Deep Sea Frontier Infrastructure and Synergy in Europe

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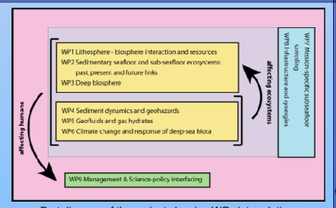
1. INTRODUCTION

Deep sea monitoring and studies represent the new frontier of science (e.g. Cochonat et al., 2007). The project DS³F provides a pathway towards sustainable management of oceanic resources on a European scale. It will develop sub-seafloor sampling strategies for enhanced understanding of deep-sea and sub-seafloor processes by connecting marine research in life and geosciences, climate and environmental change, with socioeconomic issues and policy building. The successful discovery and scientific achievement are strongly dependent on the availability, accessibility and novelty of the ocean technology and infrastructures and thus require the continuous innovation in marine engineering and knowledge transfer from a wide range of technical disciplines such as robotics, communications, energy to scientists, and then to policymakers.
DS³F Work Package *Infrastructure and Synergies* (WP8), will favour the cooperation and synergy of the major Infrastructure Stakeholders and Deep Seafloor Scientific Community in Europe within the DS³F initiative, and the elaboration of guidelines for the infrastructure development, access and utilisation in relations to:
- ships and research vessels deep-sea vehicles and equipment
- drilling facilities (i.e. borehole monitoring; DS³F WP7)
- long-term observatories/platforms for in situ measurements (threshold and continuous).

In addition, WP8 will assist in the development of advanced seafloor sampling technologies (rocks, sediments, fluids, microbiota) and the efficient use of European infrastructure (research vessels run by governmental funding in various countries, local networks, etc.) for a sustainable study of deep-sea and subseafloor ecosystems.
Another element involves the prioritisation of infrastructure development, access and utilisation. This WP will also provide guidelines for the optimal sharing and use of seagoing facilities in partnership with the EUROFLEETS FP7 project (see also Section 5). It will develop an Agreement/MoU to maintain access to scientific drilling through European membership to IODP, establish and develop in-situ long-term monitoring observation capabilities by means of multi-parameter seafloor and borehole observatories and moorings, implement a network of laboratories in Europe to improve analytical and modelling facilities in conjunction with the development of data banking and computer based handling facilities able to deal with large data sets. Collaborations and partnerships with industry and international research programmes will be another important element to achieve the goals of the project.

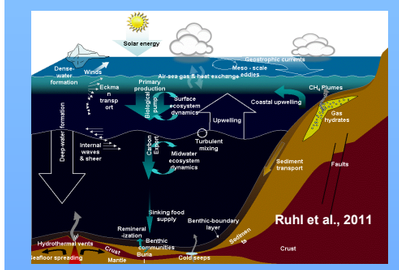
2. DS³F AT A GLANCE

Title: The Deep Sea & Sub-Seafloor Frontier (DS³F). A roadmap towards enhanced understanding and sustainability of the continental slope and deep sea of Europe and beyond
Instrument: Coordination Support Action - FP7
Time of run: 1 Jan 2010 - 30 June 2012
Consortium: 9 partners from 7 countries
Project Coordinator: University of Bremen (Achim Kopf)
Project Web Site: http://www.deep-sea-frontier.eu



Pert diagram of the project showing WPs interrelations

3. DS³F SCIENTIFIC MOTIVATIONS AND MAIN OBJECTIVES



Unravelling the complexity: interactions between atmosphere, ocean, earth processes

Scientific motivations

• To understand how deep sea ecosystems will respond to climate change.
• To understand the exchanges between the subseafloor, seafloor and water column (e.g. methane release, carbon burial) and predict how they might modulate climate change or vary due to it.
• To provide the background against which ecologically sustainable exploitation of the deep seafloor can be adequately planned and monitored.
•To better understand geohazards and the threat they pose to coastal locations.

