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ISTITUTO DI SCIENZE MARINE

REPORT ON THE OCEANOGRAPHYCAL AND GEOPHYSICAL ACTIVITIES DURING CRUISE MS07 (R/V *URANIA*)

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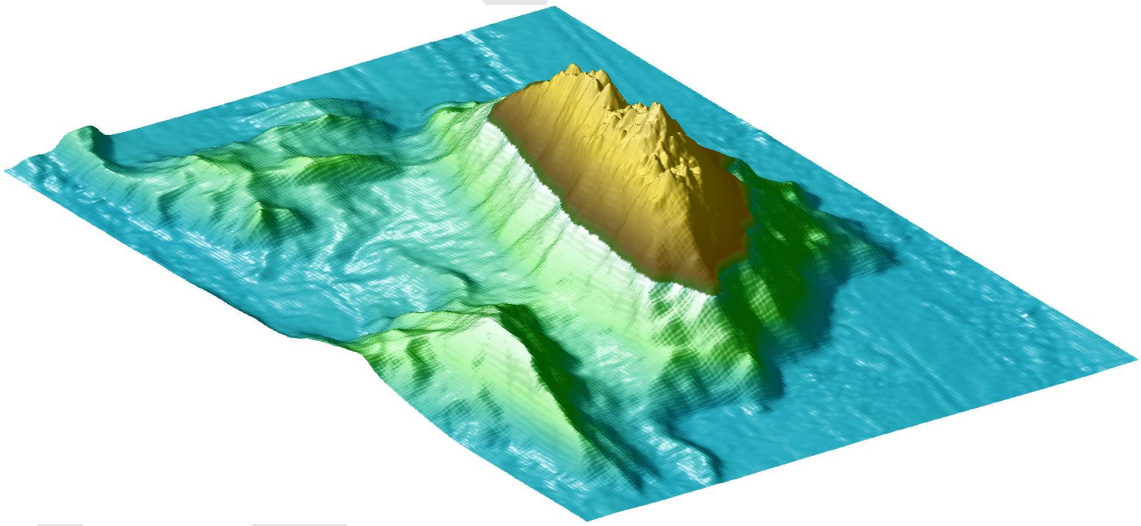

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REPORT ON THE OCEANOGRAPHICAL AND GEOPHYSICAL ACTIVITIES DURING CRUISE MS07 R/V *Urania* , by Borghini M, Bacciola D. Bortoluzzi G., Reseghetti F., Melillo C. and Polonnelli F.

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Abstract - W presente the shipboard activities and results of Cruise MS07 on R/V *Urania* . The cruise was scheduled as a mooring manintanance and deploy, alongwith XBT launches and CTD casts due to operational activities. During transits and operational 'stand-by' for deck operations, CHIRP SBP and multibeam profiles were performed. In particular the top of the Vavilov Seamount was mapped as an integration of the data collected by ISMAR Bologna during the 1996 and 1999 cruises.

Sommario - Vengono presentate le attivita' ed i risultati preliminari della crociera MS07 con R/V *Urania* , le cui attivita' principali previste erano la posa e la manutenzione di moorings e la esecuzione di lanci XBT e calate CTD. Durante i vari transiti e durante situazioni di 'stand-by' operativo sono stati eseguiti profili CHIRP SBP e 'multibeam'. In particolare, e' stata mappata la parte sommitale del Vulcano Vavilov in Centro Tirreno, a completamento di rilievi ISMAR Bologna 1996 e 1999.

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ACRONYMS

LA LORO SEPARAZIONE

ACRONYM	DESCRIPTION	URL-email
CNR	Consiglio Nazionale Delle Ricerche	www.cnr.it
ISMAR	Istituto di Scienze Marine	www.ismar.cnr.it
ISMAR-BO	ISMAR, Bologna	www.bo.ismar.cnr.it
ISMAR-SP	ISMAR, La Spezia	www.sp.ismar.cnr.it
ENEA	Ente per le Nuove tecnologie, l'Energia e l'Ambiente	www.enea.it
ENEA-SP	Centro RIcerche Ambiente Marino	www.santateresa.enea.it
UNIFI	University, Florence	http://www.unifi.it
MFS	Mediterranean ocean Forecasting System	www.bo.ingv.it/mfs
MOON	Mediterranean Operational Oceanography	
SIAM	Sistema Informativo Ambiente Mediterraneo	moon.santateresa.enea.it
PDS-2000	RESON	www.reson.com/sw1738.asp
SBE	Sea Bird Electronics	www.seabird.com
SIPPICAN	Sippican Corp.	www.sippican.com
BENTHOS	Teledyne Benthos	www.benthos.com
SWAN-PRO	Communication Technology	www.comm-tec.com
GMT	Generic Mapping Tool	gmt.soest.hawaii.edu/gmt
MBES	Multibeam Echosounder System	
SBP	Sub Bottom Profiling	
SVP	Sound Velocity Profile	
CTD	Conductivity/Temperature/Depth	
XBT	expendable Bathytermograph	
MAW	Modified Atlantic Water	
LIW	Levantine Intermediate Water	
TDW	Tyrrhenian Deep Water	
WMDW	West Mediterranean Deep Water	
GPS-DGPS-RTK	Global Positioning System	samadhi.jpl.nasa.gov
DTM	Digital Terrain Model	en.wikipedia.org

Table 1: Acronyms of Organizations, Manufacturers and Products

ACKNOWLEDGMENTS

We are particularly indebted to the Master C.L.C. Vincenzo Lubrano, the officers and crew members of R/V *Urania* for their professionalism and efforts in assuring the success of the cruise.

