EUROFLEETS

Call
"Ocean" and "Regional1"
Funded Projects Abstracts

EUROFLEETS funded projects call "Ocean"2010:

RV Polarstern

Sources and transformation of coloured dissolved organic material (CDOM) along in the Atlantic Ocean (ATLANTIC-CDOM)
Principle Investigator: Dr. Piotr Kowalczuk (Institute of Oceanology, Polish Academy of Sciences, Poland)

The main goal of the research activity of the IOPAS research team is to characterize CDOM in the Atlantic Ocean along the transect form Germany to Chile with use of the absorption and fluorescence spectroscopy in the samples collected by discrete depths sampling and continues measurements alongship track. The IOPAS contribution will be focused on spectrophotometric measurements of water samples in the laboratory and in situ sampling with use of the CDOM fluorometer. The samples will scanned with use of the spectrophotometer and scanning spectrofluorometer in the laboratory on board.

Additionally portion of the filtered water will be acidified and stored for measurements of the DOC concentrations in the IOPAS's chemical laboratory in, Sopot, Poland. The spectrofluorometric scans will composed in forms of the Excitation Emission Matrices. Those spectral data will be analysed statistically with use of the Parallel Factor Analysis – PARAFAC to estimate main components that compose the Dissolved Organic Matter. The specific components identified by the PARAFAC model should provide information about sources and sinks of the DOM. The information about the DOM composition and its transformation in the selected basins of the Atlantic Ocean obtained from the spectrophotometric analysis will be extended spatially with use of the in-situ measurements of the CDOM fluorescence and absorption with use of the TRIOS CDOM fluorometer and AC-9 meter in the quasi flow through system.

The IOPAS team would also measure full suite of measurements of the spectral properties of incident solar radiation and the apparent and inherent optical properties of oceanic waters. The along tract measurements will be also extended with above water radiometric measurements. The spectral information about the incident solar radiation and its propagation through water column will be used as the support interpretation of the photochemical transformation of the CDOM.

RV Celtic Explorer

Impacts of Sub-seabed CO2 storage on Marine Ecosystems in the North Sea (ECO2@NorthSea)
Principle Investigator: Dr. Peter Linke (Leibniz-Institute for Marine Sciences (IFM-GEOMAR), Germany)

The proposed cruise will be carried out in the framework of the EU project ECO2, which sets out to assess the risks and long-term impacts associated with the storage of CO2 below the seabed. Carbon Capture and Storage (CCS) is regarded as a key technology for the reduction of CO2 emissions from power plants and other industrial sources at the European and international level. The EU decided to support a selected portfolio of demonstration projects to promote, at industrial scale, the implementation of CCS in Europe. Several of these projects aim to store CO2 below the seabed. However, little is known about the short-term and long-term impacts of CO2 storage on marine

ecosystems even though CO2 has been stored in the North Sea (Sleipner) for more than 14 years and for 1 year in the Barents Sea (Snøhvit). In this regard, ECO2@NorthSea will assess the likelihood and impact of leakage on marine ecosystems, apply novel monitoring techniques to detect and quantify the fluxes of formation fluids, natural gas, and CO2 from storage sites, and, finally, develop a best practice guide for the management of sub-seabed CO2 storage sites. On the cruise, proposed here, we wish to investigate the Sleipner CO2 storage site operated by Statoil and the natural shallow water CO2 seep offshore Juist Island. We intend to quantify fluxes of key chemical parameters and potentially toxic metals and study the mechanisms determining the migration of CO2, CH4, and formation waters through the sedimentary overburden by a variety of novel monitoring techniques. Included in the study are investigations of seawater chemistry together with the near-field dispersion processes as key input parameters for our environmental studies and numerical model simulations. We will also carry out the assessment of the distribution of sensitive megafauna and will use fingerprinting of microbial community diversity as a key indicator of environmental impacts.

