CIESM-SUB2 Cruise

Leg 1

R/V URANIA

Messina to Sardinia Channel and back to Messina

6 - 13 December 2005

Cruise Report

The ship

The Team

CIESM SUB2 geological leg
6-13 December 2005 - CRUISE REPORT
(local time)

Period:	December 6th – December 13th, 2005
Area:	Sardinia Channel
Chief Scientist:	Francesca BUDILLON (CNR - IAMC)
Principal Invesigator:	Laura GIULIANO (CNR - IAMC)
Scientific Coordinator:	Franco DECEMBRINI (CNR - IAMC)
Research Vessel:	R/V URANIA (Consiglio Nazionale delle Ricerche)
Ship Captain:	Vincenzo LUBRANO DI LAVADERA (So.pro.mar)

LOCATION AND GOALS OF CRUISE

The CIESM-SUB2 Leg1 cruise officially started in the evening of the December 6, 2005 from the port of Messina. Thirteen people from researchers and technicians coming from 6 different institutions, 4 Mediterranean countries, 2 journalists and 13 crewmembers were on board. The first leg ended early 13th December in Messina Harbour, after 6 days of intense activities. The field operation (see map on figure 1) started on the 8th December and terminated on the 12th of December, because of about 70 h transfer time. The CIESM-SUBII cruise was carried out on-board R/V *URANIA*, a 60m long ship owned by CNR and operated by *Sopromar* s.p.a..

The Sardinia Channel between Egadi Islands (Sicily) and Capo Carbonara (Sardinia) was the target of the cruise. It represents a key sector for reconstructing the geological evolution of the western Mediterranean basin area and for the regime of water masses exchanges. In this area a submerged sector of the Apennine Maghrebian branch of the Alpine orogen is present and separates the Tyrrhenian (Neogene in age) and the Algerian-Provençal (early Miocene in age) oceanic basins. The primary goal of cruise CIESM Sub2 - Leg1 was to implement the bathymetric dataset of the southern Tyrrhenian Sea, and tentatively link it to the Italian (CNR) swath bathymetry acquisition in this crucial sector. The mapping of the seafloor involved a double purpose, namely to visualize in detail the features of the seabed and to understand how the morphology could be a forcing for water mass circulation and effects large-scale basin exchange on the western Mediterranean basin.
A second goal was to investigate the relationships between benthic biodiversity and functioning along bathymetric gradients, comparing biodiversity of different biotic components (from bacteria to meiofauna) and control areas (i.e. slope), in order to verify whether seamounts represent "hot-spots" of benthic biodiversity. Five sites for sampling relatively undisturbed sediment, with related benthic faunas have been selected and correspond to morphologies pertaining to the sectors 1 and 3. At the same sites hydrologic sampling along the water column were previewed, in order to update time series available from previous cruises in this area and measure physical and biological parameters. Two more sites for seabed sampling were selected on the northern slope of Egadi Island. Coring sites were also scheduled in order to make the ground truth respect to chirp profiles and were located on the top of Ichnusa seamount and in the deepest part of Sardinia Valley.

WEATHER CONDITION DURING THE CRUISE

The whole period of the cruise was affected by unstable weather conditions: three gales, two from southwest and one from northeast, followed one upon the other with speed rate up to 60 knots and causing very rough seas between 3-5 meters. Twice we were forced to stop (on the 7 of December the way to the area and on the way back the 11 of December) for a total period of about 25 hours. Despite such unfavourable conditions we managed to acquire geophysical, sedimentological and

hydrological data, partially matching the objectives of the Leg1, thanks even to the great cooperation of the Urania crew that gave us support in sampling operations even in rough sea conditions.

DATA GATHERING

No relevant technical failure at the instrumentation effected the data acquisitions, except for the box corer that didn't work properly in deep water. After several repairs made by the Chief engineer, satisfactory results were obtained.

Finally results consisted of:

- A coverage of about 900 kmq of Multibeam data;
- 304 nm (488 km) of Chirp data triggered at 0,5-1-2-3-4 sec rate depending on depth;
- 3 casts at sites E5, E6, E7 the last let at -2400 m down and 2 NFP;
- 2 gravity cores, the shallowest at about -210 m recovered 2,5 m of coarse sediment and the deepest at -2400 m recovered 5.4 m of hemipelagic mud;
- 3 box corer and 1 grab at depth comprised between 400 m and 1500 m of depth.