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1 INTRODUCTION

Cruise MS07, on R/V *Urania* was planned to perform instrumental check and maintanance of ISMAR, la Spezia and of the VECTOR program, and CTD casts. As a ship-of-opportunity, operational activities (XBT), morphobathymetric and SBP mapping were also done along the ship's tracks. This paper reports the shipboard activities during the cruise, including description of the ship, equipment and their usage, along with details of the general settings, performances and some scientific and technical results.

Oceanographical Setting

The Tyrrhenian Sea exchanges water with the rest of the Mediterranean Sea through the Sardinia Channel,the Sicily Strait and the Corsica Channel, that represent morphologic constraints for the circulation of the intermediate and deep waters [Millot C.(1987), Astraldi and Gasparini(1994), Sparnocchia et al.(1999), Astraldi et al.(2001)]. The surface water (0-200 m) entering the Tyrrhenian Sea through the Sardinia Channel is the Modified Atlantic Water (MAW) from the Algerian Current (AC). The MAW is characterized by low salinity (on average less than 38 PSU), and flows cyclonically along the Italian coast. Through the Sicily Strait and deeper than 200 m down to about 700 m, the basin receives the Levantine Intermediate Water (LIW), which is marked by a subsurface temperature maximum and by a higher salinity (on average 38.8 PSU), and mixes with the surface MAW and deeper water masses. From about 700 m to the bottom the Tyrrhenian Deep Water (TDW) is present, being the result of the modification of the West Mediterranean Deep Water (WMDW) that crosses the Sardinia Channel. The circulation pattern in the Tyrrhenian Sea is normally characterized by two cyclonic gyres in the south and in the northern basins, and by the presence of cyclonic and anticyclonic eddies in the central basin. Interesting features in the TDW [Zodiatis and Gasparini(1995)] are the thermoaline 'staircase' formations.

2 CRUISE SUMMARY

SHIP: R/V *Urania*
START: 2007-06-23 PORT: La Spezia
END: 2007-06-28 PORT: Palermo
SEA/OCEAN: Tyrrhenian Sea, Sicily Channel, Mediterranean Sea
LIMITS: NORTH 42:00 SOUTH: 37:15 WEST: 10:30 EAST: 13:45
OBJECTIVE: MOORING, OPERATIONAL OCEANOGRAPHY
COORDINATING BODIES: ISMAR-CNR, La Spezia
CHIEF OF EXPEDITION: Mr. Mireno Borghini
CONTACT: Mireno.Borghini@ismar.cnr.it
DISCIPLINES: OCEANOGRAPHY, MORPHOBATHYMETRY
WORK DONE: 50 KM^2 SURVEY MULTIBEAM, 200 KM SBP
3 CTD CAST, 21 XBT launches, 2 mooring deployments

LOCALIZATION:

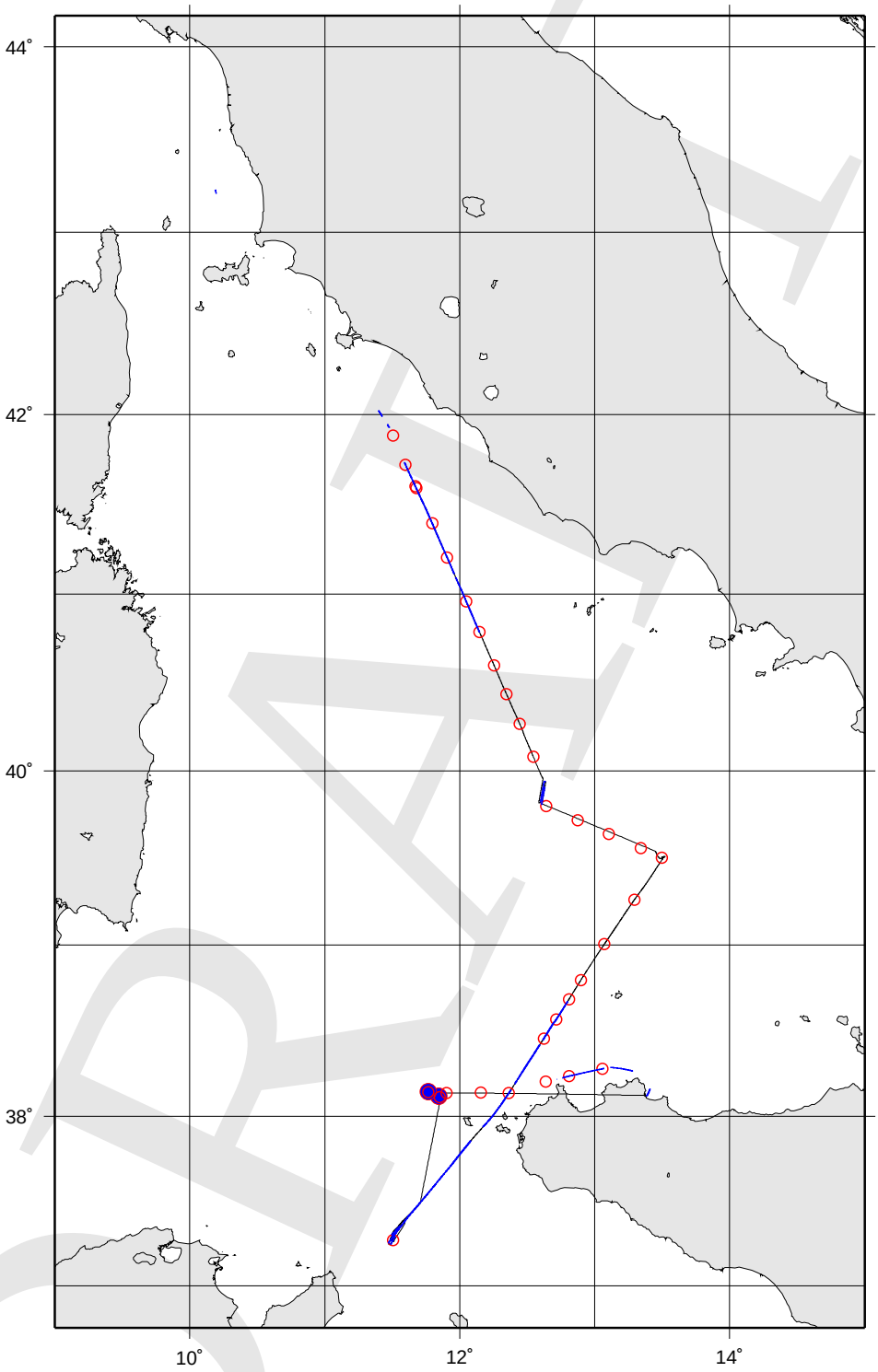

Figure 1: Whole ship track during Cruise MS07, including transits. The red circles are XBT, the blue circles are CTD casts. The blue lines are CHIRP profiles.

SCIENTIFIC AND TECHNICAL PARTIES

PARTICIPANTS	ORGANIZATION	EXPERTISE	tel & email & www
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Table 2: Scientific and technical parties

3 MATERIALS AND METHODS

The research cruise was carried out with the 61 meter R/V *Urania* (Fig. 2), owned and operated by SO.PRO.MAR. and on long-term lease to CNR. Ship is normally used for geological, geophysical and oceanographical work in the Mediterranean Sea and adjoining waters, including but not limited to, the Atlantic Ocean, the Red Sea, and the Black Sea.

Figure 2: R/V *Urania* .

R/V *Urania* is equipped with DGPS positioning system (satellite link by FUGRO), single-beam and multibeam bathymetry and integrated geophysical and oceanographical data acquisition systems, including ADCP, CHIRP SBP and other Sonar Equipment, other than water and sediment sampling. Additional equipment can be accommodated on the keel or towed, like Side Scan Sonars.

3.1 NAVIGATION AND DATA ACQUISITION

The vessel was set-up for multibeam data acquisition and navigation with PDS-2000 software by RESON. The UTC absolute time was measured and recorded at any shot produced by the PDS-2000 by the Java™Daphne software [Stanghellini and Bortoluzzi(2004)], interfaced to a Trimble Acutime and to the Fugro DGPS. The hull-mounted 16 transducer BENTHOS Chirp system was used. The data flow and performance were controlled by the Communication Technology's SWANPRO software. The SBP-CHIRP workstation received positions trough a sentence by the PDS-2000 and positions were therefore recorded on the XTF trace headers as lat/long of the DGPS antenna.

The instrumental offsets (PDS-2000) are presented in Fig. 3 and in Tab. 3

POSITION	ACROSS	ALONG	HEIGHT
REFERENCE POINT	0.00	0.00	0.00
DGPS	1.64	14.30	14.18
MBEAM	0.00	14.36	-4.96
MAHRS	0.00	0.0	-3.40
ECHO SOUNDER 33	5.50	-1.85	-3.80
CHIRP	-1.0	11.80	-4.00
A-FRAME	6.5	-6.70	0.0
STERN	0.00	-30.60	0.00

Table 3: Instrumental Offsets on Ship Urania (PDS2000). The GPS antenna (primary positioning system) is located on point DGPS.