RV Marion Dufresne

The Mediterranean-Atlantic Gateway Code - The Late Pleistocene Carbonate Mound Record (GATEWAY)
Principle Investigator: Dr. David Van Rooij (Ghent University, Belgium)

This proposal, named "The Mediterranean-Atlantic Gateway Code", aims to combine multidisciplinary high-level research at the frontier of geosphere and biosphere interactions with active training for young ocean scientists in a true "floating university" spirit. The study areas, located on the Moroccan margin at either side of the Gibraltar gateway, lie on the crossroads of (a) cold-water coral (CWC) carbonate systems, with sequences covering the Plio-Pleistocene interval, (b) siliciclastic (contouritic) processes driven by vigorous and dynamic intermediate water masses and (c) seepage and fluid flow processes. Therefore, we aim to study two major CWC mound provinces; the Pen Duick mounds in the Gulf of Cadiz and the Melilla mounds in the Southern Alboran Sea. We postulate that they hold the key to the origin and early development of the Porcupine mound provinces and comparable cases along the European continental margins. Both on- and off-mound records will document the gateway dynamics and its influence on deep-water ecosystems. The PDE and Melilla mounds are both are mature sites in terms of site-survey preparation, documented by various types of seismic profiling, multibeam and sidescan sonar data and ROV investigations within the framework of past and present national and international projects (ESF, EC). In both cases, we envisage precise (USBL-guided) coring in order to investigate and compare their spatial and temporal variability with respect to their internal palaeoenvironmental drivers, common evolution through time and the processes leading to early diagenesis. The present proposal, focussing on two mound provinces featuring an active interplay between the key internal and external processes, is therefore a logical process-driven companion and pendant of IODP expedition 307.

Tore Oceanic Reservoir Environment (TORE)
Principle Investigator: Dr. Silvia Nave (Laboratório Nacional de Energia e Geologia, Portugal)

The Tore Seamount (TS), located 300 km off Lisbon, is a 5.5 km-deep depression (TB) of enormous dimension (120x90 km), isolated from the surrounding seafloor by an elliptical alignment of individual seamounts. The bottom-waters are isolated from the Atlantic below 4.3 km, at which depth all exchanges occur through a single gate, raising challenging questions regarding the dynamics of inner circulation, water exchanges with the NA basin and the degree of ventilation of TB waters.

The unique morphostructure of the TS encourage unusual physical, geochemical and biological interactions. Four multidisciplinary research targets are proposed, considering the TS as:

1) A small vase in a wide oceanic basin, to test the (i) role of barocline tides and internal waves in mixing enclosed water inside the cratera; (ii) formation, deviation and entrance of eddies through the gateway; (iii) hypothesis of geothermal heat flux driving deep water ventilation.

2) A natural oceanic sediment trap, where the TB acts as a magnificent pool to archive the oceanic vertical particle flux and therefore productivity.

3) An in-situ paleoceanographic laboratory, to test the (i) preservation of bottom carbonate sediments through the geological record (ii) impact of glacial/interglacial AMOC changes on TB ventilation.

4) 4) The realm of gravitational currents, as the TB is cut-off from continental along slope currents which often interfere with gravitational processes and hence mask the in-situ sedimentological records. Global impact of ocean temperature and sea-level changes, of variable magnitude, will be tested in this singular environment.

This proposal benefits from the acquisition of preliminary data, like high-resolution geophysical imaging, during previous projects, and ensures an IODP proposal. It gathers a team of experts using state-of-the-art techniques to pursuit the project aims. Here, we apply for coring of one site in the Tore basin and a CTD at the same position.

RV L'Atalante

Features of Azores and Italian Volcanic Islands (FAIVI)
Principle Investigator: Prof. Dr. Francesco Latino Chiocci (University of Rome, Italy)

The project is aimed at comparing selected geological features that were studied in detail in Italian volcanic islands and in central Azores archipelago (Terceira and Faial Islands) by research groups that are proposing the cruise. Specifically the study is addressed to twofold scientific topics in Terceira and Faial (central Azores):

1) The study of peculiar and extremely uncommon eruptive products (lava balloons), relevant to intermediate-depth submarine volcanic eruptions, through the comparison of two (of the 4 worldwide known) areas where this kind of products have been erupted in historical (1891 at Pantelleria, Italy) and recent times (1998-2001 at Terceira, Azores). The study is aimed at defining eruptive processes and physical conditions associated to the genesis of those products, possibly relating them to specific geomorphic features at the seafloor. This may lead to geohazard assessment for poorly known intermediate-depth submarine eruptions.

