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Rapporto sulle attivita' oceanografiche, geologiche, geofisiche durante la crociera MNG0310 con R/V *Urania* : Mare ADriatico, 2010-03-02 - 2010-03-12. Progetti EMMA (Dr. M. Ravaioli) e ADRICOSM (Prof. N. Pinardi).

G. Bortoluzzi[1], F. D'Oriano[1], F. Del Bianco [1], V. Maselli[1] ,
C. Palmiotto[1], F. Falcieri[2], K. Marinaccio[2]
D. Radojevic[3], M. Milic[3], G. Castelli[4], E. Çomo[5], B. Murtaj[5]

[1] *CNR, Istituto di Scienze Marine, Italy*
[2] *Universita' Politecnica Marche, Ancona, Italy*
[3] *Geological Survey, Montenegro*
[4] *Environmental Protection Agency, Montenegro*
[5] *Institute Energy, Water, Environment, University, Tirana, Albania*

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SOMMARIO
Vengono presentate le attivita' ed i risultati preliminari della crociera MNG0310(2010-03-02- 2010-03-12)con R/V *Urania* , le cui attivita' principali previste erano la acquisizione di dati oceanografici lungo i transetti Gargano, Pescara, Senigallia, Rimini e Delta del Po. In aggiunta, si sono svolte attivita' di campionamento fondo mare, batimetria multibeam e SBP in Montenegro e Albania.

Parole Chiave: Oceanografia – Batimetria – CHIRP SBP – Mare Adriatico – Montenegro – Albania

1 INTRODUZIONE E INQUADRAMENTO

La crociera MNG0310, coordinata da ISMAR-CNR di Bologna, e' dedicata al progetto EMMA-LIFE project , coordinato da Dr. Mariangela Ravaioli, e dal progetto ADRICOSM-STAR, coordinato dalla Prof. Nadia Pinardi. Il progetto EMMA studia i processi di anossia e ipossia nei fondali del N.adriatico, e punta alla loro eventuale previsione, mediante modellistica operazionale fisica e biogeochimica, mediante crociere stagionali e con l'utilizzo di boe in Near Real Time, fra cui le boe ISMAR S1 ed E1.

La crociera e' stata pianificata per la ripetizione di transetti CTD 'storici' (Po-Rovinij, Rimini, Senigallia, Pescara, Gargano), oltre che studiare strutture nel promontorio Garganico e nel canyon di Bari, con particolare riguardo alla fenomenologia della dinamica della acqua densa N.Adriatica (Bignami et al. 1990a,b; Ridente et al. 2007; **?**; Canals et al. 2009).

ADRICOSM-STAR "... e' teso allo sviluppo e alla parziale implementazione di un sistema di gestione integrato delle aree costiere e delle acque fluviali e urbane, considerando componenti osservazionali e modellistiche". Le aree di ricerca sono in Montenegro e Albania, inclusa la baia di Kotor. Il progetto comprende 19 partnet pubblici e privati da Italia, Montenegro, Serbia e Albania, e ha una durata di 3 anni a partire da Aprile 2010. Gli obbiettivi della crociera sono:

- continuare la indagine sistematica del fondo mare con tencologia Multibeam e CHIRP
- raccogliere campioni di sedimento in stazioni particolari per analisi sedimentologiche e geochimiche
- raccolgliere dati meteo e CTD

Nell'insieme, i dati Multibeam e CHIRP saranno usati per lo studio della geologia superficiale e sub-superficiale, e verranno usate per la costruzione di nuove carte batimetriche. Fra i processi studiati possiamo citare (a) la caratterizzazione geochimica, (b) le vie di trasporto del sedimento sospeso e di fondo, evidenziando aree di accumulo di erosione, e (c) la valutazione di rischio.

I dati di batimetria ad alta risoluzione verranno utilizzati per costruire modelli digitali del terreno utili anche ai modelli regionali di previsione della dinamica di onde e correnti. Dati a maggiore risoluzione sono raccolti in area particolari, fra cui la baia di Kotor.

Di seguito vengono presentate le attivita' di bordo durante la crociera MNG0310, inclusa la descriione della nave, della strumentazione e del loro uso, e dettagli sulla loro configurazione e capacita' tecnica, oltre a risultati tecnic0-scientifici.

1.1 Inquadramento Geologico e Oceanografico

INQUADRAMENTO GEOLOGICO

L' Adriatico (Fig.1) e' un mare epicontintale con due configurazioni dei propri margini (Ridente & Trincardi 2005) (con referenze). La zona Nord (NA) e' circondata dalla penisola italiana a Ovest e dai Balcani a Est, ed e' l'area piu' settentrionale del Mediterraneo. E' caratterizzato da batimetrie basse e bassissime (in media $\sim$ 35 m), che si approfondiscono regolarmente verso S fino alla batimetrica di -120 m, che viene considerato il confine aperto a S, approssimativamente a N della latitudine 43:20 (Artegiani et al. 1997a; Russo & Artegiani 1996; Poulain et al. 2001). Altri autori considerano invece essere tale confine al traverso di Rimini o di Ancona.

L'area Centrale e' caratterizzata dalla fossa

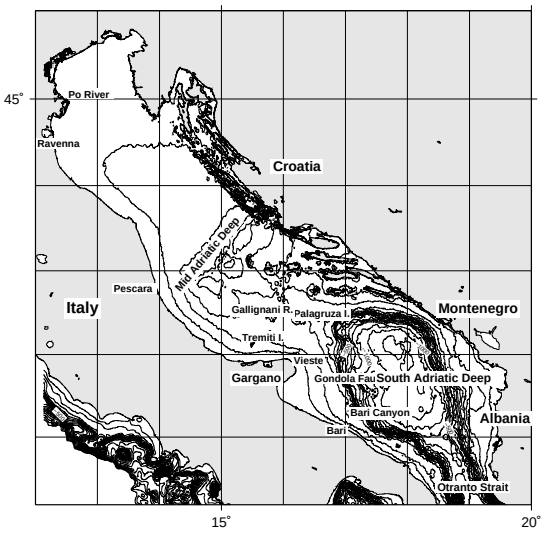

Figura 1. Adriatic Sea setting.

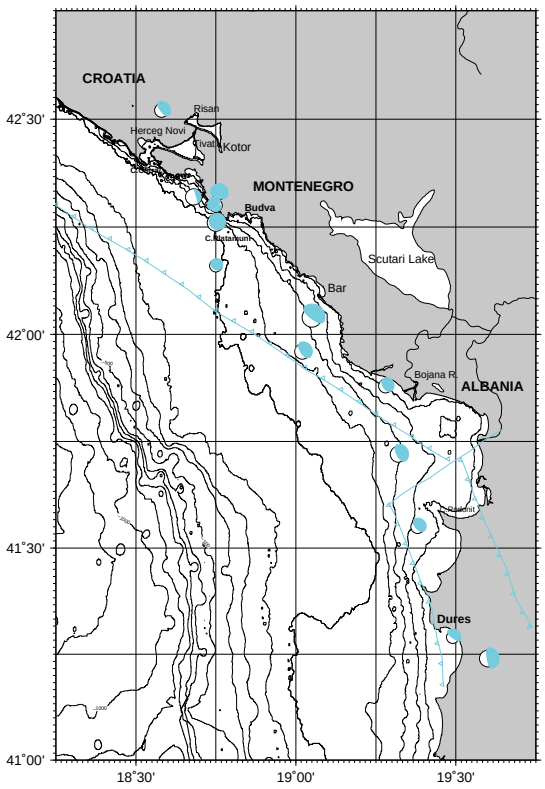

Figura 2. Structural setting of Montenegro.

