

Report on the “Young researchers workshop on cold-water coral mound formation”

The Young Researchers Workshop was held at the Department of Earth and Environmental Sciences of K.U. Leuven, Belgium, on 13-15 May 2009. The workshop gathered 10 scientists from 7 European countries (Fig. 1).



Figure 1. Participants of the “Y R W” in front of the Department of Geology at K.U. Leuven (from left to right): Matthias Lopéz Correa (GZN, Erlangen), Boris Dorschel (UCC, Cork), Lydia Beuck (GZN, Erlangen), Andres Rüggeberg (IFM-GEOMAR, Kiel), Jürgen Titschack (GZN, Erlangen), Ben De Mol (Universitat de Barcelona), Agostina Vertino (Università Catania), Furu Mienis (Royal NIOZ, Texel), Veerle Huvenne (NOC, Southampton), Anneleen Foubert (K.U. Leuven).

The aim of this workshop was to emphasise open discussions between the participants on (1) *Mound initiation and mound build up*, (2) *Sediment dynamics and coral growth, paleoceanography and paleoclimatology*, (3) *Microbial activity*, and (4) *Diagenesis*, with a focus on the following objectives:

1. Review and integration
 - a. Based on our data from different Cold-Water Coral (CWC) mound settings, to integrate our knowledge on the different factors and processes that influence CWC mound formation, trying, where possible, to quantify these effects
 - b. To identify the gaps in our knowledge – what do we need to study in more detail & which new approaches would be necessary
2. Forward look
 - a. Based on the above exercise: to define new hypotheses for study and questions that need to be tackled

- b. To design a practical approach: how are we going forward to answer those questions; i.e. which project proposals can we write at which funding level – e.g. through obtaining ship time and setting up a program around a cruise.
- c. Following the above: including an overview of the different funding opportunities we may have (funding source, amount, length of project, conditions... etc.)

The following questions were discussed during the workshop:

Wednesday 13 May

Development of models

- Can we better quantify and make models more precise?
- Do we need a hard substrate for coral settlements? Agostina: yes
- Is the Wilson ring formation of reefs important for mound development? Currents and sediments have to be in a well-balanced way to form larger build ups like banks/cigars (e.g. Traenadjupet off Norway)
- At all sites before the corals started to grow exists an unconformity in the sedimentary record, a gap of time with erosion or time of non-sedimentation, normally at large turn-over phases in the NE Atlantic with large-scale circulation changes. Are present-day initiations of mounds (e.g. Darwin mounds, Moira mounds, Norwegian mounds, Santa Maria di Leuca) comparable to the mound initiations around 2.7 Ma?
- What do we need to start a mound?
- Which studies are needed to determine the start-up of a mound (e.g., sediment tolerance of corals (check with Autun Purser and Tomas Lundälv's group), Agostina's presentation of coral re-settlement experiments at Santa Maria di Leuca)?
- Does tectonics (uplift/subsidence) play a role in mound development (comparison of subsiding Rockall Bank with uplifting Porcupine Bank)?

Mound build-up

- Do we have evidence of the degree of bioerosion of corals in the sediment cores, especially at boundaries and hiatuses?
- Can we use the different morphotypes of corals as an indicator for nutrient availability / quality of food / current intensities / ...?
- Is the degree of bioerosion dependent of the species / microbes? Occur different bioeroding species at glacials / interglacials? Do bioeroding species also shape mounds or are they relevant to mound build-up (positive or negative)?
- What parameters do we need for modelling mound development? (see below)
- Can we use mounds to produce data from intermediate water depths for climate and ocean circulation models?

Thursday 14 May

Sediment dynamics and coral growth / Paleoceanography, -climatology

- What makes coral to grow and colonize? Do they except a similar range as adult species or do they have a narrower range of environmental parameters?
- How important is the resuspension of material for the corals to grow (e.g. Rockall)?
- Are sea straits, sea mounts, canyons niches for corals to recolonisation other suitable habitats, as these sites have no limitation of food and currents?
- More colonisation experiments are needed to unravel these topics...

Microbial activity

- According to Mangelsdorf et al. (2008) methane, ethane and propane in Miocene sediments below the mound base are most certainly of biogenic origin, which is a normal condition with or without the mound (check also Webster et al. (2009): Environmental microbiology)
- We need to state in a review paper that the corals do not need any hydraulic theory / seepage à la Hovland!
- Comparison of Gulf of Cadiz mounds with Gulf of Mexico mounds (M. Becker DSR I): methane related processes change chemistry of the mound interior.

Diagenesis

- What is the role of bioerosion (see above)?
- Comparison to fossil records: what parameters can we use (grain size, pore water, porosity, permeability, grade of lithification)
- How important is the bio- and/or organomineralization in mounds (c.f. Neuweiler)?
- When are the semi-lithified layers formed?
- Are there processes, which make lithified layers “soft” again after burial?

