NATIONAL RESEARCH COUNCIL OF ITALY
INSTITUTE OF MARINE SCIENCES (BOLOGNA)
INGV (ROME)
ITU-EMCOL (ISTANBUL)

MAINTANANCE AND REDEPLOYMENT OF SN-4 OBSERVATORY. RECOVERY OF OBS AND PIEZOMETERS

EC ESONET MARMARA DEMO MISSION, R/V Yunus S., 2010-03-26, 2010-03-31, CRUISE REPORT

Gasperini Luca, Giovanni Bortoluzzi, [1]
Giuditta Marinaro, Davide Embriaco, [2]
Cristina La Fratta, Franco Italiano, [2]
Sinan Özeren , Umut Barış Ülgen, [3]
Dursun Acer, Zeynep Erden, Nazik Öğretmen, [3]
Nilay Sasa, Ayse Kaplan, [3],
Pascal Pelleau, Ronan Approioul,[4], Anke Ulrike Dannowski, [5]

[1] ISMAR-CNR, Bologna,

[2] INGV, Rome,

[3] ITU-EMCOL, Istanbul

[4] IFREMER, Brest,

[5] IFM-GEOMAR, Kiel

ISMAR Bologna TECHNICAL REPORT

Bologna, April 2010

ISMAR-CNR Cataloging-In-Publication data: ISMAR Bologna TECHNICAL REPORT

Maintanance And Redeployment Of Sn-4 Observatory. Recovery Of Obs And Piezometers. Ec Esonet Marmara Demo Mission,
R/V Yunus S., 2010-03-26, 2010-03-31.

by Gasperini L., Bortoluzzi G., Marinaro G., Innocenzi L., La Fratta C., S. Özeren , U. Barış Ülgen, Dursun Acer, Zeynep Erden, Nazik Öğretmen, Nilay Sasa, Ayse Kaplan, Pascal Pelleau, Ronan Approioul, Anke Ulrike Dannowski

Includes bibliographical reference and index.
1. tectonics 2. active faults 3. paleoseismology 4. seismology 5. Sea of Marmara

Abstract -

Sommario -

Reproduced by ISMAR-CNR from camera-ready proofs supplied by the authors.
Available in the PDF formats. Available also in other formats, upon request.

Production Notes - The document was edited with standard text editors, typeset with L.Lamport's LaTeX, translated to `PostScript` with `dvips` and printed with an A4 laser printer. The full production was done on a Linux box with `GNU-GPL` software. Converted to HTML by N.Drakos's LaTeX2HTML and to `PDF` by Alladin Ghostscripts's `ps2pdf`. Most of the maps included were produced by Wessel and Smith's `GMT` package. Some drawings were produced by `xfig` (www.xfig.org). Non `PostScript` images were converted by John Bradley's `xv` or other public-domain packages, among them `convert`.

ACRONYMS

ACRONYM	DESCRIPTION	URL-email
ESONET	European Seas Observatory NETwork	www.esonet-noe.org/about_esonet
ESONET-NOE	ESONET Network of Excellence	www.esonet-noe.org
CNR	Consiglio Nazionale Delle Ricerche	www.cnr.it
ISMAR	Istituto di Scienze Marine	www.bo.ismar.cnr.it
IFREMER	Institute Franc.Exploit. Mer	www.ifremer.fr
INGV	Istituto naz. geofisica e Vulcanologia	www.ingv.it
ITU	İstanbul Technical University	www.itu.edu.tr
EMCOL	Eastern Mediterranean Center for Oceanography and Limnology	www.mines.itu.edu.tr/emcol/
IFM-GEOMAR	Leibniz Inst. Marine Sc., Kiel University	www.ifm-geomar.de
GPS-DGPS-RTK	Global Positioning System	samadhi.jpl.nasa.gov
DTM	Digital Terrain Model	en.wikipedia.org
OBS	Ocean Bottom Seismometer	woodshole.er.usgs.gov/operations/obs
MBES	MULTIBEAM ECHOSOUNDER SYSTEM	
UTM	Universal Transverse Mercator	
UTC	Universal Time Coordinated	
WGS84	World Geodetic System 1984	
NMEA	National Marine Electronics Association	www.nmea.org
TECNOMARE	ENI Tecnomare	www.tecnomare.it
COMM-TECH	Communication Technology	www.comm-tec.com
GMT	Generic Mapping Tool	gmt.soest.hawaii.edu/gmt