Meso-Adriatica (MAD), un bacino relitto, profondo $\sim$ 260 m, separato in due depocentri dalla cintura di deformazione Centro-Adriatica (Argnani & Frugoni 1997), e bordata dalle catene Gallignani e Pelagosa a SE e dall'alto strutturale delle Isole Tremiti a S. Le due depressioni della fossa possono essere riempite dalle acque dense (NadDW) prodotte nel bacino settentrionale.

L'area a Sud (**?**) e' caratterizzata da una depressione subcircolare, profonda > 1200 m (Fossa Sud Adriatica, SAD), localizzata fra le coste della Puglia, a Ovest, e di Albania, Montenegro, Croazia a Est, e considerata essere la avanfossa della cintura di pieghe e faglie delle catene Albanidi e Dinaridi (De Alteriis 1995; Argnani et al. 1996; Bertotti et al. 2001).

I margini e le aree costiere Montenegrine e Albanesi fanno parte della cintura di pieghe e faglie Ovest-vergente delle Dinaridi e Albanidi lungo la parte sud-orientale del bacino 1. I margini hanno un ciglio della piattaforma continentale relitto, con il sedimento stoccato lungo la costa albanese, e presenza di frane e movimenti di massa a larga scala (**?**Roure et al. 2004). La piattaforma continentale e' stretta da N in Coazia fino a C.Patamuni a S della Baia di Kotor, nei pressi di Budva, dove essa si sviluppa maggiormente fino a C.Rodonit in Albania. La attivita' sismica e' presente nell'area con eventi da moderati a molto intensi. In particolare, a parte i terremoti storici, il M6.9 del 1979-04-15 e forti scosse di assestamento nella regione di Bar e Kotor in Montenegro (Console & Favali 1981; Boore et al. 1981), con epicentro localizzato 5NM al largo, nella zona del fronte esterno. L'area a S del fiume Bojana a W e Sw di Capo Rodonit e' anche sismicamente attiva, ed e' interessata da un fronte compressivo allineato WNW e faglie trascorrenti e dirette orientate ENE. Secondo Tiberti et al. (2008) e citazioni, questi terremoti hanno un forte potenziale tsunamigenico. A casua dell'ambiente carsico nella vcatena DInarica, specialmente in N Montenegro, gli acquiferi costieri possono svilupparsi a mare con sifoni sottomarini, sorgenti e risorgive, all'interno di una ambiente geologico e idrogeologico fortemente correlato alla tettonica e alle fluttuazioni climatiche e del livello del mare passate e future (Fleury et al. 2007).

Inquadramento oceanografico

Le note seguenti sono tratte da Russo et al. (2009).

Essendo un bacino epicontinentale, idrologia e dinamica del NA sono influenzate dal forzante meteorologico, variazioni termiche e dalle portate fluviali. Studi climatologici (Cushman-Roisin et al. (2001) e referenze) indicano che le situazioni meteorologiche principali in NA includono flussi dai quadranti NW, NE e SE (venti Etesiano, Bora, Scirocco). Bora e Scirocco sono i venti predominanti nell'area e possono causare forti eventi di tempesta. Nonostante il suo limitato volume, il NA riceve circa il 20% di acque dolci di tutto il Mediterraneo (Russo & Artegiani 1996), principalmente dal fiume Po (portata media $\sim$ 1500 m^3/a (Artegiani & Azzolini 1981; Raicich 1994), e portando ad un eccesso di acqua dolce.

Nel tardo autunno, gli intensi processi di raffreddamento e evaporazione, tipicamente associati con eventi di Bora sul NA, creano condizioni per

la generazione di acqua densa durante l'inverno (Vibilič & Supič 2005).

A causa dell'aumento delle portate fluviali e del riscaldamento in tarda primavera e estate, correnti di gradiente sono generate in un sistema di circolazione ciclonico (Zore-Armanda 1956; Buljan & Zore-Armanda 1976; Franco et al. 1982; Orlić et al. 1992; Artegiani et al. 1997a,b; Russo & Artegiani 1996; Hopkins et al. 1999; Poulain & Cushman-Roisin 2001), consistenti in una corrente che entra a S e fluisce verso NO lungo la costa orientale (corrente Adriatica Orientale, EAC), e una corrente che fluisce a SE lungo la costa italiana e esce a Otranto (Corrente Adriatica Occidentale, WAC). La EAC introduce nel bacino a Sud acque piu' calde e salate, mentre la WAC immette acque piu' dolci verso le regioni a S.

La circolazione generale nel NA e' inoltre estremamente affetta dai venti. Eposodi di Bora possono generare una circolazione transiente a doppia rotazione, consistente in un ciclone a N del delta del Po e un anticiclone a S, in grado di trasportare molto al largo filamenti del pennacchio fluviale (Jeffries & Lee 2007); una circolazione anticiclonica si sviluppa inoltre lungo la costa Istriana a Sud (Poulain & Cushman-Roisin 1992, 2001), mentre la Bora forza flussi nella WAC (Book et al. 2007; Ursella et al. 2006).

Il NA e' una delle zone maggiormente produttive dell'intero Mediterraneo. Il tasso di consumo di O_2 dovuto ai processi biogeochimici e' il piu' alto dell'intero Bacino Adriatico, con un massimo che generalmente si concentra attorno al delta del Po (Artegiani et al. 1997b). Questa regione puo' quindi essere considerata zona favorevole alla insorgenza di ipossie. La formazione di strati anossici di fondo in ampie aree del bacino (Degobbis et al. 1993, 2000) puo' causare grossi problemi ecologici come mortalita' massive di animali, defaunazione della popolazione bentonica e riduzione della produttivita' dell'industria della pesca.

La ipossia e' definita comunemente tale quando la concentrazione dell'ossigeno disciolto e' inferiore a 2 ml l^{-1} (equivalenti a 2.8 mg l^{-1}). Tale concentrazione e' il limite di tolleranza per molte specie bentiche (Simunovic et al. 1999; Rabalais et al. 2000; Wu 2002).

The dynamics of the SAD is dominated by the presence of a quasi-permanent cyclonic gyre that in the winter season creates the conditions for the open-ocean convection and the production of dense and oxygenated waters. Studies show that two types of dense water formation processes occur during winter within the Adriatic Sea: the major portion of the Adriatic Deep Water (ADW) is formed through open ocean convection inside the Southern Adriatic Deep (SAD) within the cyclonic gyre, while the remaining dense water is formed on the continental shelf of the Northern and Middle Adriatic that moves southward and ultimately sinks to the bottom of the SAD (Ovchinnikov et al. 1985; Bignami et al. 1990a,b; Malanotte-Rizzoli 1991). The eastern margin is characterized by the influence of the incoming waters of Ionian origin which flow northward being restricted mainly to the continental slope. This area is interested by the Levantine Intermediate water (LIW) that occupies the layer between 150 and 600m.

The coastal zone of Albanian and Montenegro in the eastern margin consists of a narrow shelf area North of the Strait of Otranto, with smooth bathymetry and with circulation features presumably determinate by inflowing Ionian waters, by local winds, and by relatively large amounts of the Buna-Bojana river. The latest provide a strong contribution to the Adriatic freshwater budget, in a way that their influence in feeding the freshwater coastal zone is sometimes felt far downstream along the Croatian coast.

