARDE-ERN network to evaluate, compile and document in a collective effort "mound reference routes", which eventually may serve both academic and industrial communities as training routes. The Ries-Franconian Alb region may well qualify for such goal, and adds to the already surveyed Asturias-León route (Oviedo field seminar) and the Moroccan mound heritage route (Morocco field seminar).

Preliminary workshop and field seminar programme

To stimulate open discussions and fuel the workshop with new ideas which can only be studied on the field, the field excursion will take place before the workshop. Moreover, the field seminar will give the opportunity to young scientists to confront their ideas and vision on carbonate build-ups with experts from industry and academia. It should be emphasized that the workshop programme such as outlined below is tentative and will be further tuned during the next weeks.

Monday October 15th, 2012 - Field seminar Ries & Frankenalb

Morning: *Ries Crater-Museum (introduction) - impact rocks Aumühle - algal reefs Hainsfarth*

Afternoon: *Oolites & freshwater deposits Breitenlohe - stromatolites Utzwingen church – travertine mound Wallerstein - optional: travertine mound Erbisberg*

Evening: *'Call of the Day' post-dinner discussion (45 min.), animated by a team (team 1) of junior scientists, to review "hot topics" and items observed and evoked in the field. Key questions are exported to the in-house workshop later in the week.*

Overnight stay Nördlingen

Tuesday October 16th, 2012 - Field seminar Ries & Frankenalb

Drive Nördlingen-Solnhofen (50 km / 1.0 h)

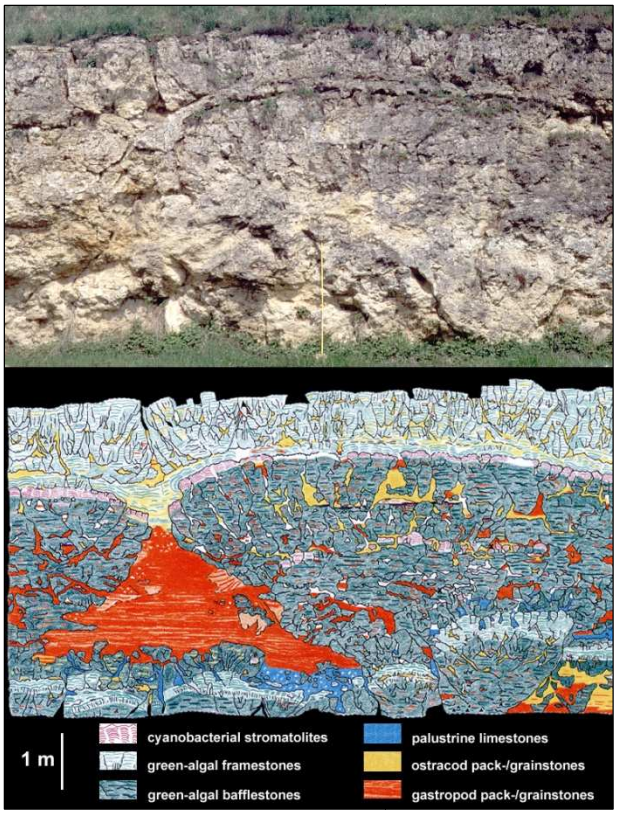
Morning: *Solnhofen quarry Haardt and Bürgermeister-Müller-Museum (09.00 – 12.00)*

Drive Solnhofen-Winnberg (70 km / 1.5 h)

Afternoon: *Treuchtlinger Marmor quarry Gundelsheim (or) Sponge-Microbialite Mounds quarry Sengenthal, optional: tufa canal Erasbach*

Evening: *'Call of the day' post-dinner discussion (45 min.), animated by a team (team 2) of junior scientists, to review "hot topics" and items observed and evoked in the field. Key questions are exported to the in-house workshop later in the week.*

Overnight stay Beilngries



Green algal reefs of the Miocene Ries Crater Lake, Hainsfarth Quarries (© G. Arp)


Steinerne Rinne" near Erasbach, a self-built tufa canal (© G. Arp)

<u>Wednesday October 17th, 2012</u> - Field seminar Ries & Frankenalb

Drive Beilngies-Saal a.d.Donau (50 km / 1.0 h)

Morning: *Kimmeridgian-Tithonian reef carbonates and Cenomanian deposits quarry Saal a.d. Donau (9:00 - 13:00)*

Afternoon: *Monastery Weltenburg & observation (from the Danube River) of incised Jurassic reef carbonates*

Drive Kelheim-Nördlingen (130 km / 2.0 h)

Evening: *'Call of the day' post-dinner discussion (45 min.), animated by a team (team 3) of junior scientists, to review "hot topics" and items observed and evoked in the field. Key questions are exported to the in-house workshop next day.*

Overnight stay Nördlingen

<u>Thursday October 18th, 2012</u> - workshop & poster presentations

Session 1: ***Lacustrine carbonate systems - Present & Past***

- A review of non-marine carbonate fabric types: abiotic vs. biologically mediated precipitates (G. Della Porta)
- Overview on the Ries lacustrine carbonate system & the Erbisberg Mound Drilling (G. Arp)
- Travertine mounds and associated microbial deposits in Denizli Basin, Turkey (A. Foubert)
- Abiotic and biotic influences on travertine formation at Mammoth Hot Springs, Yellowstone

National Park, USA (B. Fouke)
- Microbialite formation in hypersaline lakes on Kiritimati, Central Pacific (G. Arp)
- Hydrochemistry and tufa mound formation in Lake Van, Turkey (A. Reimer)
- ...