Table 1: Acronyms of Organizations, Manufacturers and Products

ACKNOWLEDGMENTS

Many people contributed to the success of the research cruise (MARM10_01R/V Yunus S.). We are particularly indebted to the Captain Mehmet Başali, the officers and crew members of R/V Junus S. for their efforts and help in assuring the success of the cruise. The project was funded EU's ESONET.

Contents

1 INTRODUCTION AND BACKGROUNDS **1**

2 CRUISE SUMMARY **2**

3 MATERIALS AND METHODS **5**

4 DESCRIPTION OFOPERATIONS **9**
4.1 Piezometer and OBS recovery 9
4.2 SN-4 observatory recovery 9
4.3 SN-4 observatory deployment 11

5 First results, recommendations and Concluding Remarks **11**

List of Figures

1 Morpho-tectonic map of the Darica basin 1
2 General ship track during Cruise MARM10_01. 2
3 General ship track during Cruise MARM10_01. 3
4 R/V Yunus S. 5
5 SN4 sketches. 7
6 The colonizer on the SN-4 8
7 SN-4 being recovered. 10
8 SN-4 seismic data. 10
9 SN-4 localization. Blue point are GPS positions (5m ahead of SN4 11

List of Tables

1 Acronyms of Organizations, Manufacturers and Products i
2 Scientific and technical parties 4
3 Cruise MARM10_01, operations at sea. Latitude, Longitude true position 4
4 INGV's SN-4 payload. 6
5 OBS and Piezometers drop positions (cruise MARM09) and status after MARM10_01. 9

1 INTRODUCTION AND BACKGROUNDS

During cruise MARM009 [Gasperini *et al.*, 2009] 5 piezometers and 10 OBS were deployed by IFREMER in the Sea of Marmara, and the SN4 observatory was deployed at the entrance of the Izmit Gulf on the main strand of NAF. This cruise have been scheduled for the recovery of the IFREMER's instruments and for the maintanance on the SN4 for a new 6 months mission.

Relevant previous or future research cruises

The present project is based on many previous research cruises carried out using Odin Finder and Urania research vessels within the framework of an Italy/Turkey collaborative programme.

The key areas have been identified through the interpretation of the previously collected geophysical and geological data along the NAF strands and cruise work was designed in order to map active structures and features likely useful to understand fault kinematics.

During cruise MARM2009 the INGV's SN-4 seafloor observatory was deployed in the main strand of the NAF at the entrance of the Izmit Gulf, between Darica and Yalova.

For details about these cruises see [Bortoluzzi *et al.*, 2001b], [Bortoluzzi *et al.*, 2001a], [Bortoluzzi *et al.*, 2005] and [Gasperini *et al.*, 2009].