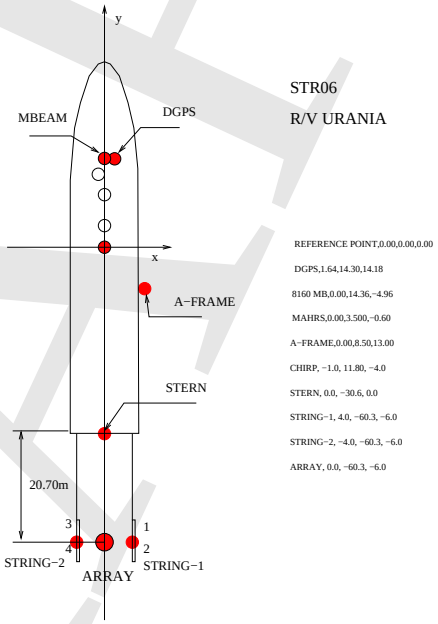

Figure 3: Cruise MS07. Instrumental Offsets (PDS-2000) on R/V *Urania*

3.2 MULTIBEAM BATHYMETRY

One workstations was used for the acquisition of multibeam data, interfacing by a multiserial and Ethernet link a RESON 8160 P1 processor, an TSS MAHRS MRU and FOG compass, DGPS receiver (Fugro Omnistar), by a MOXA Multi/serial I/O, TC/P and UDP network sockets. The MBES was the 50kHz, 126 0.5°, 150°aperture RESON 8160 (5000 m range). The sonar head is positioned on the ship's keel using a V-shaped steel frame. A Sound Velocity probe at the Sonar Head is interfaced directly to the MBES processor, thus providing the necessary real-time data for the beam-forming. XBT abd CTD casts were used for input of the sound velocity profile to the system.

In addition two data sets were generated and stored on separate computer for backup on HD and CD/DVD. The PDS-2000 was able to build a 20 m DTM during the acquisition of the entire surveyed areas. The existing multibeam datasets will therefore be used for an up-to-date regional bathymetric compilation.

3.3 OCEANOGRAPHIC MOORINGS

One oceanographic mooring was deployed 15NM NNE of Ustica Island, in the framework of the VECTOR project, at the border of the Tyrrhenian Central Deep. After preparation on board of

the mooring lines and equipment (current meters, sediment traps, CTD), ship was put halfway the mooring length (aproximately 3200 m) ENE of the planned position and the weight was released accordingly upon latest wind and waves condition. Table 4 and Fig.5 report and show the position of the mooring, while Fig.**??** shows its design.

LON	LAT	DEPTH	DATE	TIME LOCAL DST	STATION
1331.21026	3930.46278	-3450	25-Jun-2007	10:50:00	DEPLOY
1330.02004	3930.26172	-3449	25-Jun-2007	11:09:05	IMMERSED

Table 4: VECTOR Mooring deploy and buoy immersion positions.