2) The characterization of inner shelf depositional bodies commonly rimming volcanic islands (among which several Italian insular volcanoes and Faial in the Azores). These features have a terraced morphology, are located at a nearly constant depth below sea level, and display a prograding inner geometry. Despite their wide distribution, physical processes driving their formation are only partially understood, especially the relationships with relative sea-level fluctuations. The sampling of previously studied

clinoforms at Faial (Quartau et al., 2010) will allow to unravel their age of formation and their relation with the growth of this volcanic island. The comparison with well-studied cases on Italian volcanic islands (in different oceanographic and volcanic setting) would allow to test a possible comprehensive genetic and evolutionary model as well as their relationships with the eustatic changes at short, middle and long terms.

RV OGS-Explora

Salt deformation and sub-salt fluid circulation in the Algero-Balearic abyssal plain (SALTFLU)
Principle Investigator: Dr. Angelo Camerlenghi (ICREA c/o University of Barcelona, Spain)

Subsurface salt deformation is known to affect the circulation of hydrocarbon fluids on continental margins. Messinian evaporites interact with seawater and sediment pore fluids in the convergent margins of the Eastern Mediterranean where salt dissolution and tectonic deformation generate large brine pools. Mud diapirism in these areas may also be associated to the distribution of halite salt. The tectonic quiescence of the Central and Western Mediterranean extensional basins has not been considered until now to generate salt-fluid interaction other than the one deriving from de-watering of the post Messinian clastic wedges at river mouths.

The south Balearic abyssal plain remains a relatively poorly studied sector of the Western Mediterranean Sea. A scouting survey conducted in 2005 combining multibeam bathymetry and seismic reflection techniques, demonstrated that subsurface evaporite deformation structures are indeed responsible for shallow sediment deformation, and that a dense pattern of sub-vertical normal faults occurs on and around abyssal knolls and seahills. Mud volcanoes, shallow gas, and the possible presence of an active polygonal fault system suggest upward fluid migration and fluid expulsion at the seafloor.

We propose to obtain a close grid of multi-channel seismic reflection profiles and to collect a set of sediment cores in order to define in three dimensions the geometry of salt deformation, to understand the deformation below and above the salt, and to provide geochemical ground-truthing to the seismic evidence for fluid venting at the seafloor.

EUROFLEETS funded projects call „Regional 1“ 2010:

RV Dom Carlos I

Diazotrophic pico-cyanobacteria in the North Atlantic open ocean: their abundance and importance as a source of new nitrogen at the Azores Current Front (DIAPICNA)
Principle Investigator: Dr. Virginie Riou (Vrije Universiteit Brussel, Belgium)

The increase in atmospheric CO2 within the last century and its effect on climate change has urged the need for more research on the processes leading to carbon sequestration. In oceanic biogeochemistry, the ‘Biological Pump’ is the sum of a suite of biologically mediated processes transporting carbon from the euphotic zone to the ocean’s interior. As a constituent of DNA and proteins, nitrogen is a vital element and its availability limits the growth of CO2–fixing biological actors over most of the global oligotrophic oceans. The largest N pool in the ocean, dissolved N2, is

available to only a small number of planktonic microbial species producing the necessary enzymes for N2 fixation (one of which being encoded by the highy conserved NifH gene). These organisms, amongst which unicellular cyanobacteria (UCYN), introduce new nitrogen into the ocean, thereby contributing to carbon export. While the pace of research has steadily increased, the extent of the distribution and activity of N2-fixers in the ocean still remains poorly known. The present proposal aims at improving our understanding of the inter-linkages between the N2 and CO2 fixation processes mediated by unicellular cyanobacteria, in particular at the Azores Front/Current system in the North Atlantic Ocean. The front separates subtropical and temperate water masses, in each of which we will assess:

1) the influence of nutrients, temperature, depth and light on N2-fixation, NifH gene diversity, UCYN distribution;

2) the specific abundance of UCYN (using new fluorescence in situ hybridization techniques) and their contribution to N2-fixation;

3) the transfer of fixed carbon into UCYN-specific biomarkers.