Parameters for mound development models

We need to start with a simplified model and vary parameter after parameter... (nutrients, currents, water masses, sediment input, erosion, ...Fig. 2)

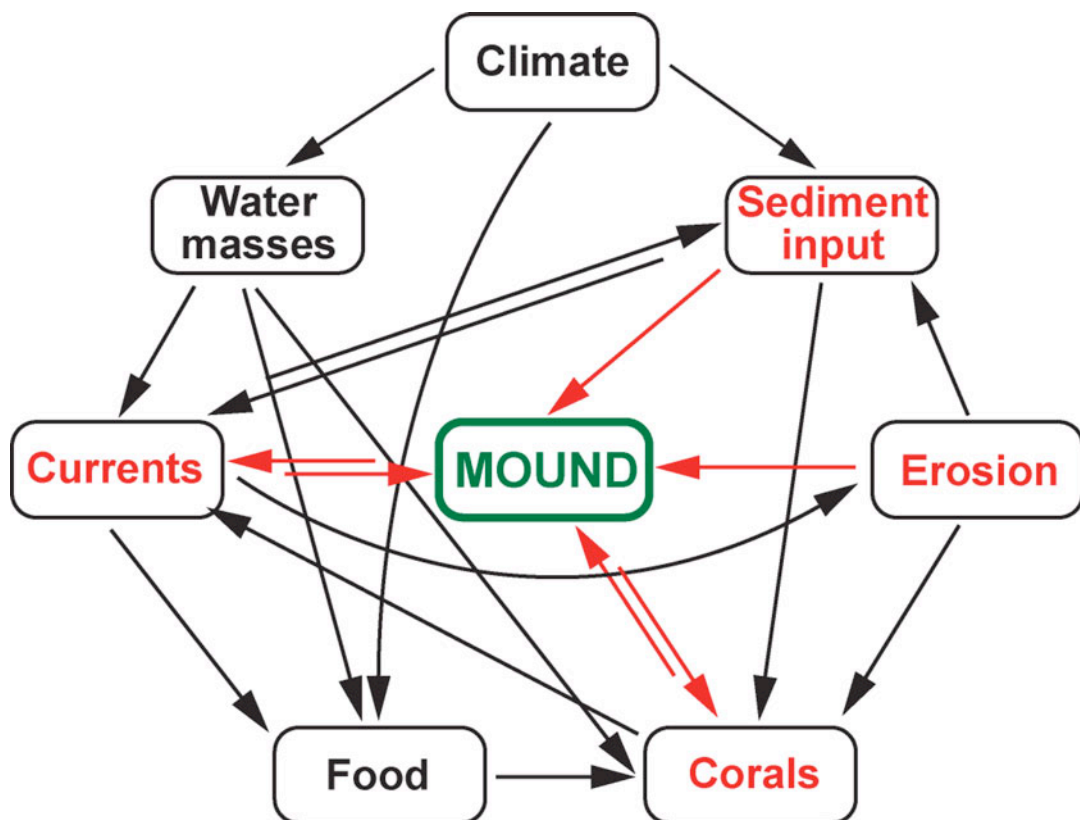


Figure 2. Factors influencing the development and growth of a coral mound (in green = mound, in red = factors with direct influence to the mound).

- How can we model the mound development? Ecosystem modelling with the integration of climate and oceanography (environmental parameters and time).
- What parameters do we have?

Food: for ecosystem functioning we need food web models: data from SAPS, moorings, sediment traps, productivity: paleoproductivity from P/Ca ratios of corals or of foraminifera? Quantification of fluxes to the ecosystem.

Currents: speed: grain size, direction: morphology of mound, periodicity, internal waves?

Watermasses: temperature: paleotemperature from corals and foraminifera, salinity: combination of proxies on corals and foraminifera

Sediment input: accommodation rate: sediment traps, laser particle sizer measurements *in situ* in the coral framework and above, check all available data of downlooking ADCP (e.g. DOS Lander, P. Linke)

Erosion: can we model erosion in our labs? Collect a complete box corer with coral framework and sediments

Friday 15 May

Funding

In general same funding conditions exist in every country except for Ireland (only PhD, ship time with Irish component) and smaller Spanish vessels (ship time with Spanish component).

Overview of proposals for Post-Docs are available on European web pages (<http://www.erc.europe.eu>, Marie Curie, EUROCORES, DG Environment, COST, ...), Belgium (<http://www.fwo.be>), Germany (<http://www.dfg.de>, <http://www.geonachwuchs.de>), Spain (ICREA), United Kingdom (NERC), The Netherlands (FWO), Italy, MIUR, PRA, FOE, FIRB)

Action points – outcome of this workshop:

1. Start a small “network” (Scientific Research Network, e.g. FWO): check possibilities for coordination money, deadlines and send it to Anneleen
2. Model study with different controls: input factors and interaction between those factors for modelling (5 main factors): create conceptual model (send to Ben), further input from specialists (Sascha)
3. Review paper: send latest version of manuscript De Mol/Rüggeberg for further input and change of the young researcher network
4. New measurements needed on five main factors during future cruises: to assure comparison of data we need to standardize methods and protocols, onshore versus offshore, onshore drilling (e.g. Agostina: La Montagna, Sicily)
5. Yearly one meeting of the Young Researcher Network, two days including PhD, one day only Post-Docs: check possibilities in Spring 2010.
6. Own EGU session in 2010?
7. Cruises to investigate end members:
 - a. Northern Norwegian (POSEIDON, G.O. SARS – Andres, Sascha, Pål)
 - b. Rockall / Hatton Bank (PELAGIA – Furu, Henk)
 - c. Mediterranean, Strait of Gibraltar, Santa Maria di Leuca (Ben, Agostina)
 - d. American Margin (Furu)
 - e. Iceland (Matthias)
8. Integration with other projects/campaigns: TRACES (EuroTRACES), COCARDE, CARBONATE, MicroSYSTEMS, Hermione, CoralFISH, ...