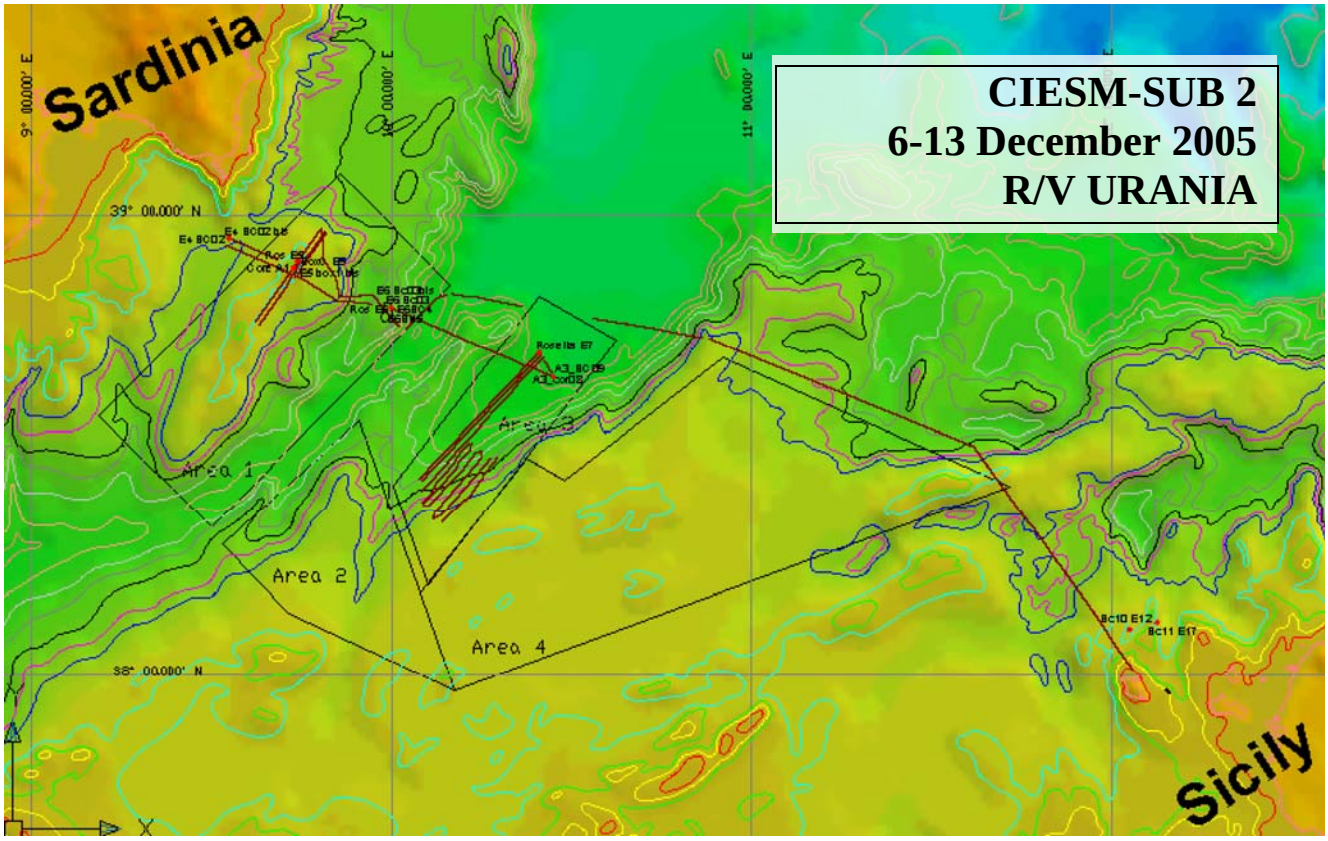

Figure 1 – Map of the survey: navigation and way points

SCIENTIFIC-TECHNICAL STAFF

The names and identities of the embarked personnel and main activity field are given in the Table I.

Table I – CIESM-SUB2 Leg1 personnel

	Name	*Affiliation*	*Country*	*Activity*
1	Francesca BUDILLON francesca.budillon@iamc.cnr.it	CNR-IAMC Napoli	Italy	Chief Scientist

