

## ***Carbonate Mounds in Shallow and Deep Space and Time***

### **THE OVIEDO DECLARATION**

Jean-Pierre Henriët, RCMG Ghent, Belgium  
Silvia Spezzaferri, Fribourg, Switzerland  
Andres Rüggeberg, RCMG Ghent, Belgium  
Anneleen Foubert, KULeuven, Belgium  
Elias Samankassou, Geneva, Switzerland  
Juan Bahamonde, Oviedo, Spain  
Alexei Suzyumov, Paris, France  
Thomas Wöhrl, Potsdam, Germany  
Giancarlo Ghilardi, Geneva, Switzerland  
Stéphanie Larmagnat, Laval, Québec, Canada  
Valentina Blinova, MSU, Moscow, Russia  
Mohamed El Amine Hazim, Rabat, Morocco  
Giordana Gennari, Fribourg, Switzerland  
Philippe Lapointe, Total, ExxonMobil, NCOG, USA  
Anne-Christine da Silva, Liège, Belgium  
Yu Zhang, LabMET Ghent, Belgium  
Hans Pirlet, RCMG Ghent, Belgium

#### **ECORD**

##### **Emerging Fields / New Topics Environment and Deep Biosphere**

***New insights in controls on carbonate factories (cold/warm) past and  
present, and relationships to the carbon cycle***

**“Beyond 2013: the Future of European Scientific Drilling Research”  
Workshop Report, Vienna, April 24-25, 2009  
Conveners G. Camoin, R. Stein, M. Wägrich**

*Recently, the discovery of cold-water carbonate mound systems, supporting cold-water coral ecosystems, has added a new dimension to the concept of carbonate factories, serving as a complementary counterpart to warm-water carbonate build-ups. The widespread occurrence of these deep-water structures presents a challenge to understand their development and preservation and possible importance in the geologic record. Research into these deep-water ecosystems is still at an early stage and will require ocean drilling to fully explore their potential importance for the global carbon cycle.*

## Background

### 1. The *academic drive: cross-pollination spurs innovative thinking*

#### a. The “continental” mound community goes oceanic.

The world of carbonate mounds in the geological record has been first unveiled by paleontologists and reef research teams from over the world. The discovery of extensive provinces of giant carbonate mounds in the deep-sea, which can be accessed by comprehensive high-resolution studies (continuous coring and logging), fuels interest towards comparative studies and opens perspectives of testing hypotheses by experimentation.

#### b. The “oceanic” mound community goes continental.

ODP Expeditions 133 and 182 off Australia and IODP Expedition 307 off Ireland have stepwise moved the boundaries of global mound research, increasingly mobilizing multidisciplinary communities. The latter venture shaped – through numerous European programmes in particular – an impressive worldwide community of young ocean researchers, who join forces to address emerging new challenges at the crossroads of Palaeo-environment, Deep Biosphere and Global Change. They now get eager to confront their findings and test their hypotheses in the present ocean with the messages from remote times. The unrivaled resolution in studies of sub-recent carbonate mound systems and the “live” observation of controls gets ideally complemented by the 3D and 4D insights gained in ancient systems.

### 2. The *industrial drive: the hunt for the subtle trap*

#### a. From lucky strikes to strategic moves.

In early times of hydrocarbon exploration, the potential of carbonate mounds as reservoirs was not always readily identified. On a background of new discoveries of giant hydrocarbon accumulations, the confrontation with the modern world, in particular revealed by ocean drilling, soon became an eye opener and presently spurs new exploration insights and strategies.

#### b. Exploration keys for new and subtle traps.

The comprehension of the importance of carbonate mound systems as hydrocarbon reservoirs passes through the understanding of the fundamental processes of mound initiation, growth and demise, and through the identification of plausible sizes, geometries, basin settings and controls.

