ECORD/ICDP

MagellanPlus Workshop Series Program

Deep-sea Record of Mediterranean Messinian events (DREAM II)

Paris, France
20th-23rd January 2014

Report to ESSAC

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April 9th 2014

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1. SUMMARY

The MagellanPlus DREAM-II workshop held in Paris on January 20-23 2014 follows only 7 months after the Magellan PlusDREAM workshop held in Brisighella (Italy) on May 5-8 2013. The goal of the DREAM initiative is to prepare a Multi-phase Drilling Project (MDP) to address a variety of exciting scientific themes that include the formation of one of the largest salt deposits (salt giants) in Earth's history, and are extended to the tectonic, hydrological and biological consequences of this extraordinary event. The fact that the Mediterranean salt giant is the youngest (it was formed about 6 million years ago during the Messinian stage of the Miocene), is still contained in the sedimentary basin where it formed and has suffered limited deformation, offers a unique opportunity to investigate geological, geochemical and biological processes in action.

In Paris we worked on the preparation of the Mediterranean MDP called "Uncovering a Salt Giant". We formulated the fundamental scientific questions that are addressed in four pre-proposals: *Messinian salinity Crisis*, *Salt Tectonics and Fluids*, *Surface to Deep Earth Connections (derived from the GOLD drilling project)* and *Deep Biosphere*. We also worked on developing a sapropel theme that will evolve into another pre-proposal in the near future. The first day of the DREAM-II workshop was dedicated to reviewing the state of the drilling proposals. We then divided into four working groups to further develop our drilling proposals. The complex task of choosing drilling sites, including alternate sites, which are adapted to tackle the wide range of questions addressed by this MDP was carried out. Based on our database of 2-D and 3-D seismic surveys, we located one deep drilling target in the Levantine Basin (eastern Mediterranean) and a shallow-to-deep transect comprising four drilling targets in the western Mediterranean basin. Our approach is multi-platform, with some sites accessible only with the RV *Chikyu* in riser mode, and others potentially accessible with the riser-less RV *Joides Resolution*.

Following the MagellanPlus DREAM-II workshop, we have submitted to IODP the "Uncovering a Salt Giant" umbrella proposal (857-MDP) and one pre-proposal (*Probing Surface to Deep Earth Connections*) on the April 1st 2014 IODP deadline. The three other pre-proposals are planned to be submitted on October 1st after the SEP response to the Umbrella proposal submission.

The road to Mediterranean scientific drilling is still long, but an important step forward was made in Paris. The actions we are undertaking to support our international effort include the submission (submitted March 28th 2014) of a EU COST action for long-term scientific networking (pre-proposal "DREAM", principal proponent Angelo Camerlenghi) and the presentation of the DREAM initiative at the upcoming EGU General Assembly in Vienna, Austria (27th April – 2nd May 2014).

2. OBJECTIVES OF THE DREAM-II WORKSHOP

During the DREAM workshop in Brisighella (May 5-8 2013), the stage was set for the preparation of a Multiphase Drilling Proposal (MDP) for scientific drilling in the Mediterranean Sea. After 20 years since the last Mediterranean ODP Leg and following the recent arrival of the Riser drilling vessel Chikyu in IODP (2004), the Mediterranean geo-scientific community led several networking initiatives aimed at attracting IODP drilling vessels in the Mediterranean. Outstanding problems that need scientific drilling to be tackled include deciphering the crustal structure of the Gulf of Lions, understanding the Messinian Salinity Crisis and the formation of Sapropels, and exploring the Mediterranean Salt Giant for subsurface life. The outcome of the first DREAM workshop was to identify four main scientific themes, each supported by a dedicated working group, which would prepare IODP pre-proposals under a general umbrella proposal called "Uncovering a Salt Giant". In addition, an important outcome of the Brisighella meeting was the identification of type-sites for drilling that are needed to tackle the scientific questions posed in DREAM. **The goal of the DREAM-II workshop held in Paris was to move forward with organising and writing the proposals for scientific drilling in the Mediterranean Sea.**

3. PARTICIPANTS

38 scientists participated to the DREAM-II workshop, including one representative from the oil industry (Richard Hedley, from Anadarko), 3 from CDEX/JAMSTEC (Nobu Eguchi, Francisco Jimenez-Espejo and Junichiro Kuroda) and one co-chair of the IODP Science Evaluation Panel (SEP, Dick, Kroon). We acknowledge the participation of Gilbert Camoin, director of EMA (Ecord Managing Agency), to the Paris workshop who underlined the strong support offered by ECORD to drilling initiatives in the Mediterranean Sea.