2	Renato TONIELLI renato.tonielli@iamc.cnr.it	CNR-IAMC Napoli	Italy	Geology (sampling and data acquisition)
3	Sara INNAGI sara.innangi@iamc.cnr.it	CNR-IAMC Napoli	Italy	Geology (geophysics acquisition)
4	Paola MUSSONI paola.mussoni@unitr.it	UNI-Parma	Italy	Geology (geophysics acquisition)
5	Alessandra SAVINI alessandra.savini@unimib.it	CoNISMa UNI-MI Bicocca	Italy	Geology (geophysics acquisition)
6	Sebastien GARZIGLIA garziglia@geoazur.obs-vlfr.fr	CNRS_Villefranche	France	Geology
7	Mohamed SAHABI sahabimohamed@yahoo.fr	Faculté des Sciences El Jadida	Marocco	Geology
8	Siri CAMPBELL siri@ciesm.org	CIESM	Monaco	Press Report - CIESM
9	Carolyn SCHEURLE cscheurle@ciesm.org	CIESM	Monaco	Geology (activity coordination)
10	Gian Marco LUNA g.luna@univpm.it	UNI-AN	Italy	Meiofauna, benthic bacteria biodiversity, viruses
11	Daniela ZEPPILLI danielazeppilli@virgilio.it	UNI-AN	Italy	Meiofauna, benthic bacteria biodiversity, viruses
12	Giovanna MAIMONE giovanna.maimone@iamc.cnr.it	CNR-IAMC Messina	Italy	Hydrographic sampling
13	Francesco RAFFA francesco.raffa@iamc.cnr.it	CNR-IAMC Messina	Italy	CTD data acquisition and processing
14	Francesco SORACI francesco.soraci@iamc.cnr.it	CNR-IAMC Messina	Italy	Hydrographic sampling
15	Werner SIEFER siefer@focus-r.de	Focus Magazin Germania	Monaco	Science writer

GEOLOGICAL AND GEOPHYSICAL ACQUISITION

Alessandra Savini[(1)], Francesca Budillon[(2)], Renato Tonielli[(2)], Sara Innangi[(2)], Paola Mussoni[(3)], Sebastien Garziglia[(4)], Mohamed Sahabi[(5)]

[(1)]Univ. Milano Bicocca, CoNISMa, [(2)] Istituto per l'Ambiente Marino Costiero, CNR Napoli, [(3)]Dip. Scienze della Terra, Univ Parma, [(4)]Obs. Oceanol., CNRS, France, [(5)]Faculté des Sciences, Lab. Géosc. Mar. Env. El Madida, Morocco.

One of the main project targets of the CIESM SUBII cruise has been the swath-mapping survey in the Sardinia Channel, aimed to cover parts of the four selected area shown in fig.1.
The acoustical geophysical devices, employed to carry out the survey, involved a medium water depth Multibeam system (Reson8160 – 50kHz) and a Chirp sonar (Datasonic - ChirpII). The data were acquired using the PDS2000 and the SwanPro software respectively. The integrated system used a TSS Motion Sensor and Gyro to correct pitch, roll and heave and a DGPS Satellite link by Skyfix to monitor ship position through time. The DGPS data were acquired and processed by both the navigation software available on-board: NavPro and PDS2000. The navigation program PDS2000 was interfaced with all the equipment working during the cruise to geo-reference all the measured data.
The datum was WGS84 and the Mercatore projection (40° parallel) was chosen for navigation and display, with:
Scale factor: 1.00000000
False Northing: 0.00

False Easting: 0.00
Origin Latitude: 40°.0000
Central Meridian: 000°.0000

The reference cartography used to plan the Cruise operations and survey comes from GEBCO® Atlas 2001.
During SUB 2 Leg 1 we recorded both the morphobathymetric and the shallow sismostratigraphic data following the on-board planned survey lines and on the navigation transfer in the working area as well, as shown in fig.1. All the data were acquired at a medium vessel speed of 8 kn.

Multibeam and Chirp survey

The Multibeam System Reson®8160 is hull mounted aboard the R/V *URANIA* and operates at 50 kHz. It provides bathymetric data with a swath width up to 150° generating 126 simultaneous high resolution receive beams. The acoustic footprint of the system varies in size with water depth, and the operational swath coverage as well.
Due to bad weather conditions during the cruise, we were able to investigate partially only two of the planned areas, where the water depth ranged from –200 up to –2400. This latter could be considered the deepest operational depth of the system, where the maximum transmit power and a sonar pulse width up to 10 ms are necessary to provide sufficient acoustic energy for a detectable return within an angular sector in the swath of 50°. At –200m water depth the system provides its best functionality reaching a swath coverage greater than 4x water depth.
Real-time data processing included statistical editing of obvious data artefacts and correction of refraction errors associated with incorrect water velocity, in particular we collected each survey day the sound velocity profile for calibration with a SeaBird 911plus CTD (fig.2).