Session 2: ***From Lacustrine to (early) marine fluid-flow related carbonate systems: lessons from Industry***

- Pre-salt non-marine carbonate reservoirs of the South Atlantic (t.b.n.)
- Assessing the petrophysical properties in travertine studies (A. Foubert)
- Reservoir compartmentalization: does it apply to mounds? (A. Immenhauser)
- Review of hydrocarbon reservoirs in microbial carbonates (S. Schroeder)
- ...

Session 3: ***Seepage-related carbonate systems in marine settings***

- Of springs and seeps: a reflection on migration (J.P. Henriet)
- Seepage related mounds in the Apennines (M. Taviani)
- Offshore carbonate mounds off Morocco: the El Arraich mud volcano province (J.P. Henriet)
- …

Young researchers session (flash presentations of own research) **and Poster session**

- The Erbisberg travertine mound drilling: REE and $^{87}Sr/^{86}Sr$ of carbonates (Miocene, Nördlinger Ries (T. Dauner et al.)
- Hydrochemistry and biofilm calcification of the "Steinerne Rinne Kuharsch" near Krautheim, Baden-Württemberg (M. Kugel et al.)
- Quaternary microbialite mounds at Tangra Yumco, central Tibetan Plateau (C. Ropers et al.)
- ...

Overnight stay Nördlingen

Kimmeridgian-Tithonian reef carbonates of the upper "White Jurassic", Quarry Saal a.d. Donau (© G. Arp)

Friday October 19th, 2012 - workshop & poster presentations, discussions

Session 4: ***Scientific Drilling in Frontier carbonate systems – Lessons from the Ries – Outlook for the future (onshore/offshore)***

- The study and potential drilling of a Silurian seepage related carbonate mound in the Eastern Atlas (R. Barbieri, Taj-Eddine)
- The Devonian Kess Kess mounds (Hamar Laghdad, Morocco) as drilling targets (R. Barbieri)
- Drilling Carboniferous mounds in Puebla de Lillo, León: ICDP proposal LIMODRILL (E. Samankassou)
- Clumped-isotopes as tool for reconstructing the temperature of carbonate precipitation in Deep Time (A. Rüggeberg)
- …

Session 4 will be finished by a hands-on writing session (mixed junior and senior scientists) channelizing the discussed items in preliminary drafts for potential research and drilling proposals.

Wrapping up
Departures in the late afternoon or facultative overnight stay Nördlingen

Practical Information

Interested participants should fill in the registration form on the website (**www.cocarde.eu**) and send this form before **31th July 2012** to **afoubert@geomar.de** with cc. to **garp@gwdg.de.** The costs for participation in the field excursion are estimated at 150 Euro/person (including excursion guide, bus transport, hotel reservation and breakfast in Beilngries, lunch). The costs for participation at the workshop will be fully covered by ESF (European Science Foundation). However, accommodation, breakfast/dinner and travel costs are NOT refunded and should be covered by the participating scientists. For participating scientists a contingent of rooms is already reserved. Young scientists (pre- or post-doctoral level) are encouraged to ask for an ESF COCARDE Workshop grant which will cover the following costs: travel expenses, refunded at real cost up to a maximum of 450 Euro - field seminar transport and access fees - participation workshop - overnight stays and meals.

Travel information

Flights could be booked to one of the following airports: Augsburg (www.augsburg-airport.com), Munich (www.munich-airport.de) or Stuttgart (www.flughafen-stuttgart.de). The location of the workshop (Nördlingen, Germany) is easily accessible by public transport (www.bahn.de). Deutsche Bahn operates hourly train service to Munich (€21, 2 hours), Augsburg (€12, 1 hour), and Stuttgart (€18, 2 hours).

Location of the venue

Field Trip

We meet on **Monday - 15th October 2012** - at **8:30** at the entrance of the **Ries Crater Museum** (Eugene-Shoemaker-Platz 1, 86720 Nördlingen, Germany - www.rieskrater-museum.de) to start with an introduction to the Ries Crater in the museum (ca. 45 min.). After this short introduction, the bus (Osterrieder) will leave from the parking lot '**Kaiserwiese'** to drive to the outcrops.

Workshop

The workshop (Thursday 18th - Friday 19th) takes place in the historic **town hall** of Nördlingen (Gewölbesaal Rathaus, Marktplatz 1, 86720 Nördlingen, Germany).

Accommodation

A contingent of 30 beds has been reserved in two hotels in the city centre of Nördlingen: 'Hotel Goldene Rose' (www.goldene-rose-noerdlingen.de) and 'Gasthof Walfisch' (www.walfisch-noerdlingen.de). During the field trip, one overnight stay will be in 'Hotel Gallus' at Beilngries (www.hotel-gallus.de). For a final reservation, please indicate in your registration mail to afoubert@geomar.de (with cc. to garp@gwdg.de) which hotel you prefer, and - if possible - with whom you may share your room. Please note that most of the rooms are double room.

Please find below a map indicating the geographic location of the hotels, workshop venue (Rathaus), start excursion (Ries Crater Museum) & parking place of the bus (Kaiserwiese).