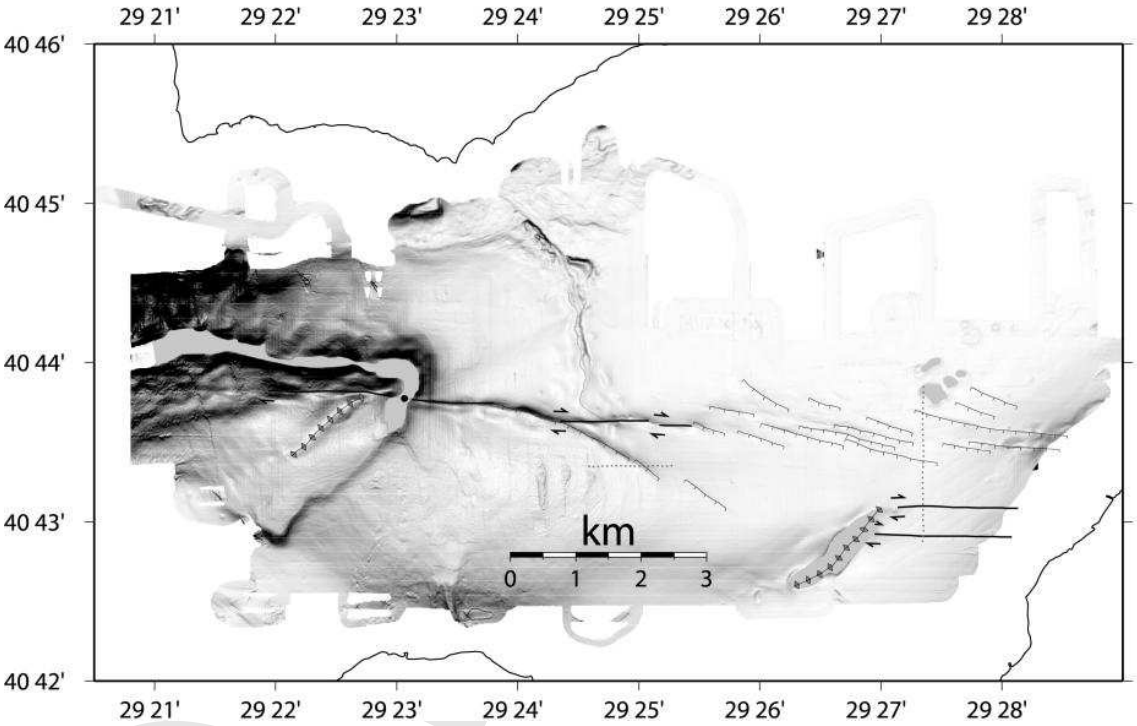

Figure 1: Morpho-tectonic map of the Darica basin close to the SN4 deployment site.

2 CRUISE SUMMARY

SHIP: R/V Junus S. Flag: Turkish Call Sign: TC7750
START: 2010-03-26 PORT: Istynie
END: 2010-03-31 PORT: Istynie

SEA/OCEAN: Sea of Marmara, Mediterranean Sea
LIMITS: NORTH 40:43.0 SOUTH: 40:44.0 WEST: 29:23.0 EAST: 29:24
OBJECTIVE: Active Faults and historical earthquakes in the Marmara Sea
COORDINATING BODIES: ISMAR-Bologna BOLOGNA (ITALY)
CHIEF OF EXPEDITION: Luca Gasperini (ISMAR-CNR) Giuditta Marinaro (INGV)
CONTACT: Luca.Gasperini@ismar.cnr.it giuditta.marinaro@ingv.it
DISCIPLINES: BOTTOM OBSERVATORIES DEPLOYMENT, WATER SAMPLING,
WORK DONE: SN4 RECOVERY AND DEPLOYMENT, 10 OBS AND 5 PIEZOMETERS RECOVERED, 2 WATER SAMPLING CASTS WITH SUBSAMPLING

LOCALIZATION:

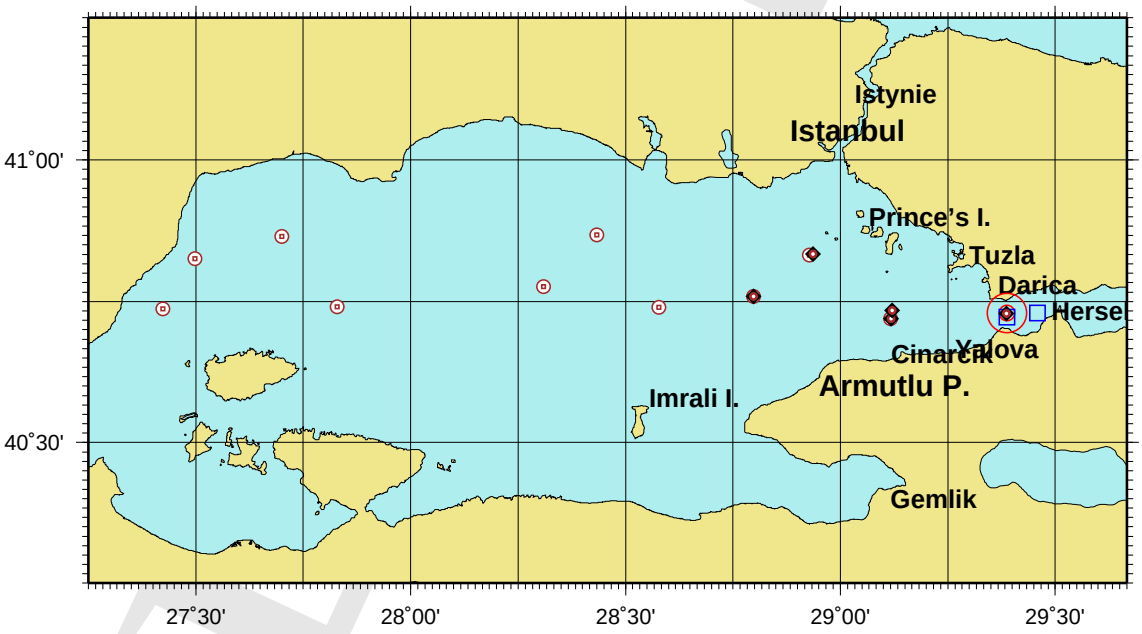

Figure 2: General ship track during Cruise MARM10_01, including transits from Istynie and Tuzla. Red circle is SN4, blue squares are the Water Sampling Stations.

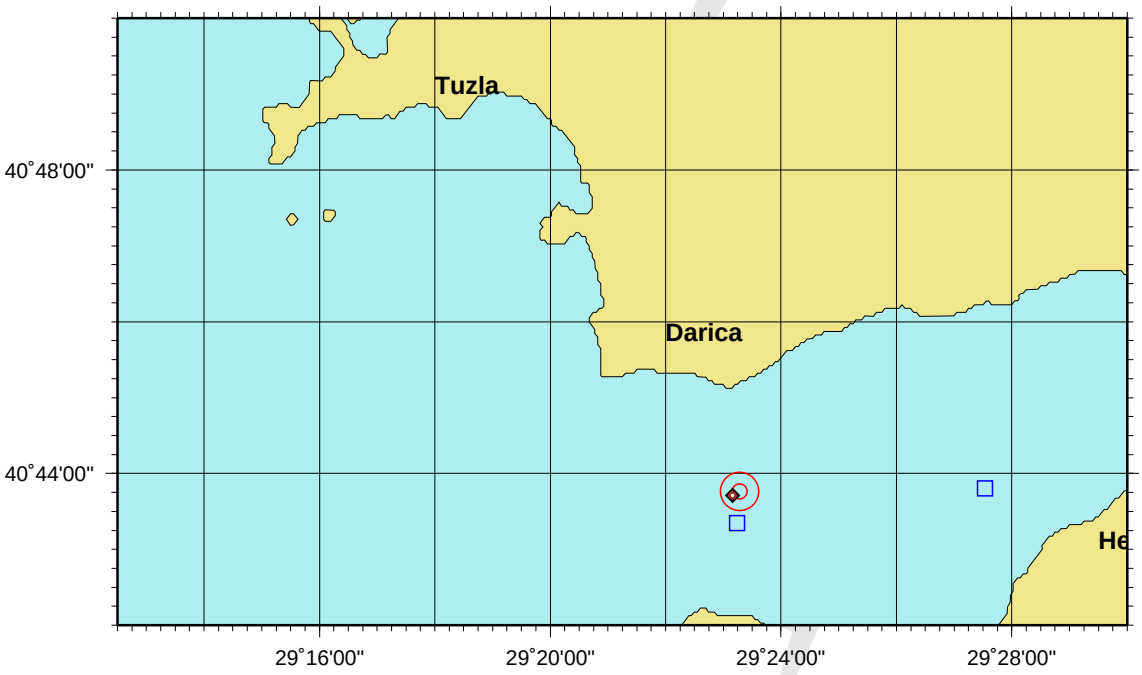

Figure 3: General ship track during Cruise MARM10_01, including transits from Istynie and Tuzla. Red circle is SN4, blue squares are the Water Sampling Stations.