Main Objectives:

• Integrate the multi-disciplinary Deep-Sea Frontier community and experts in scientific drilling and subseafloor processes into a strategic partnership, in order to assess which targets are needed and how seabed sampling will contribute to emerging questions.
• Provide a link for various deep-sea, observatory & sub-seafloor frontier projects underway across Europe and create synergies, and maximise the potential use of seagoing platforms, technology and scientific expertise.
• Produce a "white paper" and web portal for future research priorities in the deep-sea, seafloor and subseafloor frontiers that are required to underpin Europe's emerging Marine Strategy and Maritime Policy.
• Document areas where academia, and explicitly the international drilling initiatives and subseafloor sampling programs, have overlap with industry, and how synergy is gained when combining the two.

4. WP8: INFRASTRUCTURE AND SYNERGIES

WP8 Leader: INGV, Italy (Angelo De Santis)
WP8 Co-Leader: NOC Univ. South., UK (Phil Weaver)

WP8 Overall Objective
- To favour the cooperation and synergy of the major infrastructure Stakeholders and Deep Seafloor & Sub-seafloor Scientific Community in Europe within the DS³F initiative

WP8 Tasks:
- ***8.1*** Establishment of a **working group** (WG-8) on infrastructure, laboratory network, data banking development, aimed at the expression of priorities.
- ***8.2*** Planning of meetings able to address major issues ("guidelines") and meeting organisation
- ***8.3*** Requirements to enhance the seafloor monitoring measurement methods/techniques on the basis of supplementary scientific inputs obtained from WPs 1 to 6.
- ***8.4*** Contribution to a DS³F "white paper" on the basis of inputs from working group on infrastructure and to the final version of a road map.

(*) WG-8 is a core group of experts experienced in Development/Establishment/Maintenance of Infrastructure/laboratory networks/data banking and Synergies. Members:
A. De Santis, *INGV, Italy* (*seafloor observatories, synergies);* P.Weaver, *NOC Univ. Southampton, UK* (*ships, ROVs and labs);* J.-F. Rolin, *Ifremer, France (ESONET);* C. Waldmann, *MARUM, Germany (Metadata and Data management)*; V. Lykousis, *HCMR , Greece (Ships, marine laboratories)*; C. Mevel, *IPGP, France (IODP related equipment)*; P. Coyle, *CNRS, France (ANTARES underwater station)*; G. West, *NOCS, UK (Deep-sea platforms, AUVs, ROVs)*; E. Migneco, *INFN, Italy (KM3NET)*; J.J. Danobeitia, *CSIC- UTM Spain (Ships)*; G. Hansen, *SIOS (Infrastructures)*, M. Gilloly (F. Grant), *IMI, Ireland (Infrastructure),* L. Beranzoli, *INGV, Italy (Seafloor Observatories),* N. Zitellini, *CNR-ISMAR, Italy (Marine laboratories)*. (underlined: waiting for acceptance)

5. INFRASTRUCTURE AND SYNERGIES IN EUROPE

Marine technology has strongly evolved over the past decades and has been offering Science new tools to achieve advances. As example, deep-sea vehicles (e.g., ROVs, AUVs) are now key tools for the exploration of the deep ocean realms as well as drill ships which can provide long records into the past. Moreover, since developments in industry run in parallel, the science community has benefited from a mature industrial supplier base and has been able to progress towards greater depth and higher reliability regarding new sensor systems for physical, chemical and oceanographic in situ measurements. The DS³F project will contribute to set the preconditions to fulfill the crucial technological and infrastructure needs of the deep-seafloor scientific community like:
• access to surface support ships and research equipment;
• improved high resolution mapping and imaging of the seabed and the subsurface, including 3D seismics;
• advanced sampling technologies for rocks, sediments, fluids, fauna and microbiota;
• *in situ* measurements for key oceanographic, geological and biogeochemical parameters;
• access to drilling facilities for a variety of scientific tasks, including borehole monitoring;
• long-term *in situ* observation and monitoring, including repeated high-resolution surveys,
• continuous measurements, and event-triggered sampling and analyses;
• high throughput and high resolution analytical service platforms;
• improved analytical and modelling techniques;
• global databases and sample archives.