The current state of knowledge of oceanographic characteristics of the Albanian shelf is limited. Numerical simulations and satellite infrared images indicates that the circulation on the Albanian shelf responds strongly to the local wind forcing (Bergamasco & Gačič 1996). More specifically, the northeasterly wind generates very intense coastal upwelling along the Albanian shoreline due to the sudden change of the coastline orientation in that area. Bora wind induces an undercurrent at intermediate depths near the Albanian shelf break, which is directed in the opposite direction of the Levantine Intermediate Water (LIW) inflow from the Ionian. Therefore, in addition to coastal upwelling, Bora in the Strait of Otranto weakens and occasionally blocks completely the LIW inflow.

2 MATERIALI E METODI

The research cruise was carried out with the 61 meter R/V *Urania* 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.

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, e.g. Side Scan Sonars.

2.1 NAVIGAZIONE, CHIRP, MATIMETRIA MULTIFASCIO

The vessel was set-up for data acquisition and navigation with PDS-2000 software by RESON, in-

Figura 3. R/V *Urania* .

terfacing by a multiserial and Ethernet link several instruments, among them the DGPS (Fugro), the Atlas-Krupp Deso-25 single-beam echosunder, the MAHRS MRU and the meteorological station. The position and depth data were also distributed to the CTD data acquisition console. A Kongsberg processor running the SIS software, collected the multibeam data, including a SEAPATH MRU, compass, and DGPS. The MBES was the 70kHz, 400 1x2° beams, 150° aperture EM-710 (2000 m range) model by Kongsberg. The sonar head is positioned on the ship's keel using a V-shaped steel frame. A Sound Velocity probe at the keel 1m above the Sonar Head is interfaced directly to the MBES processor, thus providing the necessary real-time data for the beam-forming. CTD casts were normally used for input of the sound velocity profile to the system. An Anderaa Meteorological Station was also made available, at a rate of one measurement every 5 minutes.

BATIMETRIA

The SIS (EM-710) was able to build real-time DTM at the resolution of 20 and 5 m during the acquisition of the entire surveyed areas. The data from these production DTMs were exported and

POSITION	ACROSS	ALONG	HEIGHT
REF.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
DESO	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
MAGNETOM.	-5.50	-210	0.0
DGPSGRAV	0.0	-4.0	10.0
GRAV	-1.0	-1.0	0.0

Tabella 1. Instrumental Offsets of PDS2000 on Ship Urania (PDS2000). The GPS antenna (primary positioning system) is located on point DGPS.

POSITION	ACROSS	ALONG	HEIGHT
REF. POINT	0.00	0.00	0.00
SEAPATH_GPS	-4.039	0.163	-18.211
MRU	-0.341	-1.342	-1.596
MBEAM_TX	0.0936	10.2964	5.0623
MBEAM_RX	-0.0031	11.0144	5.0600
SEALEVEL	0	0	-0.0875

Tabella 2. Instrumental Offsets on Ship Urania (EM710). The DGPS antenna (primary positioning system) is located on point SEAPATH_GPS.

used for planning and update of the SIS projects. The raw data were instead saved in the Kongsberg's .all format, for postprocessing with packages like NEPTUNE or MB-SYSTEM or other. The processed data will therefore be used for an up-to-date regional and local bathymetric compilation.

CHIRP SBP

A Teledyne Benthos CHIRP-III SBP system (16 hull-mounted transducers) was used. The data were acquired by the SWANPRO software by Communication Technology, with direct interfacing to the DGPS, therefore actual positioning data have to be converted according to the offsets of Tab.1. The data were recorded in the XTF format and converted also into the SEG-Y format for processing with ISMAR's SEISPRHO package Gasperini & Stanghellini (2009). The system setting was: length 5-10 ms, trigger rate variyng from 0.25 to 1.5 s,gain 9dbm preamp gain ranging from 1.5 to 3 db. Power to the transducers and gains were set in order to obtain non-clipped returns.

CAMPIONAMENTYO FONDO

Bottom sampling was performed by 60cm diameter box corer and grab. Table 3 shows the position of samples. On the undisturbed sample a minimum

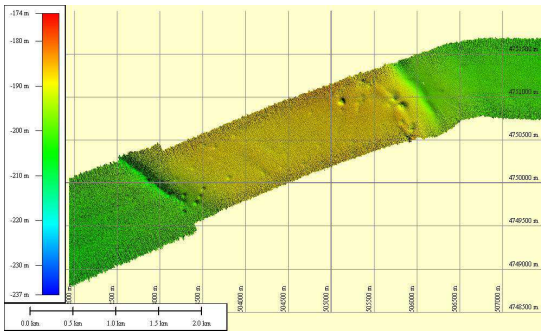

Figura 4. CruiseMNG0310: pokmark filed on faults and tectonic lineaments on top of Gallignani Ridge, Pomo.

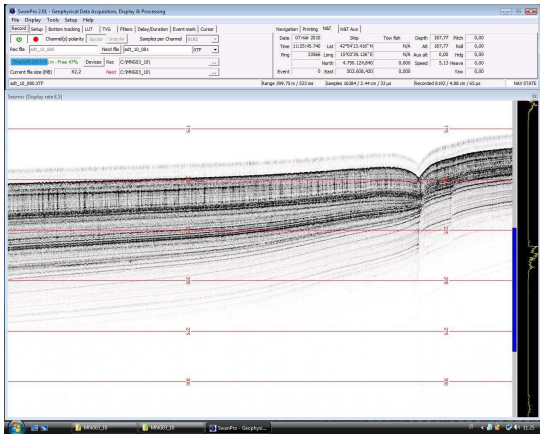

Figura 5. CruiseMNG0310: fault on top of Gallignani Ridge(WSE), Pomo (see Fig. 4).

of 2 subcores were taken and stored. Subsampling at particular levels was also performed. Some subasamples were washed and seived.

CTD

CTD data were obtained by a Sea Bird SBE 911 probe. Table A5 in the appendix shows the position of the stations.

MAGNETOMETRIA

A Seaspy by Marine Magnetics magnetometer was used. Sensor was towed at 180 m from stern, on the port side. Data acquisition was by Marine Magnetic's Sealink software.

CARTOGRAFIA E MISCELLANEA

An ROV by GEI of Barga was used on a karstic hole in the Kotor Bay.

The datum was set to WGS84 and the Direct

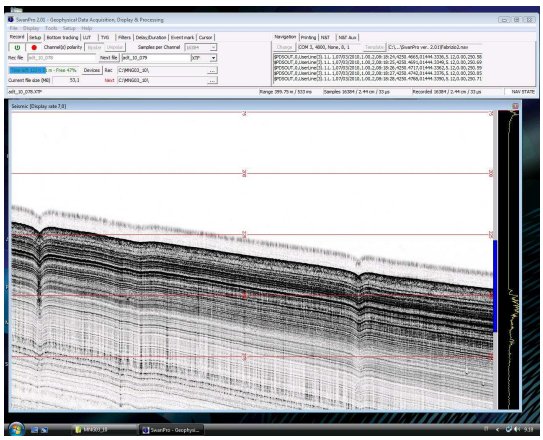

Figura 6. CruiseMNG0310: pokmark filed on top of Gallignani Ridge, Pomo.

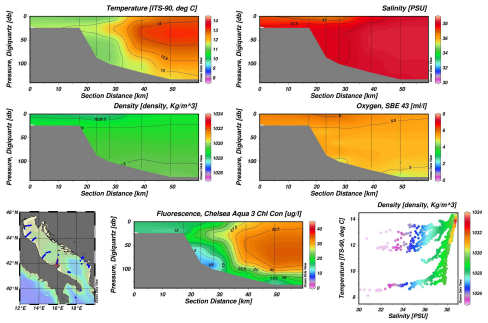

Figura 7. CruiseMNG0310: Gargano transect.