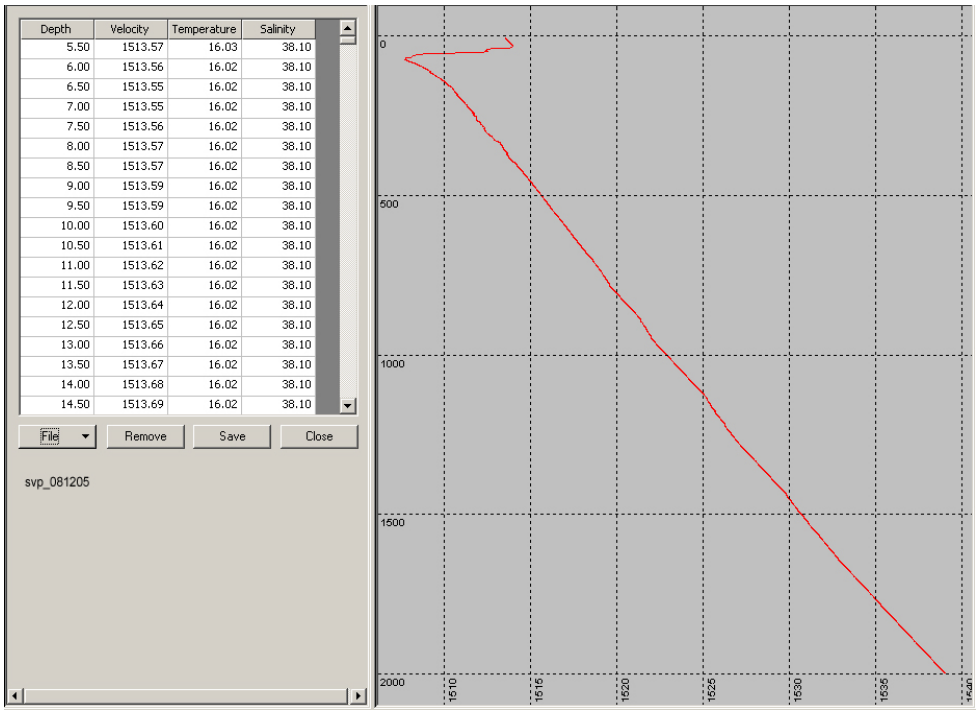

Figure 2 – Sound velocity profile for Multibeam calibration

We grid the bathymetric data at a resolution that is on the order of the average beam footprint size among the different investigated water depth and so that with a cell size at 30m. The covered areas are shown in fig.3 and fig.4.