SCIENTIFIC AND TECHNICAL PARTIES

PARTICIPANTS	ORGANIZATION	EXPERTISE	tel & email & www
Luca Gasperini	ISMAR		L.Gasperini@ismar.cnr.it
Giovanni Bortoluzzi	ISMAR		G.Bortoluzzi@ismar.cnr.it
Giuditta Marinaro	INGV		giuditta.marinaro@ingv.it
Luigi Innocenzi	INGV		innocenzi@ingv.it
Cristina La Fratta	INGV		cristina.lafratta@geostar.ingv.it
Davide Embriaco	INGV		davide.embriaco@ingv.it
Franco Italiano	INGV		italiano@ingv.it
Sinan Özeren	ITU-EMCOL		ozerens@itu.edu.tr
Umut Barış Ülgen	ITU-EMCOL		ulgenum@itu.edu.tr
Dursun Acer	ITU-EMCOL		dursunacaracar@hotmail.com
Zeynep Erden	ITU-EMCOL		erdenz@itu.edu.utr
Nazik Öğretmen	ITU-EMCOL		
Pascal Pelleau	IFREMER		p.pelleau@ifremer.fr
Ronan Apprioual	IFREMER		r.apprioual@ifremer.fr

Table 2: Scientific and technical parties

OPERATIONS

- 2010-03-27 08:30 R/V Yunus S. leaves Istynie harbour, with INGV, ITU-EMCOL and IFREMER teams onboard, heading to SN4 site. Ship arrives on SN4 station at 09:50 local. At 10:30 water sample cast with 2 bottles (bottom and 5 m above). At 11:47 Piezometer P2-D is recovered. SN4 release is recovered at 12:30. Ship heads to Tuzla and docks at 15:45.
- 2010-03-28 09:07 Recovery of Piezometers and OBS
- 2010-03-29 09:07 Recovery of Piezometers and OBS
- 2010-03-31 09:07 R/V Yunus S. leaves Tuzla harbour
- 2010-03-31 10:05 at the SN4 deployment site
- 2010-03-31 14:34 SN4 release
- 2010-03-31 15:15 water sample
- 2010-03-31 16:10 SN4 interrogation
- 2010-03-31 16:40 leave area, heading to Istanbul
- 2010-03-31 21:30 Docked at Istinye

LAT LON(TRUE) UTM35(TRUE)	DATE TIME	OPERATION
29:23.239'E 40 43.344'N - -	2010-03-27T07:30+00	WS01
29:23.239'E 40 43.344'N - -	2010-03-27T08:47+00	PIEZO P2-D ON BOARD
29:23.283'E 40:43.767'N 701665 4511467	2010-03-31T11:34+00	SN4 RELEASE
29:27.531'E 40 43.803'N - -	2010-03-31T12:45	WS02

Table 3: Cruise MARM10_01, operations at sea. Latitude, Longitude true position

3 MATERIALS AND METHODS

The research cruise was carried out with the 32 meter R/V Junus S.. (Fig.4), owned and operated by the Istanbul University.

Figure 4: R/V Yunus S.

Navigation And Data Acquisition

Navigation was performed by the COMM-TECH's NAVPRO software. WAAS/EGNOS GPS data were provided by a Garmin receiver.