Mercator 38N, UTM, zone 33N and 34N were 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 & Smith (1998).

The multibeam data were pre processed on board by the CARIS and GMT software and ISMAR's routines and scripts, using the SIS production DTMS or raw .all file.

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

3 RISULTATI INIZIALI

OCEANOGRAFIA

During MNG0310cruise, the water column properties on the western side of the basin have been investigated along transects from Gargano to the Po Delta (Figures 7, 8, 9, 10 and 11). In addition, some CTD casts were performed on the Eastern coast during the activities on Montenegro and Albania.

In the Appendix Table A5 shows the CTD data collected during cruise MNG0310, and figure A4 plots a summary of the data.

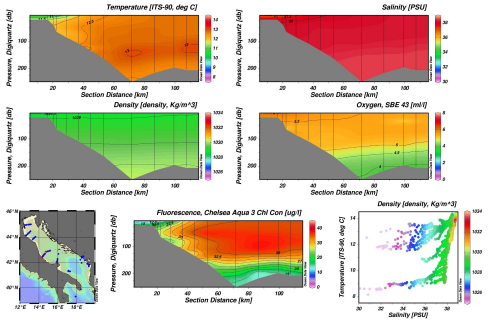

Figura 8. CruiseMNG0310: Pescara transect.

LON-LAT (ddmm.xxx)	UTM34	DEPTH	SAMPLE	DATE
1921.142 4149.869	363184 4632342		BC1	2010-03-09
1920.910 4149.706	362858 4632046		BC2	2010-03-09
1920.716 4149.509	362582 4631687		BC3	2010-03-09
1917.880 4149.743	358665 4632196		BC4	2010-03-09
1844.785 4228.379	314748 4704753		G1	2010-03-10
1840.878 4229.979	309476 4707859		G2	2010-03-10
1839.704 4225.942	307662 4700431		G3	2010-03-10
1832.515 4226.064	297812 4700937		G4	2010-03-10

Tabella 3. Samples on cruise MNG0310. BC=box-corer, G=grab.

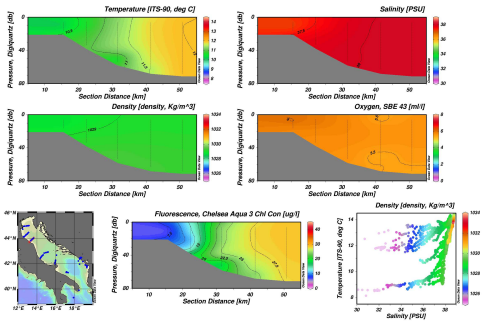

Figura 9. CruiseMNG0310: Senigallia transect.

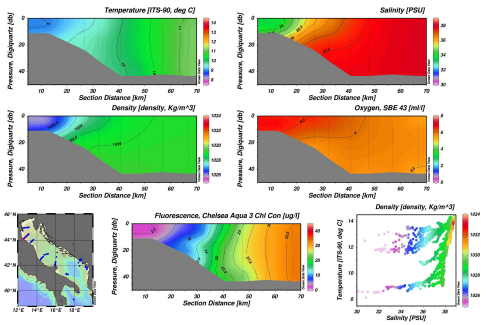

Figura 10. CruiseMNG0310: Rimini transect.

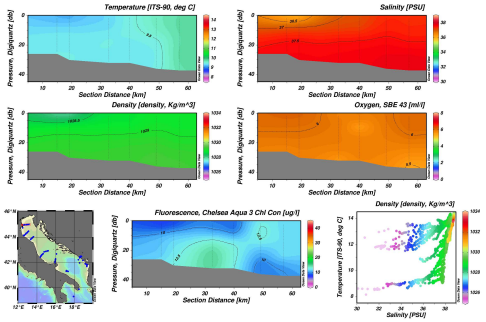

Figura 11. CruiseMNG0310: Po Delta transect.

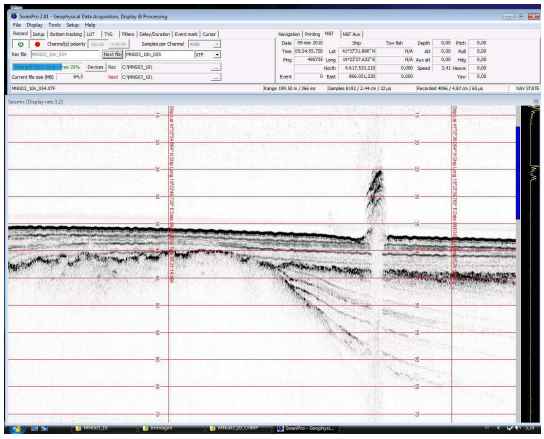

Figura 12. CruiseMNG0310: Ship wreck, Montenegro, CHIRP.

BATIMETRIA, CHIRP

During MNG0310cruise, high-resolution morpho-bathymetric and CHIRP SBP surveys were made. We present hereafter a set of figures showing the capabilities of the Multibeam and CHIRP systems. See hereafter some of the images obtained by the multibeam.

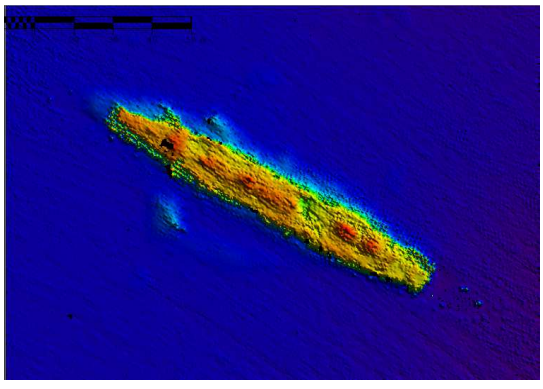

Figura 13. CruiseMNG0310: Ship wreck, Montenegro.

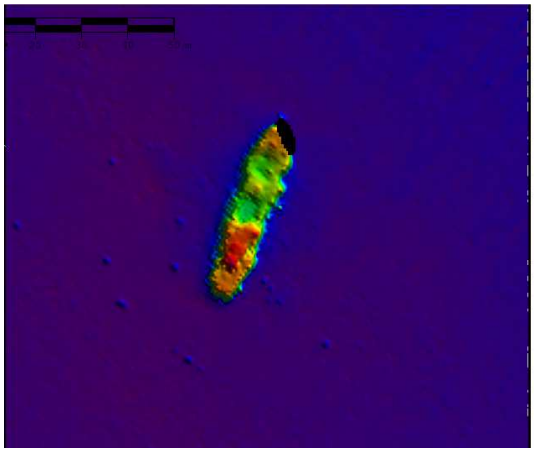

Figura 14. CruiseMNG0310: Ship wreck, Montenegro.

CAMPIONAMENTO FONDO

A number of 5 box corers and 4 grabs were performed. Table 4 shows sample description. Some pictures hereafter show some of the samples.

4 CONCLUSIONI

During the 11 days of cruise MNG0310, including transits and port calls, we obtained:

- CTD casting and water sampling along Adriatic transects;
- high-resolution SBP and multibeam coverage on the Montenegrin and Albanese offshore;
- bottow sampling on the Buna-Bojana offshore and in the Bokakotorska;
- ROV investigations

Analysis of the data collected during the expedition is under process, and will continue during the forthcoming several months.