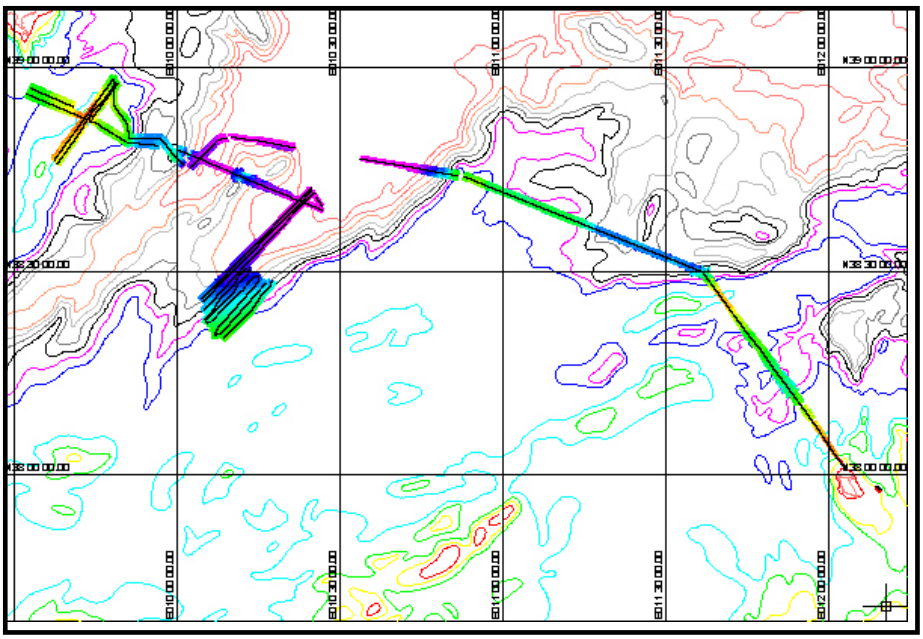

Figure 3 – Coverage map of multibeam survey

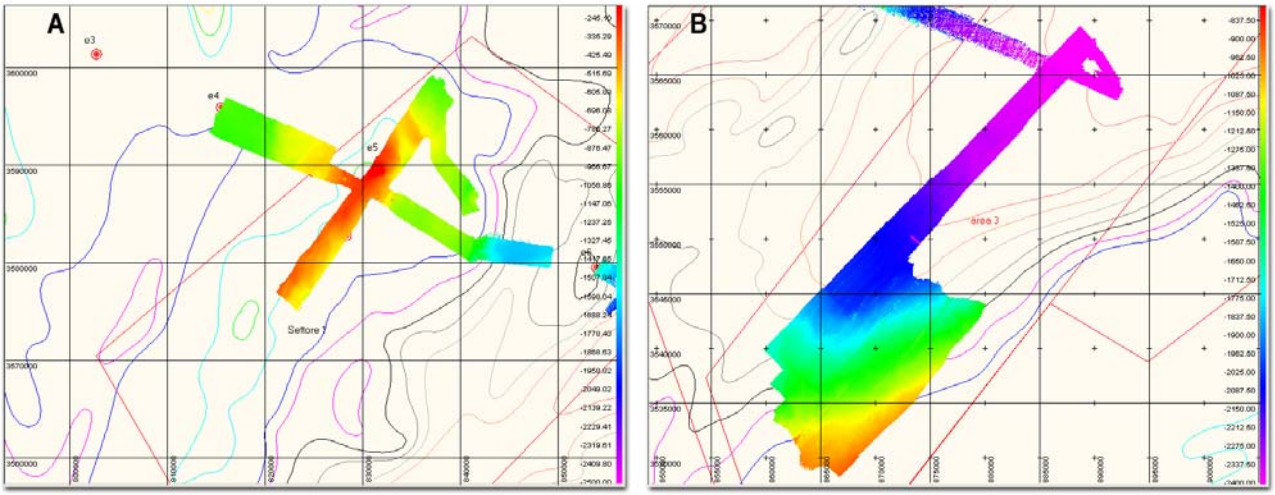

*Figure 4 – detail of coverage map in Area 1 (**A**) and 3 (**B**)*

The Chirp sonar DATASONIC CHIRP II CAP6600 employed is hull-mounted aboard the R/V URANIA and operates generating a FM swept pulse with a frequency band of 2±7 kHz as a source signal.
The survey lines were always acquired within the swath mapping survey, using a pulse width ranging from 5 up to 10ms and the multi-pinger mode, in order to provide the best reachable vertical and horizontal resolution on the investigated depth.
The shallow seismic-stratigraphic data collected has been essential to place the sediment samples stations (fig.4).
All the data provided by the geophysical devices were recorded as digital raw format. They were recorded on HD on the same computer connected with the deck unit system where the proper acquisition software ran. A full copy of data has been made on-board for each cruise participant during the way-back transfer.