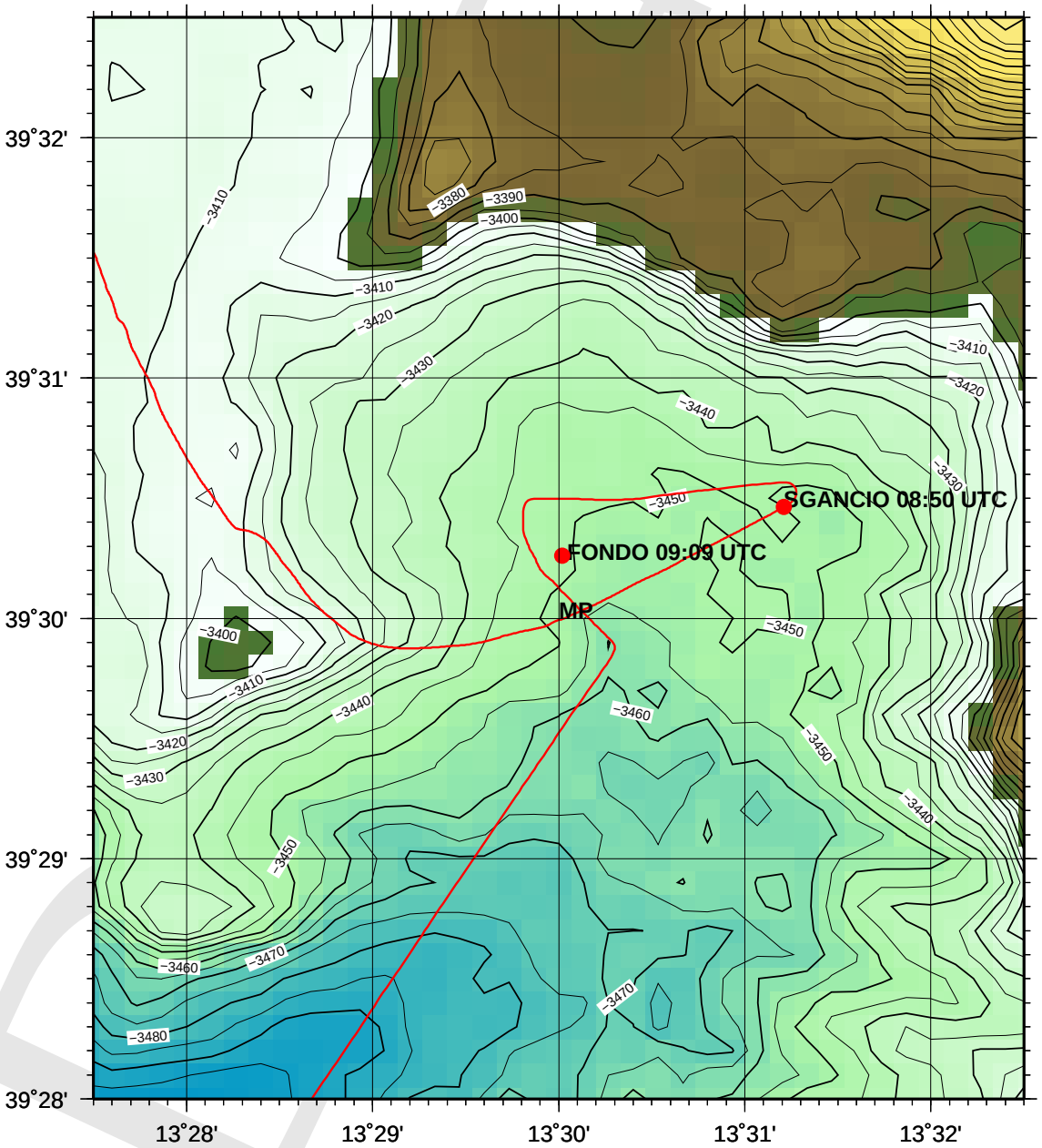

Figure 4: Cruise MS07. VECTOR Mooring. The red line is ship's track during operation. Red circles are the positions of weight release and and of the surface buoy immersion (FONDO), respectively. Bathymetric data by [Bortoluzzi et al.(1999)],[Marani, Gamberi and Bonatti(2004)].

Figure 5: Cruise MS07. VECTOR Mooring Project Plan.

3.4 CTD AND XBT CASTS

CTD casts were taken on surveyed area. Data were collected by a Mod. 911Plus SBE profiling system. CTD data (conductivity, temperature, oxygen, fluorimetry) were taken by a Seabird SBE 11 PLUS interface and SEASAVE V5.33 PC software. XBT were collected by a Sippican hand-held launcher and a MK21 data logger interface and software(USB). DGPS NMEA Position data were interfaced directly to the CTD and XBT acquisition systems.

The position of the XBT and CTD stations are reported in Tables 5 and 6, respectively, and can

be viewed in Fig. 1. The recorded data were converted to the CNV (for CTD) and EDF (for XBT) formats and further plotted with the ODV software [Schlitzer(2004)]. The Sound Velocity data from the acquired profiles were immediately imported into the PDS-2000 software for multibeam data corrections (see Fig.6.

LON	LAT	DATE	TIME UTC	STATION
11:30.32	41:53.05	24062007	0628	2899_T6
11:35.92	41:43.29	24062007	0734	3499_T7
11:40.30	41:36.06	24062007	0821	2199_T7
11:40.63	41:35.50	24062007	0825	2599_T7
11:47.75	41:23.77	24062007	0941	4199_T7
11:54.37	41:12.33	24062007	1054	5499_T7
12:02.87	40:57.53	24062007	1229	2999_T7
12:08.77	40:47.15	24062007	1336	3699_T7
12:15.27	40:35.90	24062007	1451	5199_T7
12:20.84	40:26.03	24062007	1555	5599_T7
12:26.68	40:15.96	24062007	1700	0099_T7
12:32.69	40:04.79	24062007	1813	1399_T7
12:38.42	39:47.88	24062007	2205	0599_T7
12:52.44	39:42.95	24062007	2316	1699_T7
13:06.20	39:38.30	25062007	0029	2999_T7
13:20.44	39:33.37	25062007	0144	4499_T7
13:29.93	39:30.18	25062007	0909	0999_T5
13:04.30	39:00.28	25062007	1344	4499_T5
13:17.66	39:15.63	25062007	1130	3099_T5
12:53.89	38:47.81	25062007	1518	1899_T7
12:48.51	38:41.01	25062007	1604	0499_T6
12:42.96	38:34.10	25062007	1654	5499_T7
12:37.35	38:27.35	25062007	1745	4599_T7
12:21.81	38:08.23	25062007	2007	0799_T6
11:30.41	37:16.33	26062007	0350	5099_T6
12:48.70	38:14.21	27062007	1254	5499_T7
12:09.45	38:08.44	27062007	0939	3999_T6
12:38.25	38:12.33	27062007	1201	0199_T6
13:03.47	38:16.78	27062007	1410	1099_T6
11:51.00	38:06.77	27062007	0559	5999_T7
11:45.92	38:08.63	27062007	0743	4399_T7
11:54.12	38:08.32	27062007	0825	2599_T7

Table 5: XBT Stations geographical positions.

LON	LAT	DATE	TIME UTC	STATION
1150.7800	3807.1900	2007-06-27		214
1146.0060	3808.7058	2007-06-27	07:41:01	215
1129.22	3716.93	2007-06-26	07:02:00	460

Table 6: CTD Stations positions.