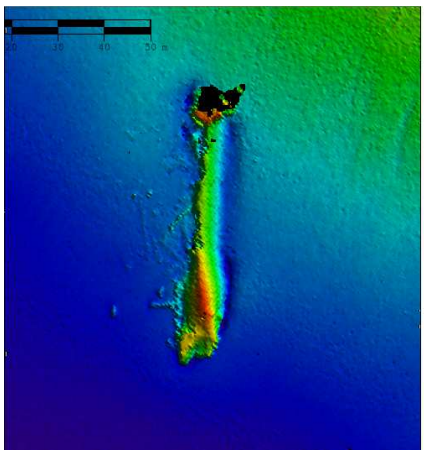

Figura 15. CruiseMNG0310: Ship wreck, Montenegro.

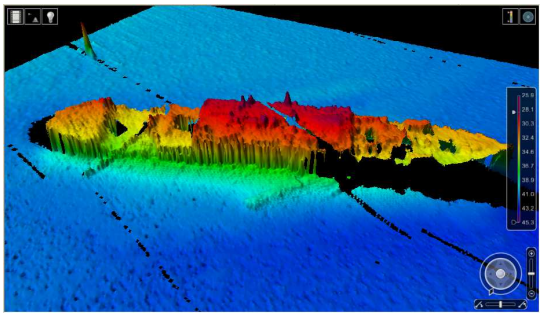

Figura 16. CruiseMNG0310: Ship wreck, Albania.

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

RINGRAZIAMENTI

We are indebted to the officers and crew members of R/V *Urania* for their professionalism and efforts in assuring the success of the cruise.

Figura 17. CruiseMNG0310: Box corer 01.

STATION	DATE	DESCRIPTION
BC01	2010-03-09	0-2cm oacre, silty mud, oxidized, liquid on top, presence of *turritella comunis*; 2cm to bottom, olive-gray mud, more plastic
BC02	2010-03-09	0-2cm oacre, silty mud, oxidized, liquid on top, presence of *turritella comunis*, less than BC01; 2cm to bottom, olive-gray mud, more plastic
BC03	2010-03-09	0-2cm oacre, silty mud, oxidized, liquid on top, very scarce presence of *turritella*; 2cm to bottom, olive-gray mud, more plastic
BC04	2010-03-09	25 cm; TOP (0 - 1 cm): silty mud, sub-mm bioclasts, light brown, olive (5Y4/1), oxidyzed 1-5 cm: low plastic clay, low fluid content, non organic, odorless, rare sub-mm bioclatic fragments, darker olive (5Y4/1). BOTTOM (5 cm): very plastic clay, non organic, odorless, no bioclasts. color 5Y4/1. WASHED: 1 valve of bivalve (2-3 mm), 2 young *turritella comunis*, piece of sea-urchin, sub-cm foraminifer; round, reworked black coal clast(?).
BC05	2010-03-09	23 cm; same as BC04 (?)
G01	2010-03-10	Kotor Bay. (?)
G02	2010-03-10	Risan Bay. (?)
G03	2010-03-10	Tivat Bay. Mud with stones. (?)
G04	2010-03-10	Herzeg-novi bay. Mud with shells. (?)

Tabella 4. Bottom samples description. G=grab, BC=Box-corer

Figura 18. CruiseMNG0310: Box corer 01, washed.

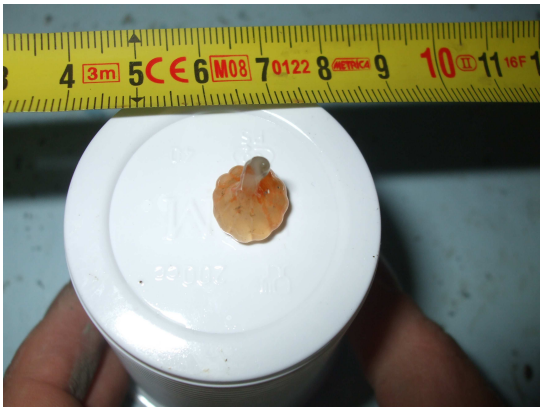

Figura 20. CruiseMNG0310: Box corer BC04, foraminifer.

Figura 19. CruiseMNG0310: Box corer BC04.

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APPENDICI A: CRUISE SUMMARY

SHIP	R/V *Urania*
START	2010-03-02 PORT: Messina
END	2010-03-12 PORT: Bari
SEA/OCEAN	Adriatic Sea
LIMITS	NORTH: 45:30 SOUTH: 41:00 WEST: 12:00 EAST: 19:45
OBJECTIVE	Oceanography ...
COORDINATING BODIES	ISMAR-CNR Bologna
CHIEF OF EXPEDITION	Giovanni Bortoluzzi
CONTACT	G.Bortoluzzi at ismar.cnr.it
DISCIPLINES	Oceanography, morphobathymetry, Chirp SBP, magnetometry, bottom sampling.
WORK DONE	∼3500 KM SBP, ∼xxx KM MAGNETOMETRY, ∼xxx KM^2 MULTI-BEAM, 66 CTD CASTS, 4 GRABS , 5 BOX-CORERS.

Tabella A1. Cruise Summary.

PARTICIPANTS	ORGANIZATION	EXPERTISE	tel & email & www
Giovanni Bortoluzzi	ISMAR,Bologna	Chief-of-Expedition	G.Bortoluzzi@ismar.cnr.it
Andrea Gallerani	ISMAR, Bologna		A.Gallerani@ismar.cnr.it
Fabrizio Del Bianco	ISMAR,Bologna		F.Delbianco@bo.ismar.cnr.it
Vittorio Maselli	ISMAR,Bologna		V.Maselli@bo.ismar.cnr.it
Camilla Palmiotto	ISMAR, Bologna		palmi8camy@hotmail.it
Francesco Falcieri	UNIVPM, Ancona		f.falcieri@univpm.it
Katia Marinaccio	UNIVPM, Ancona		katiamarinaccio@libero.it
Bledar Murtaj	IEWE, UNITIRANA		murtajbledar@yahoo.com
Elvin Çomo	IEWE, UNITIRANA		elvincomo@yahoo.com
Dragan Radojevic	GSM		radojevic.d@geozavod.co.me
Mileva Milic	GSM		mileva.milic@gmail.com
Giuliano Castelli	EPAM		giuliano.castelli@epa.org.me

Tabella A2. Scientific and technical parties

DATE	OPERATIONS
2010-03-02 mob Messina. Departure 18:30 local, head to S.Maria di Leuca, CTD, CHIRP, MULTIBEAM	
2010-03-03 transit, CTD, CHIRP, MULTIBEAM	
2010-03-04 CTD Gargano, CTD, CHIRP, MULTIBEAM	
2010-03-05 transit CTD Senigallia, CTD, CHIRP, MULTIBEAM	
2010-03-06 transit CTD Po-Rovinij, Rimini, CTD, CHIRP, MULTIBEAM	
2010-03-07 transit CTD Pescara, CTD, CHIRP, MULTIBEAM	
2010-03-08 Zelenika 08:00 embark Montenegrin Albanese, CTD, CHIRP, MULTIBEAM	
2010-03-09 Chirp, Multibeam Bojana,CTD, CHIRP, MULTIBEAM, Box corer	
2010-03-10 Chirp, Multibeam, Bokakotorska ROV, GRABS,CTD, CHIRP, MULTIBEAM	
2010-03-11 08:00 Disembark Montenegrin, Albanese people, head to Bari CTD, CHIRP, MULTIBEAM	
2010-03-12 12:00 de-mob Bari	

Tabella A3. Diary of Operations.