SN4 Bottom Observatory

The INGV and TECNOMARE SN-4 observatory was developed in the framework of ORION (Ocean Research by Integrated Observatory Networks) EC project and deployed as node of ASSEM (Array of Sensors for long-term SEabed Monitoring of geohazards) EC project during a joint experiment in the Corinth Gulf (Greece, 400 m w.d.) in 2004 [Favali & Beranzoli, 2009], proving compatibility of GEOSTAR-class observatories with other networks. In its first configuration SN-4 was based on a light frame whose main characteristics are summarised in Table 1.

All sensors installed on the observatory are managed by dedicated low-power electronics, able to perform the following tasks: (a) management and acquisition from all scientific packages and status sensors; (b) event detection; (c) preparation and continuous update of hourly data messages; (d) management of bidirectional communications via hydro-acoustic telemetry link (including transmission of seismic wave forms); (e) actuation of commands received (e.g., data request, system reconfiguration, restart) and (f) complete data back-up on internal memory. The SN-4 electronics can manage a wide set of data streams with quite different sampling rates tagging each datum according to a unique reference time set by a central high-precision clock.

During its first mission in Corinth Gulf SN-4 was equipped with a 3-C broad-band seismometer, an hydrophone and a methane sensor, with one year autonomous operation with 12-V, 960-Ah lithium battery pack. To reduce disturbance of the frame and electronics, special devices were designed and implemented for installing the seismometer, which is lodged in a dedicated vessel integrated in a separate structure connected to the SN4 by a special mechanical release. To guarantee a good coupling with the sea bottom, the structure is disconnected just after the touch-

down and kept linked to the frame by a slack rope. This method of seismometer installation proved to record higher quality data during all the GEOSTAR-class observatory missions.

For the Marmara mission the configuration of the SN4 was modified, aiming at better quantifying the temporal relations between fluid expulsion, fluid chemistry and seismic activity along the NAF. The new payload and relevant sampling rates are summarised in Tab.4. The station will be deployed using ship's winch and an acoustic release like in ASSEM mission, but the recovery procedure was redesigned, i.e. station will be recovered by a rope released by an acoustic command, letting the operations be performed by ship-of-opportunity. To achieve this result, the total weight in water was reduced to 0.15kN ($\approx$ 150 kg)from the 500kg in air by installing 8 benthospheres on the frame and adopting new lighter vessels for batteries and Electronics. This new fitting will make recovery and redeployment eeasier at the end of scheduled 6 months of activity . For future applications, SN-4 can be re-configured to operate as cabled observatory for permanent long-term real-time monitoring of the Marmara Sea to study relationship between fluids and seismicity.

INGV SN-4 is a multidisciplinary observatory, designed and built in cooperation with Tecnomare. It can support on-demand payloads and it is based on technical solutions developed for INGV Geostar-class observatories (¿4000 days of operation, 13 missions, up to 3320 m water depth). Its original seismometer management procedure, allows SN-4 to be re-configured to operate as cabled observatory (using a simple and cheap electrical umbilical cable, with cost in the order of few E/m).

The configuration for the ESONET Marmara Mission (Fig.5) is as follows:

- Communication with ship of opportunity by Sercel High Speed Acoustic Modem for data transfer and system's control
- Deployment via winch and acoustic release and recovery via pop-up system (recall buoy canister) actuated by acoustic release
- Autonomy about 6 months; Power: 12V,1920 Ah primary lithium pack;data storage 30GB HD
- Dimensions: 2000 x 2000 x 2000 mm; Weight: 6.5 kN in air, 1.5 kN in water

SENSOR	MODEL	SAMPLING RATE
Seismometer	Guralp CMG-40T	100Hz
Current meter	Nobsvka MAVS-3	5 Hz
CTD	SBE-16 Plus	1 sample/10min
Turbidimeter	Wet Labs Echo-BBRTD	1 sample/10min
CH_4 #1	Franatech METS	1Hz
Oxygen	Aanderaa Oxygen Optode 3830	1Hz

Table 4: INGV's SN-4 payload.