Table 1 - Participants (in bold the leaders of the proposals submitted or in preparation)

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DREAM-II Workshop participants : 1 Nicolas Waldmann, 2 Angelo Camerlenghi, 3 Terry McGenity, 4 Dick Kroon, 5 Lucien Montadert, 6 Marc de Rafelis, 7 Agnès Maillard-Lenoir, 8 Andrea Moscariello, 9 Daniel Garcia-Castellanos, 10 Rachel Flecker, 11 Christian Gorini, 12 Marina Rabineau, 13 Veronique Gardien, 14 Francisco-Javier Sierro, 15 Daniel Aslanian, 16 Speranta Popescu, 17 Antonio Caruso, 18 Fabrizio Lirer, 19 Vinicio Manzi, 20 Stefano Lugli, 21 Andrea Argnani, 22 Alessandra Negri, 23 Johanna Lofi, 24 Francisco José Jimenez-Espejo, 25 Gert deLange, 26 Junichiro Kuroda, 27 Vanni Aloisi, 28 Eguchi Nobu, 29 Lucas Lourens, Not on the photo : Christian Hübscher, Gilbert Camoin, Richard Hedley, Rolf Kipfer, Sierd Cloetingh, Zohar Gvirtzman, Catherine Pierre, Jeffrey Poort, Jean-Marie Rouchy.

4. PROGRAM

We dedicated the first day and a half to presentations by invited speakers and by leaders of the pre-proposals identified during the Brisighella DREAM workshop. A presentation by Dick Kroon (chairman of SEP) was particularly useful in directing our MDP preparation and submission strategy. A presentation by Sierd Cloetingh (Utrecht University) made it clear that DREAM will benefit from collaborating with the European network TOPOEUROPE ("The Geoscience of Coupled Deep Earth - Surface Processes"), specifically on the link between vertical tectonics and the rapid loading and unloading of the upper lithosphere during the emplacement of the Mediterranean Salt Giant.

Monday, 20th January

Morning – Arrival of participants

2 pm – Workshop Starts

1. Workshop Introduction (V. Aloisi).
2. Actions taken following the Brisighella DREAM meeting (A. Camerlenghi)
3. Commercial seismics from the Levantine basin, possibilities of collaboration within DREAM (Zohar Gvirtzman, Geological Survey of Israel)

3:30 pm – Coffee Break

4. Salt Logging (C. Bücker, RWE Dea; pres. given by C. Hübscher, University of Hamburg).
5. Noble gases as tracers of fluid flow in lake sediments (R. Kipfer, EAWAG, Dübendorf).
6. Mediterranean Seismic Database (J. Poort, Université Pierre et Marie Curie).
7. DREAM at EGU and other meetings (D. Garcia-Castellanos, CSIC-IJA, Barcelona).

Tuesday, 21st January

9:00 am

1. The TOPOEUROPE project: an example of a successful European research consortium (S. Cloetingh, Utrecht University).
2. The multi-proposal IODP strategy: about pre-proposals and the umbrella (Dick Kroon, University of Edinburgh, *RV Jodies Resolution* Scientific Evaluation panel, Co-Chair).
3. Uncovering A Salt Giant – the DREAM umbrella proposal (A. Camerlenghi, OGS, Trieste), followed by discussion.

10:30 am – Coffee Break

4. Pre-proposal : Messinian Salinity Crisis (J. Lofi, University of Montpellier / A. Camerlenghi, OGS),
   followed by discussion.
5. Pre-proposal : Crust and Sub-Salt Basin Stratigraphy (M. Rabineau, University of Brest), followed by discussion.