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
UNIVPM	Universita' Politecnica delle Marche	www.univpm.it
IBMK	Inst.Marine Biology, Kotor	
GSM	Geol.Survey Montenegro, Podgorica	www.geozavod.cg.yu
EPAM	Environmental Prot. Agency Montenegro	epa.org.me
UNITIRANA	University of Tirana	www.upt.al
IEWE	Inst.Energy Water Environment, UNITIRANA	
ADRICOSM	ADRIatic sea integrated COastal areaS	gnoo.bo.ingv.it/adricosm
ADRICOSM-STAR	ADRICOSM integrated river basin an coastal zone management system: Montenegro coastal area and Bojana river catchment	gnoo.bo.ingv.it/adricosm-star
ADRICOSM-EXT		gnoo.bo.ingv.it/adricosm-ext
MEDPOL	Program for the Assessment and Control of Pollution in the Mediterranean region	http://195.97.36.231/medpol
MFS	Mediterranean ocean Forecasting System	www.bo.ingv.it/mfs
MOON	Mediterranean Operational Oceanography	
SIAM	Sistema Informativo Ambiente Mediterraneo	moon.santateresa.enea.it
SIS	Sea-floor Information System	www.kongsberg.com
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	
MAW	Modified Atlantic Water	
LSW	Levantine Surface Water	
LIW	Levantine Intermediate Water	
CIW	Cretan Intermediate Water	
CDW	Cretan Deep Water (Involved recently in EMDW. Sometimes referred as CSOW).	
LDW	Levantine Deep Water (Formed in NW Levantine Basin).	
EMDW	Eastern Mediterranean Deep Water (Kept for historical reasons).	
EOW	Eastern Mediterranean Overflow Water (Sometimes called AIW or EMDW at the Sicily channel).	
GPS-DGPS-RTK	Global Positioning System	samadhi.jpl.nasa.gov
DTM	Digital Terrain Model	en.wikipedia.org

Tabella A4. Acronyms of Organizations, Manufacturers and Products

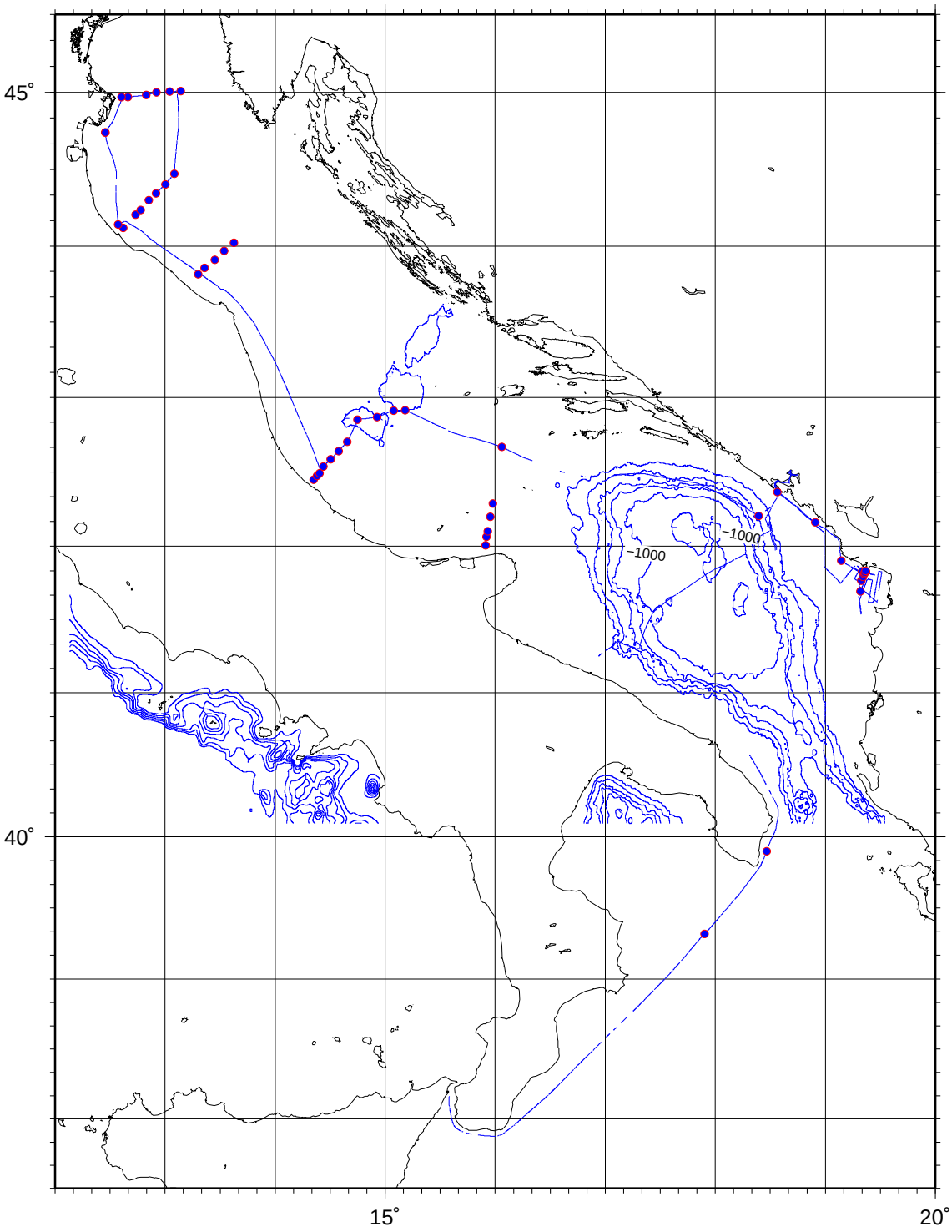

Figura A1. Whole ship track during Cruise MNG0310. Blue circles are CTD stations. Blue line shows CHIRP lines.