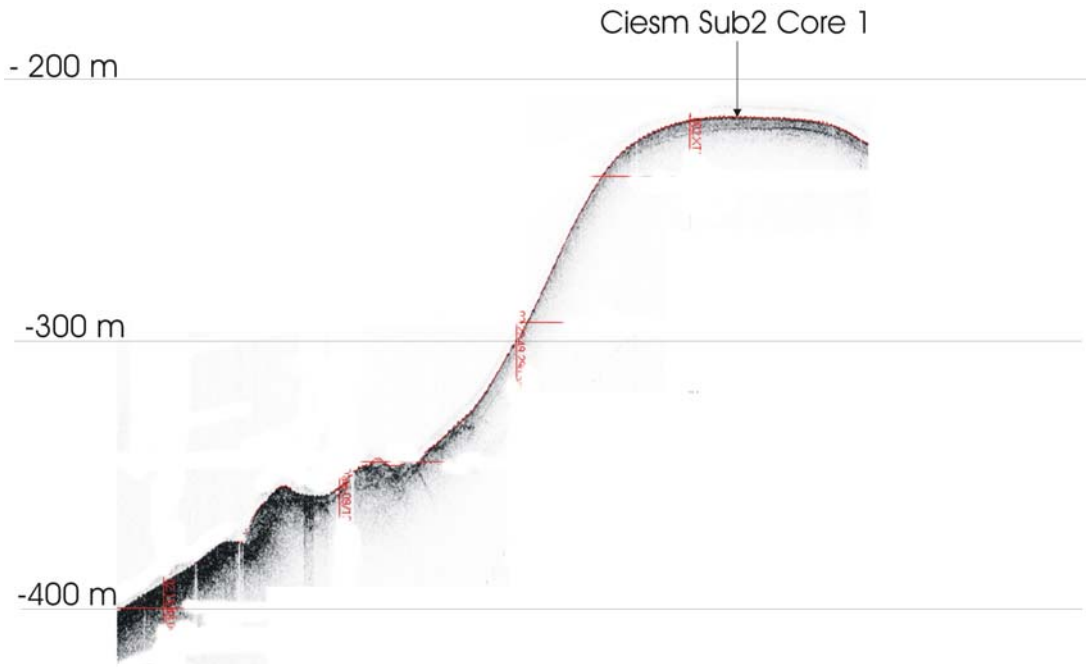

Figure 5 – Chirp profile of Ichnusa seamount and core location

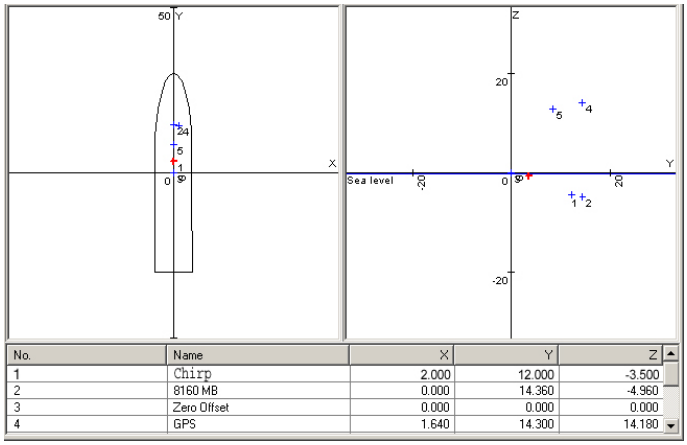

Figure 6 –offset of Chirp Subbottom Profiler

SEABED SAMPLING

A box corer with a 30X40X30 cm case was used to sample the sea bottom for biological purposes. Several courses were run and many failed due to malfunctioning of the corer; after repairs, thanks to mechanical facilities available on board, some changes were adopted and finally three significant samples were obtained (see next paragraphs).

A gravity corer equipped with a 6 m long tube and release devise (fig.7), 1,2 tons heavy was used to collect sediments in the first metres below seabed. Sites were chosen on the base of Chirp reflections typology and in particular to avoid reworked sediment areas. The shallowest site (203 m) revealed to be an area of coarse biogenic sedimentation and the corer entered the sediment for 2,5 m. At the deepest site (2440 m) the core recovered 5.4 m of hemipelagic mud with the fraction 90>x>63µ possibly made by foraminifers assemblages (table 2). This core is well suited for lithostratigraphic and biostratigraphic studies, finalized to the geochronology of recent sedimentary infilling and events stratigraphy based on:

- physical properties of sediment
- tephra-stratigraphy of possible ash layers recovered in core;
- paleomagnetic event stratigraphy;

- calcareous plankton bio-ecozones and stable isotope stratigraphy based on planktonic and benthonic foraminifera..

Figure 7– the gravity corer

table 2 – cores location and length

Core	Location	date	Water depth	Core lenght	Sediment type
A1_core01	9°43.7276' E 38°53.2184' N	09/12/2005	203	2,5 m	coarse bioclastic sand
A3_core08	10°21.5576'E 38°38.5364'N	10/12/2005	2379	5,5 m	Hemipelagic mud

PHYSICAL, BIOLOGICAL AND BIOCHEMICAL PARAMETERS (CTD, OX, FL, CHLA AND ETS)

Francesco Raffa[(1)], Giovanna Maimone[(1)], Francesco Soraci[(1)]
[(1)]Istituto per l'Ambiente Marino Costiero – CNR Messina - Italy

During this first leg, profiles of temperature, salinity, fluorescence, dissolved oxygen, and water samples were collected by equipment provided by R/V Urania. The basic package consisted of a Sea-bird Electronics SBE911+ CTD system fitted with a couple of pumped conductivity-temperature sensor and SBE 43 dissolved oxygen sensor. A fluorometer with 3000 m depth capability and altimeter were also installed.

Data was acquired at the maximum frequency (24 Hz) using a PC running Windows XP and Sea-Bird's Seasave version 5.33 for Windows software. Preliminary post-processing was carried out using SBE Seasoft to provide a variety of CTD products (plots, files, and tables) to the CIESM-SUB2 scientific team.

All profiles were planned to reach within 5-10 m of the bottom (fig.8). Water samples were collected using a 24-position SBE 32 Carousel sampler with 12 litres water sample bottles. Water samples at different layers were collected for subsequent analysis.

Table 3- CTD casts, location and sub-sampling

CTD cast	Cast depth	Depth	Date	Hour	Lat. °N	Long. °E	Sample Depth (n°)	PAR	Chl *a*	ETS
E5	255	261	09/12/2005	8.00	38°53,982'	09°44, 416'	5	X	X	
E6	1470	1480	09/12/2005	17.10	38°48,010'	09°59, 975'	9	X	X	
E7	2400	2441	10/12/2005	01.10	38°39,023'	10°27, 015'	11		X	X