12:30 am – Lunch at the *Ardoise* restaurant (on campus)

5. Pre-proposal : Salt Tectonics and Fluids (C. Hübscher, University of Hamburg), followed by discussion.
6. Ideas for the Deep Biosphere proposal (T. McGenity, University of Essex).

3:30 pm – Coffee Break

7. Ideas for the Sapropel proposal (Gert de Lange, Utrecht University)

Wednesday, 22nd January

9:00 am

Participants break–up in groups to work on the different pre-proposals.

10:30 am – Coffee Break

12:30 am – Lunch at the *Ardoise* restaurant (on campus)

3:30 pm – Coffee Break

7.15 pm – DREAM dinner at a the Bouillon Racine restaurant

Thursday, 23rd January

9:00 am

Pre-proposal presentations: what needs to be done before submission (the various PIs).

10:30 am – Coffee Break

Next steps in the DREAM initiative (A. Camerlenghi, OGS).

12:30 am – Lunch at the *Ardoise* restaurant (on campus)

3 pm - Departure of participants

5. OUTCOME OF THE WORKSHOP

The main outcome of the DREAM-II workshop is the preparation – during the workshop and the two months that followed – of the MDP Umbrella proposal "Uncovering a Salt Giant." This umbrella proposal was submitted to IODP on April 1st 2014.

In addition, a milestone in the DREAM initiative, was the link established in Paris with the TOPOEUROPE project, whose objectives complement the part of DREAM addressing deep earth to surface connections in relation to the Messinian event in the Mediterranean.

After the presentations introduced in the previous section, the workshop participants split up in working groups to work on the pre-proposals that compose the MDP:

- DREAM: Deep-Sea Records of the MSC,
- Deformation and fluid flow in the MSC salt giant,
- Probing the Salt Giant for its Deep Biosphere secrets,
- Probing deep Earth and surface connections,

Starting from February 2014, IODP umbrella proposals follow the format of a Full IODP drilling proposal, and therefore require considerably more work than pre-proposals. We therefore concentrated, during the workshop and after, to co-ordinate our working groups in:

1) Defining four key scientific questions for the MDP

- What are the causes, timing and emplacement mechanisms of the MSC salt giant?
- What are the factors responsible for early salt deformation and fluid flow across and out of the halite layer?
- Do salt giants promote the development of a diverse and exceptionally active deep biosphere?
- What are the mechanisms underlying the spectacular vertical motions inside basins and their margins?

2) Identifying drilling locations

Two deep basin sites (A-Sites), including alternate sites, have been identified, one each in the Western and Eastern Mediterranean basin, aiming at the recovery of the complete Messinian sequence (Figure 1). One of these, in the Western Basin, will be extended down to basement, whereas the one in the Eastern Mediterranean will be limited to the Tortonian-Messinian boundary. Four intermediate basins sites (sites B and C) are located at shallower water depths and target the recovery of MSC records to reconstruct a shallow-to-deep transect where the A-Sites are the basinal end-member. Marginal basins sites (Sites D) are under consideration for ICDP, will obtain a continuous record of MSC deposits in order to provide some landward end-members of the shallow-to-deep transect approach.