Deep Sea Vehicles

www.marum.de/en/ROV.html

MFSTEP glider at sea just before starting the operations

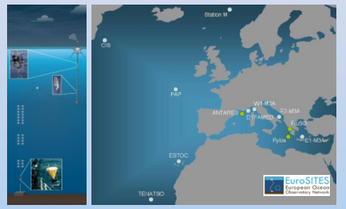
mfstep.bo.ingv.it

Research Vessels

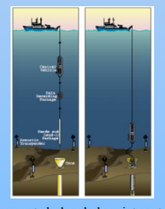
www.eurofleets.eu

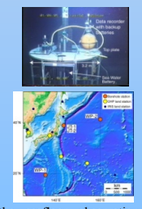
In-situ measurements: temporary and permanent

Sustained in-situ observations at short-time (seconds, minutes, hours, days) and long-time (months, years, decades) scales are essential to explore the whole time-scale of the changes of the oceanic environment and to investigate the complex interrelations between processes.



EuroSITES (www.eurosites.info) is a FP7 Collaborative Project (2008-2011) which is integrating and enhancing the deep-ocean (water depth >1000m) observatories into a coherent network. The EuroSITES network is coordinated by the National Oceanography Centre, Southampton, UK and involves 13 Partners across Europe (7 member states) and the Cape Verde Islands (eg Lampitt et al., 2009).

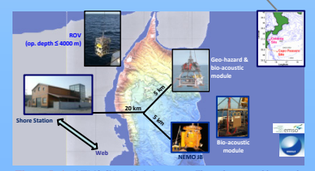




Instrumented boreholes integrate the seafloor observation systems and experience were gained especially in Western Pacific. As an example, above figures on the left report the sequence of operations for downhole installations and a sketch of the local acquisition system (Shinohara et al., 2006). The above figure on the right show the instrumented borehole of Site 1179 observatory developed that produces high-quality digital seismic data under the ongoing Japanese OHP programme. Tests with other borehole seismometers show that the background noise level for oceanic borehole instruments is much less than most of their counterparts on land (e.g. Stephen et al., 1999, 2003). The extension of this experience to Europe would be of great utility for geohazard and other marine disciplines.

EMSO (European Multidisciplinary Seafloor Observatory) is a Research Infrastructure of the ESFRI (European Strategy Forum on Research Infrastructure) Roadmap. It is the European network of fixed seafloor and water column observatories constituting a distributed infrastructure for long-term monitoring of environmental processes. EMSO is presently in the third year of the Preparatory Phase Project (2008-2012) including 12 partners from 12 countries. The Preparatory Phase has the objective to establish the legal entity managing and maintaining the infrastructure.

1) GEOSTAR observatory during the ESONET-LIDO demo mission; 2a, 2b) Seafloor installation during the ESONET-MODOO demo mission; 3) junction box of MEUST-cabled observatory; 4) POSEIDON experiment; 5) ESONET-Marmara demo mission.



Western Ionian NEMO-SN1 cabled observatory: The underwater cable extends from Catania harbour 25 km off-shore down to over 2000 m w.d. The observatory is able to acquire geophysical, oceanographic, bioacoustic time-series.

6. WHAT'S NEXT ?

Specific actions have been identified with the aim to accomplish the main goal of DS³F WP8 such as the elaboration of appropriate guidelines for the infrastructure development, access and utilisation in relations to ships and research vessels, deep-sea vehicles and equipment, drilling facilities and long-term observatories/platforms for in situ measurements. A first version of the Table of Content of the WP8 guidelines has been set up and presented during the first WG8 meeting hosted by the General Assembly of ESONET- NoE (Marseille, Dec. 2010). Next steps will be to produce a draft of this document to be circulated for additions by WG8 members. Also inputs from leaders of other DS³F WPs and WGs members will in turn produce refinements/modifications/additions according to an *iterative* approach. Then the document will be presented during next planned workshops for further integrations and improvements.

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