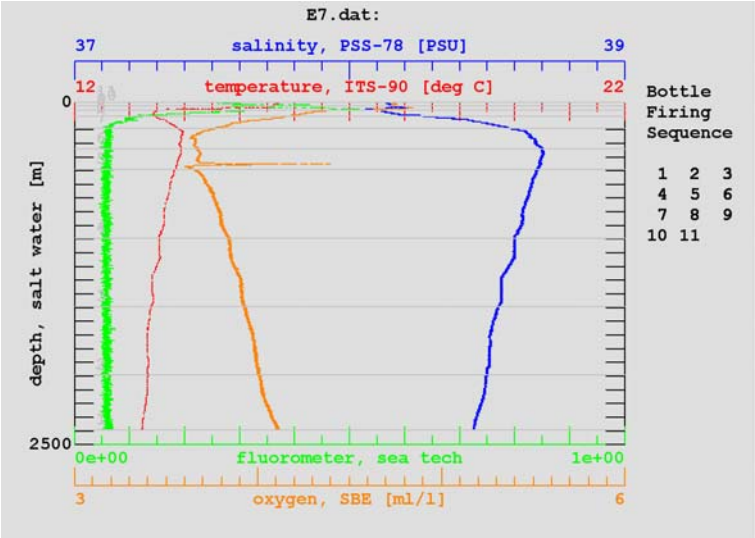

Figure 8 – Plot of physical parameters of the water column

The main objectives of this task could be synthesized in the investigation of microplanktonic diversity patterns of the Sardinia Channel that is a key area for investigating the effects of large-scale basin exchange on the western Mediterranean basin. The vertical gradients of microbial respiration and biochemical factors such as concentration of photosynthetic pigments (such as chlorophyll *a*, by HPLC and fluorescence, pheo-pigments) in different size-fractions will be analyzed in IAMC Lab.

Water samples were collected at 3 stations (table 3). The sampling depths (generally 3-4 levels) for evaluating phytoplankton biomass and activity were selected mainly according to fluorescence by chlorophyll *a* (using induced fluorescence to the CTD downcast profiles and natural fluorescence profiling by PNF-300), Deep Chlorophyll Maximum (DCM) and to the physical and chemical discontinuities that have been detected on CTD downcast profiles. Optical depth are detected measuring the scalar underwater and surface PAR by the PNF-300.

Measurements of microbial respiration activity (ETS) have been carried out on samples collected at site E7 by means of Niskin bottles, at 11 depths (4 optical levels corresponding to the ones previously described plus 100, 200, 350, 500, 1000, 1500, 2000, 2400m).

BENTHIC SAMPLING

Gian Marco Luna[(1)] *and Daniela Zeppilli*[(1)]
[(1)] *Polytechnic University of Marche (UNIVPM), Ancona (Italy)*

The sampling activity was finalized at:

- investigating the microbial and viral dynamics in different deep benthic areas of the Sardinia Channel
- describing the benthic prokaryotic and meiofaunal assemblages, in terms of density, community structure and biodiversity
- assessing the quantity and quality of sedimentary organic matter available to benthic consumers
- studying the relationships between biodiversity and ecosystem functioning along a bathymetric gradient in deep sea sediments.

To achieve these aims, different stations had been identified, based on the existing bathymetric maps (table 4). The selected stations also included a station located at the centre of a seamount-like area (site E5), which had been selected in order to explore possible influences of seamounts-like areas on the diversity and functioning of deep-sea benthic biota.

Table 4 -List of sampled stations

Station	Depth (m)	Sampling Date	Location
E4	970	09.12.2005	38°37.001' N; 09°33.008' E
E5	269	09.12.2005	38°53.976'N; 09°44.421' E
E6	1500	09.12.2005	38°48.013' N; 09°59.982' E
E7	2371	10.12.2005	38°38.541'N; 10°21.525' E
E12	445	12.12.2005	38°06.006' N; 12°02.965' E
WP17	643	12.12.2005	38°06.914' N; 12°07.499' E

Sediment samples were collected using a box-corer. Unfortunately, due to several problems occurring with the box-corer, it was only possible to collect samples only from stations E4, E6, E12 and WP17. At station E6, sediments was collected with a grab, following 3 unsuccessful box-corer deployments. At station E5, no sediment samples were collected despite 4 independent box-corer deployments. At station E7, due to the water depth (2400 metres) and to adverse meteorological conditions, only one box-corer deployment was attempted, which was unsuccessful.

From stations E4, E12 and WP17 we collected samples for the following parameters:
- Chloroplastic pigments
- Total and soluble proteins
- Total and soluble carbohydrates
- Total lipids
- Sediment grain size
- Bacterial biodiversity (assessed using molecular methods: Fluorescent *in situ* Hybridisation, Terminal – Restriction Fragment Length Polymorphisms, Automated Ribosomal Intergenic Spacer Analysis)
- Total and active bacterial abundance
- Total virus abundance
- Viral production
- Viral lysogenic fraction
- Bacterial Carbon Production
- Enzymatic activities (aminopeptidase, alkaline phosphatase)
- Meiofaunal abundance, community structure and diversity (by means of both classical and molecular methods).