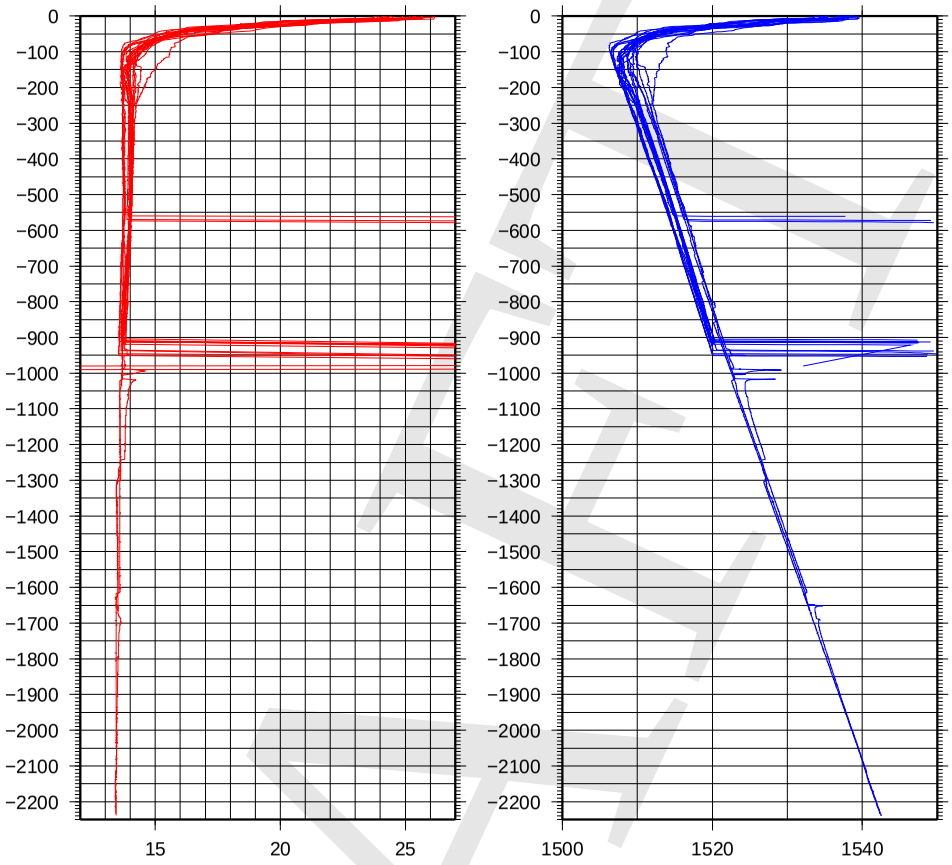

Figure 6: Cruise MS07. XBT whole data set (temperature, left, Sound velocity, right, unfiltered).

3.5 CHIRP

A Teledyne Benthos CHIRP SBP system (16 hull-mounted transducers) was used. The data were acquired by the SWANPRO software by Communication Technology. The system was checked during transits. An example of the data can be viewed in fig.7.

Figure 7: Example of CHIRP SBP acquisition. Unprocessed data, SEGY-format.

3.6 MISCELLANEOUS

The datum was set to WGS84 and the UTM, zone 33 was chosen for navigation, display, and data acquisition. The time zone was set to the UTC for the instrumental data acquisition. The positioning maps and bathymetric images were produced with GMT [Wessel and Smith (1995)]. The multibeam data were pre processed on board by the PDS2000 and GMT software and ISMAR's routines and scripts, using the PDS-2000 production DTMS or XYZ ASCII converted data.

Photographs and video were taken by digital cameras and video-camera.

4 INITIAL RESULTS

Some initial results are presented, in order to address the importance of the preliminary findings and processing sequence of the data acquired.

4.1 OCEANOGRAPHY

Figure 8 shows the Tyrrhenian Sea section obtained by using the quality controlled XBT temperature profiles (ODV plot).

Figure 8 shows the Tyrrhenian Sea section obtained by using the quality controlled XBT temperature profiles (ODV [Schlitzer(2004)] plot).