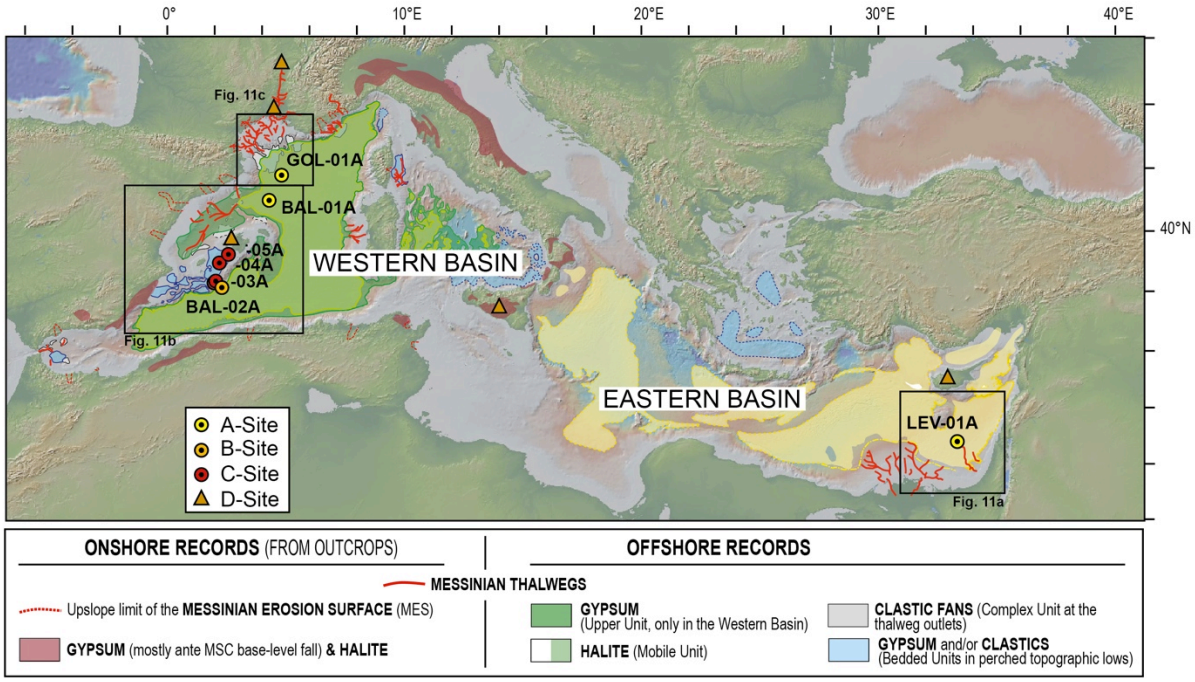

Figure 1. Location of drilling sites identified during the Paris DREAM-II workshop and included in the Umbrella proposal « Uncovering a Salt Giant ». A sites - Deep Basin ; B/C sites - Intermediate basins ; D sites – marginal basins

3) Putting together a strong umbrella proposal explaining our strategy and goals

The umbrella proposal "Uncovering a Salt Giant" can be downloaded by following this link:

http://cabernet.ogs.trieste.it/scambio/download_form.php?code1=aabca683a1707f10&code2=337899bb1929f4e3

4) Defining the overarching question and scientific objectives for the pre-proposals that will come under the umbrella "Uncovering a Salt Giant"

Pre-proposal 1 - DREAM: Deep-Sea Records of the MSC

Overarching question
What are the causes, timing and emplacement mechanisms of the MSC salt giant?
Scientific objectives

- to establish the chronology of the MSC in the deep Mediterranean comparing western and eastern settings;
- to uncover the nature and the origin of the evaporates in the deep Mediterranean setting;
- to develop unifying models for the MSC salt giant.

Pre-proposal 2 - Deformation and fluid flow in the MSC salt giant,

Overarching question
What are the factors responsible for early salt deformation and fluid flow across and out of the halite layer?
Scientific objectives
- to understand syn-sedimentary salt tectonics and halite creep;
- to constrain post-depositional salt deformation and its consequences on sedimentary mass wasting;
- to understand the physical and mineralogical conditions that allow fluids to migrate in and through thick tabular salt sequences.

Pre-proposal 3 - Probing the Salt Giant for its Deep Biosphere secrets

Overarching question
Do salt giants promote the development of a phylogenetically diverse and exceptionally active deep biosphere?
Scientific objectives

- to determine whether evaporitic sulfate minerals are fuelling the Mediterranean's deep biosphere;
- to establish whether the interaction between limiting factors (pressure, temperature, salinity) and a highly variable chemical environment has produced a diverse and novel deep biosphere community;
- to use the biomarkers and surviving microbes trapped within brine inclusions to reconstruct the depth, photic and oxic conditions of ancient, hypersaline depositional environments.