We expect to increase the pool of data on this group of organisms which might be key players in the atmospheric CO2 sequestration.

RV Akademik / RV Mare Nigrum

Bio-Optics for Ocean Color Remote Sensing of the Black Sea (BIO-OPT)
Principle Investigator: Prof. Dr. Temel Oguz (Institute of Marine Sciences (IMS), Turkey)

Optical remote sensing (satellite ocean color) can reliably provide synoptic information of the biogeochemical properties of the oceans. However, it does not provide satisfactory product for marginal seas and more specifically in coastal regions because of the lack of methodologies accounting for regional ecological regimes. This is the case for the Black Sea which, despite of its political and economical importance, has been little explored in terms of bio-optics.

Aiming at generating satellite ocean color products suitable to investigate environmental and climate processes in the Black Sea, a spontaneous regional collaboration has recently grown to more efficiently tackle logistic and scientific problems. Primary objective of this collaboration is a comprehensive bio-optical characterization of the western-central regions of the Black Sea (those exhibiting the highest environmental stress and range of variability in bio-optical features) using state of the art measurement methods and instrumentation during seasons exhibiting different trophic regimes. Such an objective will be achieved by performing quality assured measurements of the apparent and inherent optical properties of seawater, in addition to the concentration of optically significant constituents. Apparent optical properties are the remote sensing reflectance, the irradiance reflectance and the diffuse attenuation coefficient. Inherent optical properties are the absorption, scattering, back-scattering coefficients and volume scattering function. Concentrations of specific seawater suspended constituents include those of pigments and total suspended matter. These in situ bio-optical measurements will be later used for the development of regional bio-optical algorithms essential for the generation of highly accurate satellite ocean colour products (i.e., maps of chlorophyll a, total suspended matter and yellow substance).

RV Akademik

Spatial methane flux quantification from a pockmark area in the Black Sea (SPUX)
Principle Investigator: Prof. Dr. Jens Greinert (Royal Netherlands Institute for Sea Research (NIOZ), The Netherlands)

Cold seeps at which methane is released as or dissolved free gas phase (bubbles) are a global phenomenon at continental margins and shelf areas. The Black Sea with its un-oxic conditions below ~110m water depth is well known for its occurrence of methane seeps at very different water depth inside and outside the gas hydrate stability field with unique microbial communities and very high flux rates. This makes the Black Sea an exceptionally well suited area to study methane generation and consumption in the sediment as well as methane-bubble transport through the water column and its distribution and consumption under different geochemical conditions.

We propose to investigate a large seep area (4 by 40km) southeast of Varna in Bulgarian waters where a large number of pockmarks as well as bubble release has been documented two decades ago but with no further studies after that (Dimitrov & Dontcheva, 1992). Scientifically we intend to study a) pockmark formation mechanisms and the influence of sediment properties and water currents on size and shape; b) investigate the area for active fluid seepage, determine the gas and fluid sources as well as flux rates into the water column; c) study the relevant geochemical and microbiological processes related to the methane seepage; d) elucidate the fate of methane in the water column and the bubble dissolution behavior inside and outside the an-oxic zone; and finally e) quantify the amount of methane that reaches the sea surface and maybe the atmosphere.

RV Garcia del Cid

Carbonate-shelled zooplankton along the western Iberian margin: Genetic diversity and stable isotope signals (Iberia-Forams)
Principle Investigator: Dr. Antje Voelker (Laboratório Nacional de Energia e Geologia, Portugal)

We aim to collect 1) planktic foraminifer and pteropods and 2) sea water samples along one longitudinal and several latitudinal transects from the nearshore to offshore regions along the western Iberian margin for proxy calibration and genetic studies and for understanding the modern planktic foraminifer diversity and abundance in this eastern boundary upwelling region. Depending on the season in which the cruise will take place, either upwelling conditions (spring/ summer) or the influence of the subtropical Iberian poleward current in fall/ winter will be sampled. Studying the influence of either hydrographic situation on the planktic foraminifer fauna and the stable isotope composition in their carbonate shells is essential if we want to know which foraminifer species best reflect(s) the seasonally variable hydrographic conditions in this region. Having evidence from the water column with known hydrographic and ecological conditions would greatly help in extracting seasonal signals in our paleoceanographic studies and thus to provide climate modellers with more precise information for the model/ data comparison.