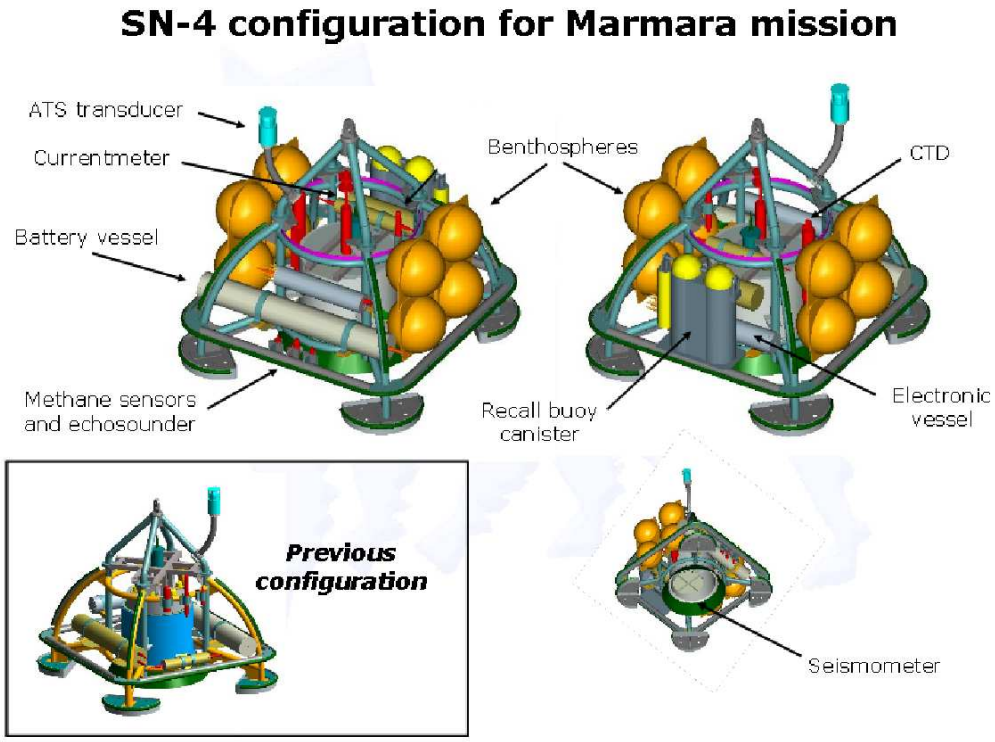

Figure 5: SN4 sketches.

Water and gas sampling

Water and gas samples were taken ...

Microbial colonization experiment in a methane seep observatory

by Purificacin López-García
Equipe Diversié et Evolution Microbiennes,
Unité d'Ecologie, Systématique et Evolution, CNRS UMR 8079, Université Paris-Sud, France;
puri.lopez@u-psud.fr

A microbial colonizer (see Fig.6) has been installed on the SN-4 just before deployment.

The pilot experience proposed here is a complement to an ongoing project initiated during the Marnaut 2007 cruise aiming at better understanding the microbial ecology of the Marmara deep plankton and sediment communities, with a particular emphasis in biogeochemical processes associated to methane seeps [Quaiser *et al.*, 2010] and (Chevalier et al., in preparation). The discovery of anaerobic oxidation of methane (AOM) by mixed microbial consortia formed by archaea belonging to newly identified phylogenetic groups (ANME 1 to 3 groups) and sulfate reducing bacteria belonging to the *Deltaproteobacteria* dates back only to the beginning of the 2000s'. This hitherto unknown metabolic process linking AOM to sulfate reduction appears extensive in marine sediments of methane seep areas all around the world (for a review, see [Jorgensen & Boetius, 2007]). Very recently, the possibility that AOM is linked to manganese and iron reduction [Beal *et al.*, 2009] as well as to nitrification (in particular the conversion of nitrite to dinitrogen) [Ettwig *et al.*, 2010] has been shown. This highlights our limited knowledge about AOM and suggests that links, via symbioses, to other metabolic processes are possible and remain to be discovered. Microbial communities associated to marine anoxic sediments, where sulfate is relatively abundant, are dominated by deltaproteobacterial sulfate-reducers, which explains that AOM in methane seep anoxic sediments is coupled mainly to sulfate reduction. However, sediment bacterial communities are extremely rich and complex. This makes it difficult to study the real contribution of the different

microbial species to these microbial AOM consortia. So far, the physical separation by magnetic beads of symbiotic assemblages has facilitated the study of those symbioses when there is a close and stable physical interaction [Brown *et al.*, 2008].