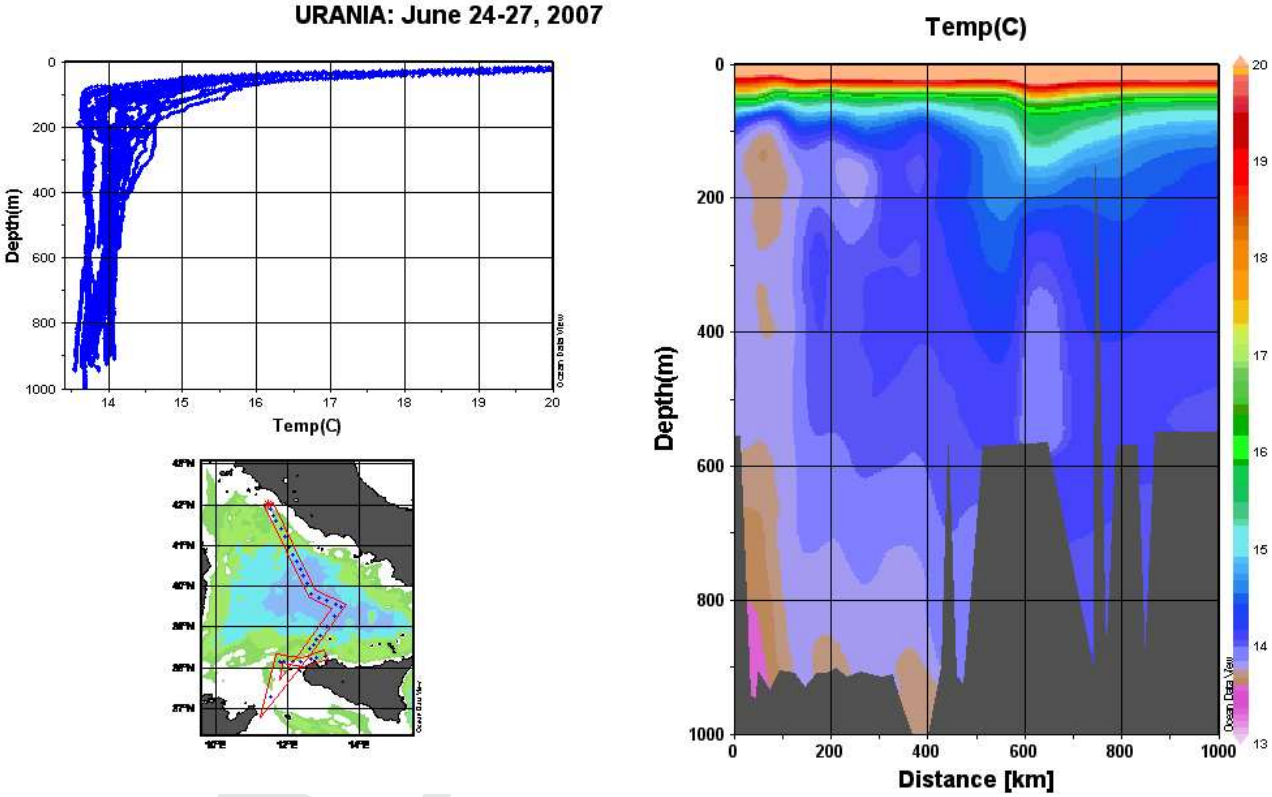

Figure 8: Cruise MS07. XBT temperature data section, by ODV processing.

4.2 BATHYMETRY

We present here the bathymetry of the Vavilov Seamount(Fig.9), including a zoom of the top (minimum depth -764m, Fig.10), that was mapped during present survey, from -2200 m depth.

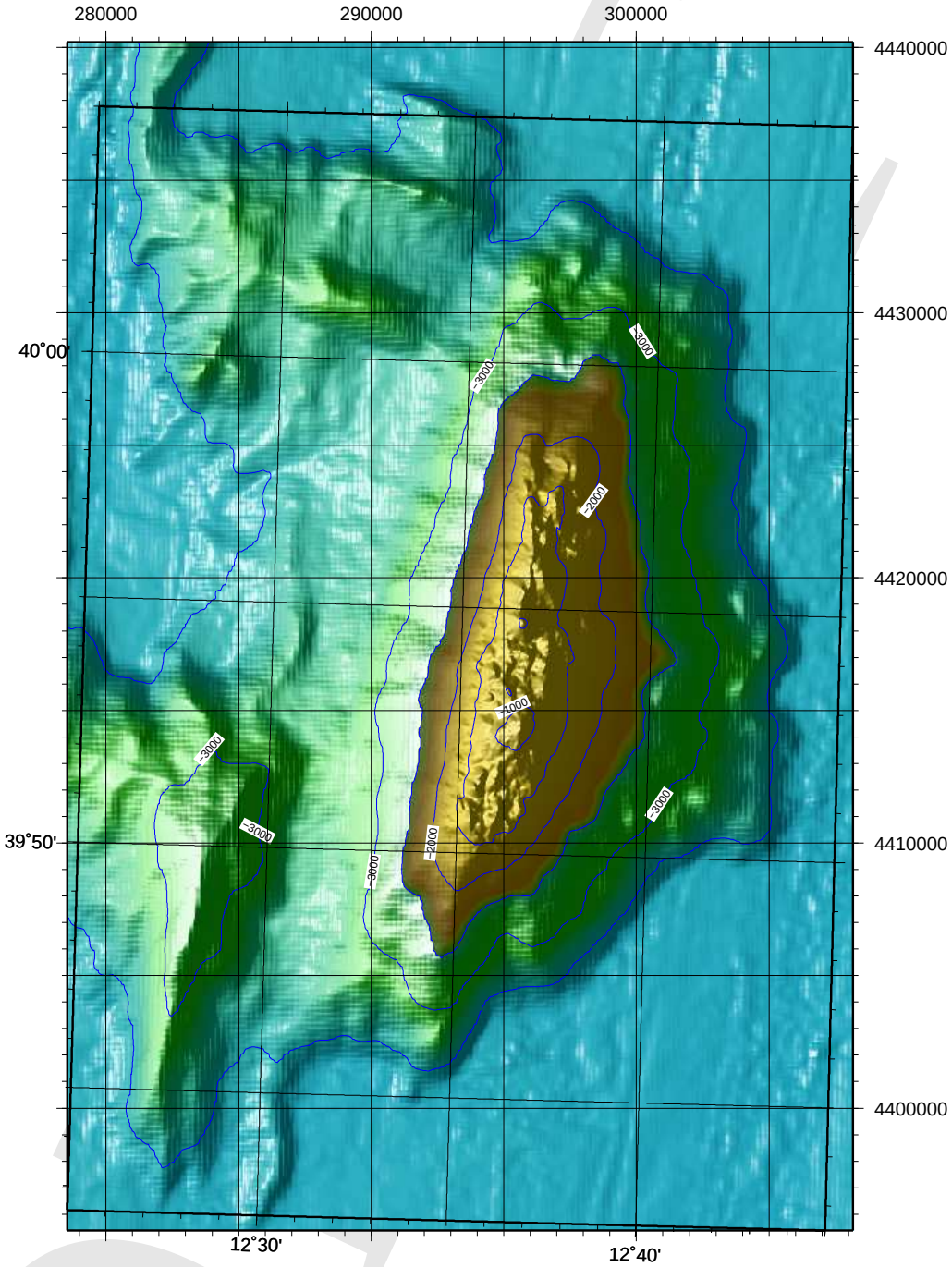

Figure 9: Cruise MS07. The Vavilov Seamount.Bathymetric data deeper than 2200m by [Bortoluzzi et al.(1999)],[Marani, Gamberi and Bonatti(2004)].