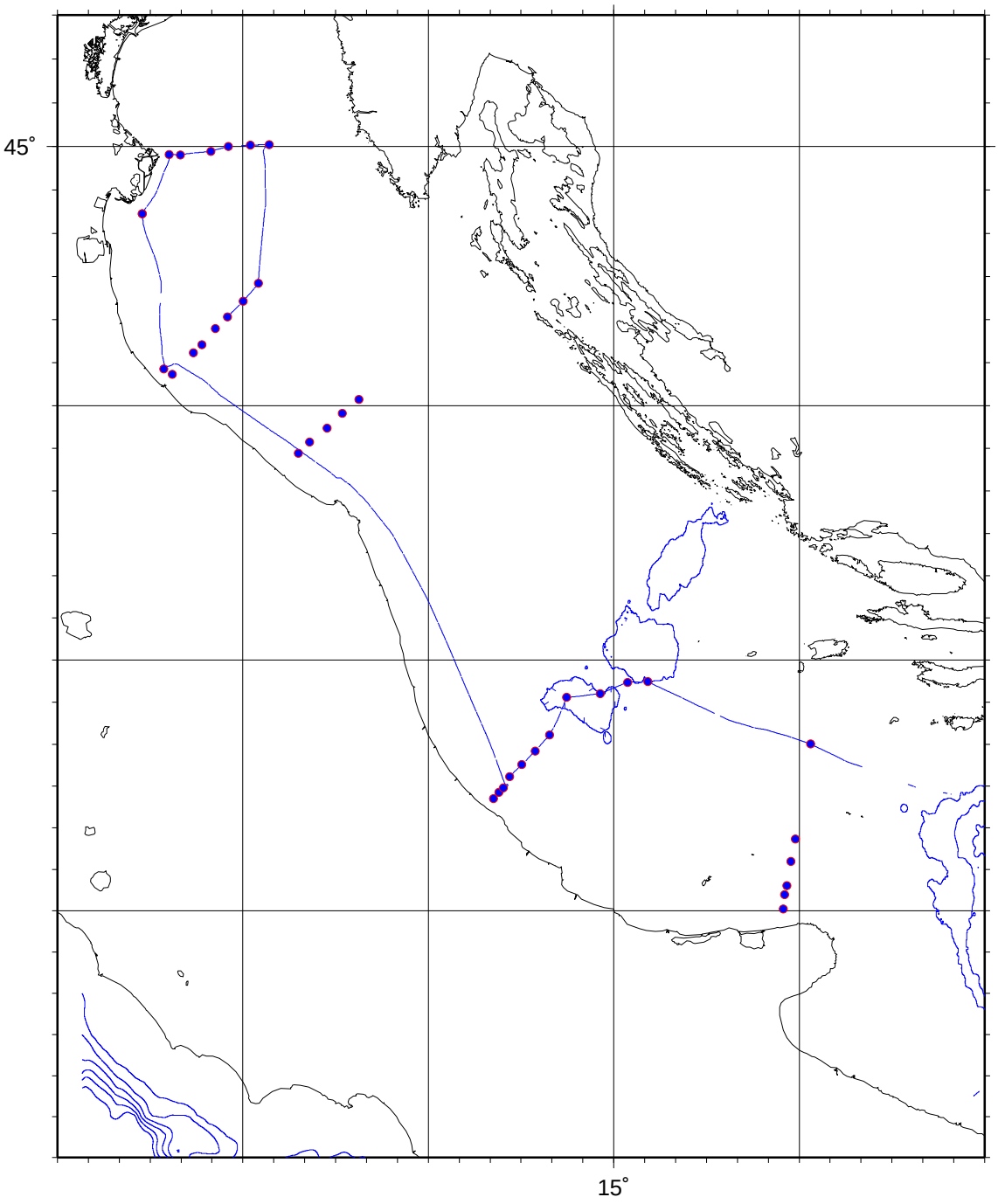

Figura A2. Whole ship track during Cruise MNG0310. Blue circles are CTD stations.

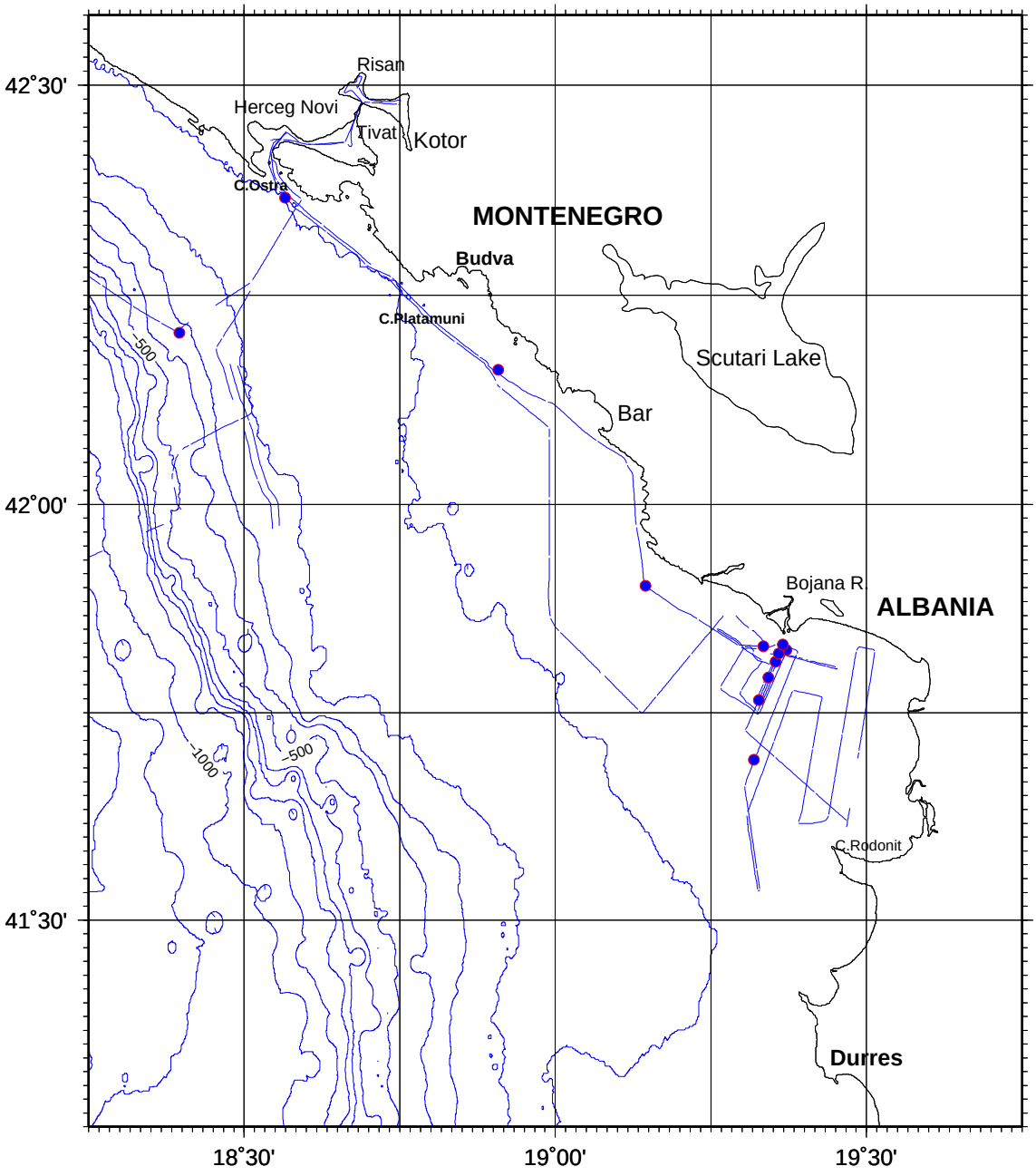

Figura A3. Whole ship track during Cruise MNG0310. Blue circles are CTD stations. Blue line show CHIRP data.