By comparing the stable isotope values of the sea water samples with those measured in the respective foraminifer shells we can calculate the offset that reflects the vital effects on the stable oxygen and carbon ratios that a foraminifer incorporates into its shells. Additionally, the genetic fingerprinting will help to distinguish between subspecies. There will be 2-3 plankton tows over different depth intervals at each station to obtain sufficient material for the subsequent geochemical and genetic analyses.

The samples will be used for a PhD thesis and would provide an important bridge between the CALIBERIA project off Vigo and the ISO-TRACES project, if funded, on the southern Iberian margin.

RV Urania

The Panarea natural CO2 seeps: fate and impact of the leaking gas (PaCO2)
Principle Investigator: Dr. Daniel McGinnis (Leibniz-Institute for Marine Sciences (IFM-GEOMAR), Germany)

Carbon capture and storage (CCS), both on- and offshore, is expected to be an important mitigation for climate change due to anthropogenic carbon dioxide (CO2) emissions. In marine environments, however, the impacts of CO2 leakage, appropriate detection methods, and risk and pathways of atmospheric emissions are poorly defined. To address these issues, we propose an investigation into the natural CO2 gas seeps that occur in the relatively shallow waters off the coast of Panarea Island (Aeolian Islands, Italy). This site would ideally serve as a large-scale, real-world analogue of the impact and fate of CO2 in the water column should leakage occur at an offshore CCS site. We propose the application of integrated biological, chemical, and physical measurements at this site, comprising the following work:

1) Regional acoustic/seismic survey to locate bubble seeps related to shallow geological features;

2) Air-sea CO2 exchange survey to map CO2 transfer to the atmosphere;

3) Utilizing hydroacoustic data to select 20 stations for vertical profiling and measurements in and around defined seeps with emphases on the spatial biological and chemical impact;

4) High-resolution physical measurement campaign at two bubble plumes to determine structure, transport and mixing characteristics;

5) Using data to calculate rates of CO2 bubble flux, dissolution, and dispersion; and finally,

6) Plume modelling using collected data to allow extrapolation of the Panarea results to other potential and current CCS marine sites.

The results of this intense and multidisciplinary study will allow us to address questions specific to the Panarea site, such as estimating fluxes, pathways, atmospheric emissions, etc., and will also allow us to provide guidance for monitoring and CO2 leakage impact estimations at CCS locations.

RV Ramon Margalef

Sea trials of newly develop deep sea messenger buoy systems (DRUMB)
Principle Investigator: Mr. Thierry Terre (French Research Institute for Exploitation of the Sea (Ifremer), France)

There is an increasing need for timely and save data return from moored instrumentation not only for scientific but monitoring. In particular in harsh ocean environments permanent

constructions/buoy that host data telemetry systems at the ocean surface comprise a high risk of loss and require frequent service. One less costly and saver solution is data telemetry by using messenger buoys. Messenger buoys are installed subsurface in a launcher frame, either at the sea floor or in an oceanographic mooring. The device stores data from directly attached or inductive linked instrumentation and release, in predefined intervals, one of its messenger buoys which then rises to the surface and telemeters the stored data via satellite a shore.

So far we are aware of three such systems that are currently under development in France (IFREMER), in Germany (OPTIMARE/IFM-GEOMAR) and in US (NOAA/AOML). The general design of all three systems is based around a central node that collects and stores data from attached instruments and that transmits the data to a number of attached messengers. At IFREMER, it uses a microwave underwater channel to exchange data from the central node to the expandable messengers. The basic functioning of the microwave link has been validated by trials in a seawater pool. The remaining functions (programmable release, satellite link, data storage) and the overall integration are still in progress. After ongoing and planned tests and trials in our testing facilities (hyperbaric tank, 20-m deep pool, ...) it is mandatory to launch a sea trial to qualify the fully assembled system under real conditions. The German and the US systems use different communication between central node and messengers (optical). To be able to validate the three systems against each other we propose to have a parallel deployment of the three systems and the required ship time is applied for here.