From the sample E6, due to highly disturbed conditions of the sediments, it was possible to collect only sediments for meiofaunal analyses.
For measuring some of the above mentioned parameters, we carried out onboard incubations. These analyses included:

- estimation of bacterial carbon production (by means of the incorporation of aminoacids into bacterial biomass)
- measurements of bacterial enzymatic activities (by means of enzymatic cleavage of fluorogenic substrates and fluorometric determinations)
- measurement of viral production rates (following incubation with virus-free, 0.02 m-filtered seawater)
- quantification of the viral lysogenic fraction (after incubation with Mytomicin C)

For all other variables, the samples were fixed according to specific protocols and then stored at appropriate temperatures until return to UNIVPM laboratories.

FINAL COMMENT

Siri Campbell[(1)]
[(1)] *CIESM, Monaco*

First I want to say thank you to all the wonderful people who work on board R/V Urania, who have made this difficult trip much more enjoyable. Their professionalism is outstanding as is their sense of humor during some very stormy seas. All the scientists could not have been nicer in explaining what they were doing, or talking about their work. It was unfortunate that we had such bad luck with the weather and did not reach all of our scientific goals. For me I have seen another side of the Mediterranean Sea. One thinks of it as a calm, peaceful sea as it usually is in the summer, but it has another side during the winter. But the research is just as important in the winter as the summer so that we can more accurately monitor the changes taking place. I also think it is important that journalists be a part of the research cruise experience in order to let the general public know how important this work is.

SEQUENCE OF KEY EVENTS (IN LOCAL TIME)

6 December Messina- Embarking of people and equipments. Visit of SAS Alberto di Monaco, press conference, bunker;
19.00 All onboard, departure, transfer to Area 1

7 December 10:00 Safety meeting
16.00 Sheltered south of Favignana Island due to gale from west
17.00 probe test
18.00 check of the instruments

8 December 06.30 Departure from Favignana toward Area 1
08.00 CTD and Multibeam (MB) calibration
10.30 MB and Chirp acquisition during the transfer
21.30 Area 1: Sound Velocity Profile (SVP) and MB and Chirp acquisition during the whole night.

9 December 08.00 E5 site: Rosette, Profile of Natural Fluorescence (PNF), box corer (recovered bioclastic coarse sand).
10.00 transfer south to E5 station to core site and coring the top of Ichnusa structure. Recovered 2,5 m of sediment.
11.00 transfer to point E4 and MB and Ch acquisition
14.00 box corer E4 (recovered 15 cm of mud), transfer to E6 site and MB and CH acquisition
17.30 water casts on E6 site, box core (empty) and grab; recovered small quantity of mud
22.00 MB and CH acquisition in area 3

10 December 00.40 E7 site: CTD (06) calibration
01.05 E7 site: Rosette, CTD (08)
02.44 MB and CH acquisition
02.54 MB software got stacked. Neede 3 hours
07.21 Sound velocity profile (SVP)
10.58 tranfer to core site, CH acquisition

11.09 coring the deepest part of the area 3. Recovered nearly 5,50 m of sediments (hemipelagic mud)
13.15 box-corer sampling failed
15.04 MB and CH acquisition
22.56 Stop CH acquisition

11 December 9.28 Stop MB acquisition, transfer to Favignana, stand by on meteo.

12 December 08:00 Box corer at site E12, and Wp 17 respectively -440 and -644 m.
11.00 transfer to Messina harbour
12.00 report drawing up and backup of data
20.00 final scientific meeting

13 December 8.00 Dock in Messina harbour and disembark procedures.

ACKNOWLEDGEMENTS

Despite the weather conditions, all the efforts possible to us make this short cruise successful were made. The atmosphere on board was always friendly and warm even if time to time people had to have a rest due to roughness of the see. Scientists collaborated with a nice spirit of cooperation and this cruise definitely was a multipurpose one. The R/V Urania is a very efficient ship, staffed with a fine group of capable and congenial people.

My personal appreciation goes to Captain Vincenzo Lubrano, to Chief Engineer Pietro Ciano and to Bosun Vincenzo Conte (SoPROMar) for their capability and competence, but all the crew is warmly acknowledged.

A special thank you goes to Laura Giuliano – who helped make possible this second CIESM Sub2 cruise and who gave us the opportunity to open our minds to multidisciplinary experiences.

Urania, December 13th Francesca Budillon