LON-LAt (ddmm.xxx)	UTM34	CTD	
1554.850 4200.400	78789 4663044	CTD-003	Mar 04 2010 12:22:45
1555.240 4203.870	79710 4669436	CTD-004	Mar 04 2010 13:00:07
1556.010 4206.020	81009 4673353	CTD-005	Mar 04 2010 13:32:27
1557.290 4211.910	83419 4684152	CTD-006	Mar 04 2010 14:34:05
1558.780 4217.250	86054 4693917	CTD-007	Mar 04 2010 15:33:42
1337.500 4401.380	-91110 4900940	CTD-008	Mar 05 2010 09:52:27
1332.140 4358.140	-98818 4895589	CTD-009	Mar 05 2010 10:42:28
1327.160 4354.670	-106068 4889773	CTD-010	Mar 05 2010 11:37:05
1321.530 4351.410	-114166 4884434	CTD-011	Mar 05 2010 12:37:51
1317.950 4348.800	-119416 4880048	CTD-012	Mar 05 2010 13:21:12
1237.220 4407.240	-170539 4919536	CTD-013	Mar 05 2010 17:43:00
1243.930 4412.340	-160633 4928068	CTD-015	Mar 05 2010 18:59:12
1246.780 4414.220	-156486 4931166	CTD-016	Mar 05 2010 19:27:11
1251.050 4417.970	-150107 4937539	CTD-017	Mar 05 2010 20:08:29
1254.960 4420.680	-144410 4942039	CTD-018	Mar 05 2010 20:44:28
1300.160 4424.250	-136851 4947967	CTD-019	Mar 05 2010 21:30:15
1304.980 4428.410	-129703 4955043	CTD-020	Mar 05 2010 22:20:33
1308.560 4500.440	-119196 5013886	CTD-021	Mar 06 2010 02:01:14
1302.470 4500.250	-127230 5014320	CTD-022	Mar 06 2010 02:47:43
1255.350 4459.970	-136633 5014733	CTD-023	Mar 06 2010 03:37:16
1249.680 4458.900	-144282 5013504	CTD-024	Mar 06 2010 04:18:18
1239.810 4458.080	-157408 5013315	CTD-025	Mar 06 2010 05:21:55
1236.180 4458.100	-162175 5013848	CTD-026	Mar 06 2010 05:54:09
1227.430 4444.490	-176345 4989861	CTD-027bis	ctd bis Mar 06
1227.410 4444.510	-176368 4989900	CTD-027	ctd Mar 06 2010
1234.430 4408.550	-174011 4922345	CTD-028	Mar 06 2010 12:53:17
1421.040 4226.950	-46902 4721118	CTD-029	Mar 07 2010 03:42:24
1422.780 4228.480	-44293 4723764	CTD-030	Mar 07 2010 04:08:54
1424.220 4229.560	-42163 4725609	CTD-031	Mar 07 2010 04:32:16
1426.360 4232.260	-38842 4730380	CTD-032	Mar 07 2010 05:04:49
1430.290 4235.190	-33043 4735390	CTD-033	Mar 07 2010 05:46:30
1434.590 4238.400	-26706 4740882	CTD-034	Mar 07 2010 06:28:47
1439.200 4242.160	-19879 4747367	CTD-035	Mar 07 2010 07:14:42
1444.770 4251.150	-11033 4763443	CTD-036	Mar 07 2010 08:26:55
1455.610 4252.080	3858 4764080	CTD-037	Mar 07 2010 09:38:47
1504.540 4254.730	16367 4768117	CTD-038	Mar 07 2010 10:38:49
1510.980 4254.910	25154 4767837	CTD-039	Mar 07 2010 11:25:54
1603.720 4240.070	95309 4735764	CTD-040	Mar 07 2010 15:56:05
1823.750 4212.300	285015 4675821	CTD-041	Mar 08 2010 04:27:47
1833.940 4221.980	299549 4693322	CTD-042	Mar 08 2010 09:04:02
1854.490 4209.640	327192 4669733	CTD-043	Mar 08 2010 11:50:10
1908.680 4154.130	346108 4640578	CTD-044	Mar 08 2010 14:40:08
1920.050 4149.760	361669 4632169	CTD-045	Mar 08 2010 15:58:08
1922.260 4149.510	364719 4631648	CTD-046	Mar 08 2010 17:43:06
1919.140 4141.600	360115 4617093	CTD-047	Mar 08 2010 22:31:49
1919.600 4145.900	360908 4625038	CTD-048	Mar 09 2010 10:18:04
1920.520 4147.530	362240 4628030	CTD-049	Mar 09 2010 10:48:37
1921.230 4148.680	363264 4630139	CTD-050	Mar 09 2010 11:13:16
1921.530 4149.270	363700 4631223	CTD-051	Mar 09 2010 11:33:21
1921.930 4149.890	364276 4632359	CTD-052	Mar 09 2010 11:55:30
1754.070 3919.160	232851 4356794	CTD-1ionio	Mar 03 2010 11:05:52
1828.000 3953.840	283419 4419435	CTD-2-leuca	Mar 03 2010 16:27:50

Tabella A5. CTD on cruise MNG0310.

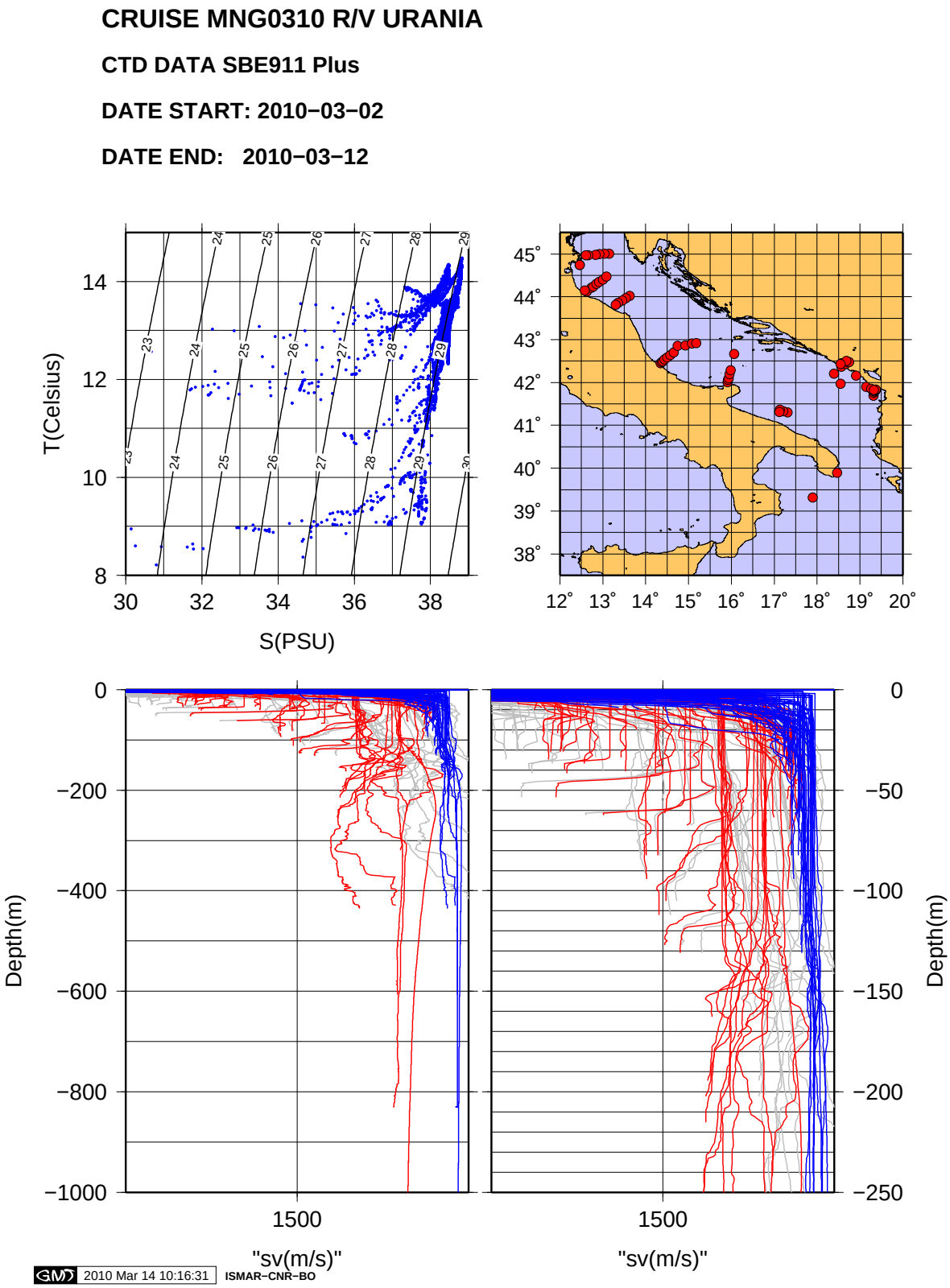

Figura A4. CTD data of MNG0310.