The diversity of carbonate mound systems in the sub-recent world is a key to the diversity of mound settings, morphologies and characteristics in deep time. The comparative analysis of mound evolution – with a focus on early to late diagenetic processes, products and patterns – in the recent and ancient world through integrated ventures in oceanic and continental scientific drilling fuels new insights in reservoir plumbing systems and spurs improvements in reservoir prediction.

### 3. The *environmental gain: tracking and protecting threatened habitats*

It may sound as a paradox, but it truly is the very geophysical exploration of Porcupine Basin off Ireland – both industrial and academic – that has directly led to the discovery, surveying and protection of still pristine cold-water coral reefs, driven to a critical state of survival by decades of past, uncontrolled deep-sea trawling. The continuing, worldwide exploration and survey of modern carbonate mounds, of which many still support thriving ecosystems, acts as spearhead of nature conservation and ocean stewardship.

*Delegates from the concerned “oceanic” and “continental”, academic and industrial communities convened in particular in three dedicated ESF- and ECORD-supported preparatory workshops in Switzerland (Magellan workshops in Murten, April 2007 and Fribourg, January 2009) and Spain (MiCROSYSTEMS-COCARDE-CHECKREEF workshop and field seminar, Oviedo, September 2009) to set the base for future **integrated and comparative** scientific drilling research in sub-recent and ancient carbonate factories, on land and at sea.*

## **Rationale**

### 1. The **Carbonate Mound *Hotspot*** in the **Carbonate Factory**

- a. New views on the *global* carbonate factory: cold and warm waters.  
The prominent position of carbonate mound systems in both warm- and cold-water carbonate factories is increasingly recognized and analyzed in terms of relevance and importance in the global carbon cycle. The recurrence of prolific mound provinces at the turn between icehouse and greenhouse sparks interest for their potential significance and role in a changing world.
- b. New views on *processes, actors and products* in *mound formation*  
The new wave of mound research sweeps the full spectrum of Biosphere and Geosphere plays, on a stage of major oceanic turnovers in aragonitic / calcitic seas. In the Biosphere, benthic, planktonic and microbial ecosystems move equally to the foreground, in all their diversity. Bio-mineralization gets challenged by new insights in organo-mineralization. In the Geosphere, new and exciting observations are made about the role of siliciclastic input.
- c. New views on *processes, actors and products* in *mound transformation*  
The integration of sub-recent and fossil mound research for the first time sheds light on the full *catena* of diagenesis, from the immediate post-depositional stage to deep burial, as well as on the prominent role of geofluids.

d. *New views on old mounds*

Mounds represent a recurrent strategy of Life – throughout Phanerozoic times – and an exemplary mode of Geosphere-Biosphere coupling. Scrutinizing parallelisms and contrasts between mound systems in the present ocean and in the geological record deepens our insights in the basic drivers.

2. The **Carbonate Mound Recorder** in a **Changing Ocean**

a. *Nature and significance* of the carbonate mound record.

IODP Exp. 307 in particular, which added the power of the most advanced shipboard analytical capacity to a pioneering “hybrid” environmental / biogeochemical core flow, is a milestone in the deciphering of the ocean and climate message, locked in carbonate mounds. Depositional and diagenetic signals get progressively disentangled.

b. *The Shrine of the Lost Records*

IODP Exp. 307 has demonstrated how major records, lost from the embedding siliciclastic environment, could be recovered from carbonate mound sequences. This message may form a key in the comprehension of enigmas in ancient systems.

### Strategy

Hop in shallow and deep space and time in a *Holistic Vision*.

Develop *New Tools and Proxies* towards *Exploring* Mound **Space** and **Time**.

Shift from Exploration to *Experimentation*.

Enhance the *Human* and *Societal Dimension*.

Walk over *Stepping Stones* in the implementation process.

### Roadmap

The “Oviedo Declaration” team has identified major methodological and thematic stepping stones for navigating in a multidisciplinary and multi-cultural way through the world of sub-recent and ancient carbonate mound systems. Ocean drilling science and continental drilling science move in phase, in an integrated and cross-feeding strategy.