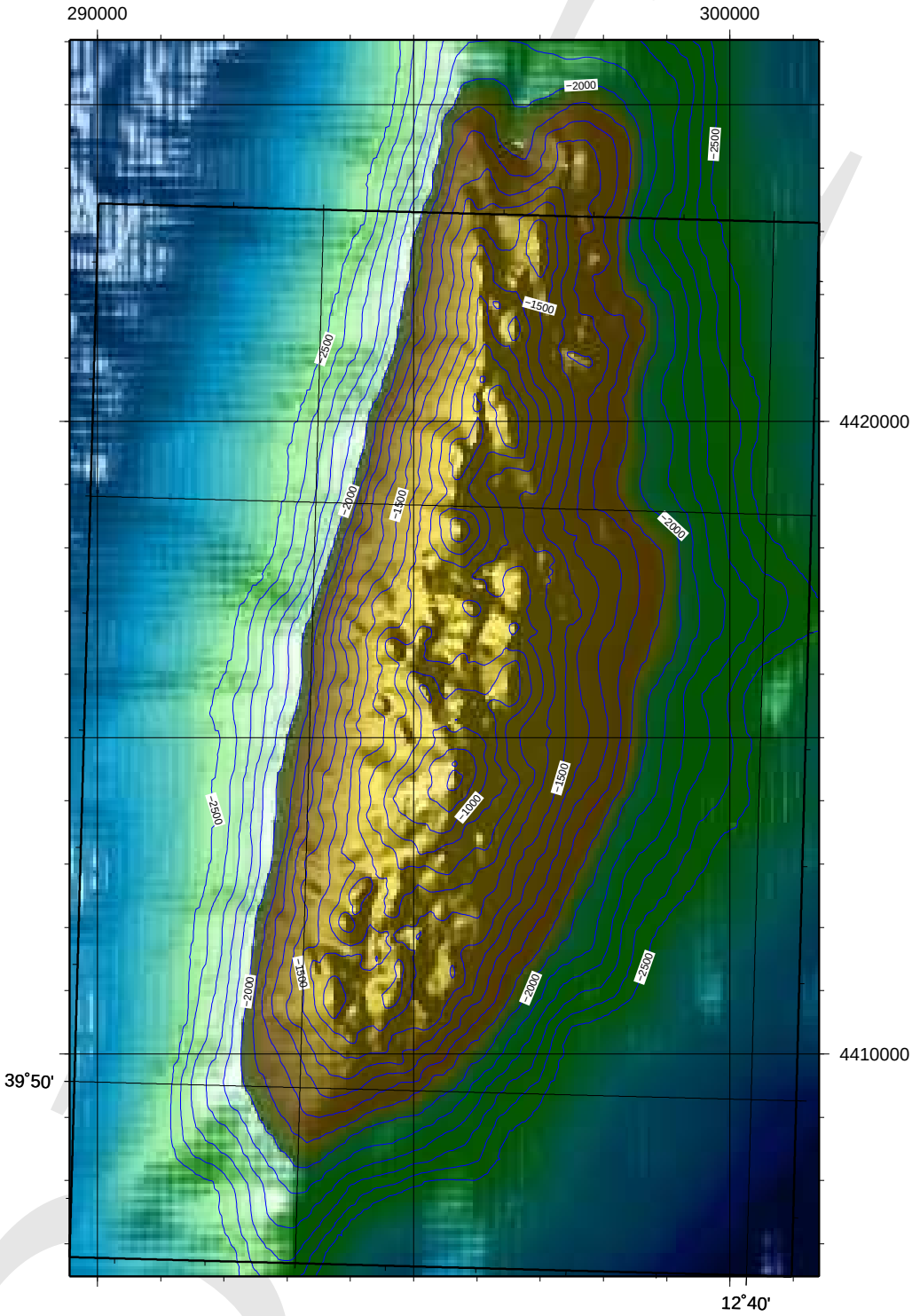

Figure 10: Cruise MS07. The Vavilov Seamount

5 CONCLUSIONS

During the 5 days cruise in transit from Tyrrhenian sea to the Sicily Channel we obtained:

- the succesful deployment of a deep mooring in the Central Tyrrhenian Sea
- 21 XBT and 3 CTD casts
- high resolution bathymetric images and DTMs of some investigated areas, including the topmost area of the Vavilov Seamount from the 2000m to 765m depth (top)
- SBP lines

The XBT and CTD data will be used for assimilation on the weekly runs of the MFS model and will be soon deposited in the MOON database, at ENEA S.Teresa Centre.

No problems were encountered regarding neither the people nor the environment during the cruise.

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