Pre-proposal 4 - Probing deep Earth and surface connections

This pre-proposal, which derives from the Full GOLD proposal developed in the past years, has been submitted together with the Umbrella proposal *Uncovering a Salt Giant* on April 1st.

Overarching question
What are the mechanisms underlying the spectacular vertical motions inside basins and their margins?
Scientific objectives

- to quantify the consequences of base-level change on river behavior, the erosion, supply, transport of sediment, karstification and landscape-relief evolution;
- to reconstruct a complete history of basin evolution, with a specific focus on the paleoenvironment, bathymetry and chronology of early sedimentation;
- to characterize the thermal and mechanical properties of the lithospheric crust underlying the western Mediterranean;
- to constrain the tectonic mechanisms that contributed to the closure of the gateways.

6. FUTURE ACTIONS SUPPORTING THE DREAM INITIATIVE

To support the DREAM initiative, we have carried out, or will carry out, the following actions:

- we have submitted a preliminary proposal for a EU COST action (principal proponent: Angelo Camerlenghi). This is aimed at creating a new network that will support the Mediterranean scientific community working on the Messinian Salinity Crisis and the formation of the Mediterranean Salt Giant. As an important part of this research can be addressed by scientific drilling, the DREAM group will benefit greatly from this initiative.
- During the IODP / ICDP colloquium in Erlangen, Germany (17 - 19 March 2014) a talk about DREAM will be given:

  Uncovering a Salt Giant. Deep-Sea Record of Mediterranean Messinian Events (DREAM) multi-phase drilling project

  Presented by: Christian Hübscher, Angelo Camerlenghi, Vanni Aoisi, Johanna Lofi, Gert deLange, Rachel Flecker, Daniel Garcia-Castellanos, Christian Gorini, Zohar Gvirtzman, Wout Krijgsman, Stefano Lugli, Yizhaq Makowsky, Vinicio Manzi, Terry McGenity, Giuliana Panieri, Marina Rabineau, Marco Roveri, Francisco Javier Sierro, and Nicolas Waldmann
- At the upcoming EGU General Assembly in Vienna, Austria (27 April – 2 May 2014) the dream initiative will be presented in the EuroForum 2014 session "Major achievements and perspectives in scientific ocean and continental drilling" :

  Uncovering a Salt Giant. Deep-Sea Record of Mediterranean Messinian Events (DREAM) multi-phase drilling project

  Presented by: Angelo Camerlenghi, Vanni Aoisi, Johanna Lofi, Christian Hübscher, Gert deLange, Rachel Flecker, Daniel Garcia-Castellanos, Christian Gorini, Zohar Gvirtzman, Wout Krijgsman, Stefano Lugli, Yizhaq Makowsky, Vinicio Manzi, Terry McGenity, Giuliana Panieri, Marina Rabineau, Marco Roveri, Francisco Javier Sierro, and Nicolas Waldmann

- The DREAM initiative will be also presented at a separate session chaired by a number of DREAM-team members:

  Capturing a Salt Giant: causes, processes and impacts of the Messinian Salinity Crisis in the Mediterranean realm (co-sponsored by IAS)

  Conveners: Daniel Garcia-Castellanos. Co-Conveners: Rachel Flecker, Angelo Camerlenghi, Christian Huebscher, Judith A. McKenzie, Lofi Johanna, and Sean Willett

  Messinian Salinity Crisis – DREAM (Deep-sea Record of Mediterranean Messinian events) drilling project.

  Presented by: Johanna Lofi, Angelo Camerlenghi and the DREAM Team

7. HOW THE MAGELLAN PLUS GRANT WAS SPENT

The allocated sum amounted to 15 k€. All but 418,60€ were spent:

Object	**Amount (€)**
3 Lunches at university restaurant	-2656,23
6 Coffee breaks	-693,60
1 Dinner at local restaurant	-1261,84
Travel and hotel costs for 25 participants	-9969,73
Total	**-14581,40**
Magellan Plus grant	+15000,00
Unspent grant to be returned to ECORD	**+418,60**