In the present experiment, we propose to explore by molecular biology tools the diversity of microorganisms that colonize a porous inert substrate exposed for six months to methane-enriched seawater in a cold seep area in the Marmara Sea. This will allow (i) to test whether potential AOM symbiotic consortia colonizing this substrate are similar to those inhabiting the sediments or whether, on the contrary, they correspond to other kind of anaerobic methanotrophic consortia being part of methane-consuming plankton that remain to be described and (ii) to identify the first microorganisms colonizing this particular niche. If these turn out to be AOM communities similar to those inhabiting the sediments, they will constitute a natural in situ enrichment that could be subsequently studied by metagenomic approaches and compared to sediment and plankton communities from the Marmara Sea.

Figure 6: The colonizer on the SN-4

Miscellaneous

The WGS84 datum, the UTM, zone 35N projection and UTC were chosen for navigation and display, and for data acquisition. The positioning maps and bathymetric images were produced

with GMT [Wessel & Smith, 1995] and Globalmapper.

Photographs and video were taken by digital cameras and video-camera by INGV dedicated personnel and by all participants.

4 DESCRIPTION OFOPERATIONS

4.1 Piezometer and OBS recovery

The IFREMER's Piezometers and OBS deployed during cruise MARM09 (**??**) were recovered. Table **??** summarizes the results. Two GEOMAR OBS (on the NW and SE slope and platform of the Sea of Marmara) were also recovered.

LON LAT	DATE_TIME	OBS	NOTES	STATUS
2725.3936 4044.2150	2009-09-27T03:06:04	OBS01	Recovered	
2729.9079 4049.5494	2009-09-27T04:45:42	OBS02	Recovered	
2742.0275 4051.8859	2009-09-27T06:16:09	OBS03	Recovered	
2749.7209 4044.4076	2009-09-27T07:19:41	OBS04	Recovered	
2818.5332 4046.5612	2009-09-27T09:48:00	OBS05	Recovered	
2834.6671 4044.3661	2009-09-27T11:18:06	OBS06	Recovered	
2847.8779 4045.5176	2009-09-27T17:19:18	OBS07	Recovered	
2825.9607 4052.0406	2009-09-27T20:03:59	OBS08	Recovered	
2907.0253 4043.1647	2009-09-28T11:54:17	OBS09	Recovered	
2855.6879 4049.9109	2009-09-28T17:33:18	OBS10	Recovered	
2847.8665 4045.5046	2009-09-27T15:36:01	PZ-A	Recovered	
2907.0277 4043.1575	2009-09-28T08:39:32	PZ-B	Recovered	
2907.2033 4044.0456	2009-09-28T13:05:47	PZ-C	Recovered	
2923.1742 4043.6853	2009-09-29T07:48:34	PZ-D	Recovered	
2856.2232 4050.0033	2009-09-29T12:48:18	PZ-E	Recovered	
-	-	OBS-GEOMAR	Recovered ??	

Table 5: OBS and Piezometers drop positions (cruise MARM09) and status after MARM10_01.

4.2 SN-4 observatory recovery

The recovery of SN4 took place on 2010-03-26 (Fig. 7). System was recovered on ITU's pier at Tuzla and maintanance started. First, the collected data were downloaded and checked. Second, the system was cleaned, the batteries were replaced and all subsystems and sensors were controlled. A problem in current meter software was solved. Figure 8 shows the seismometer data of the 2010-03-08T02:32+0000 M6 event in E Turkey on NAF.

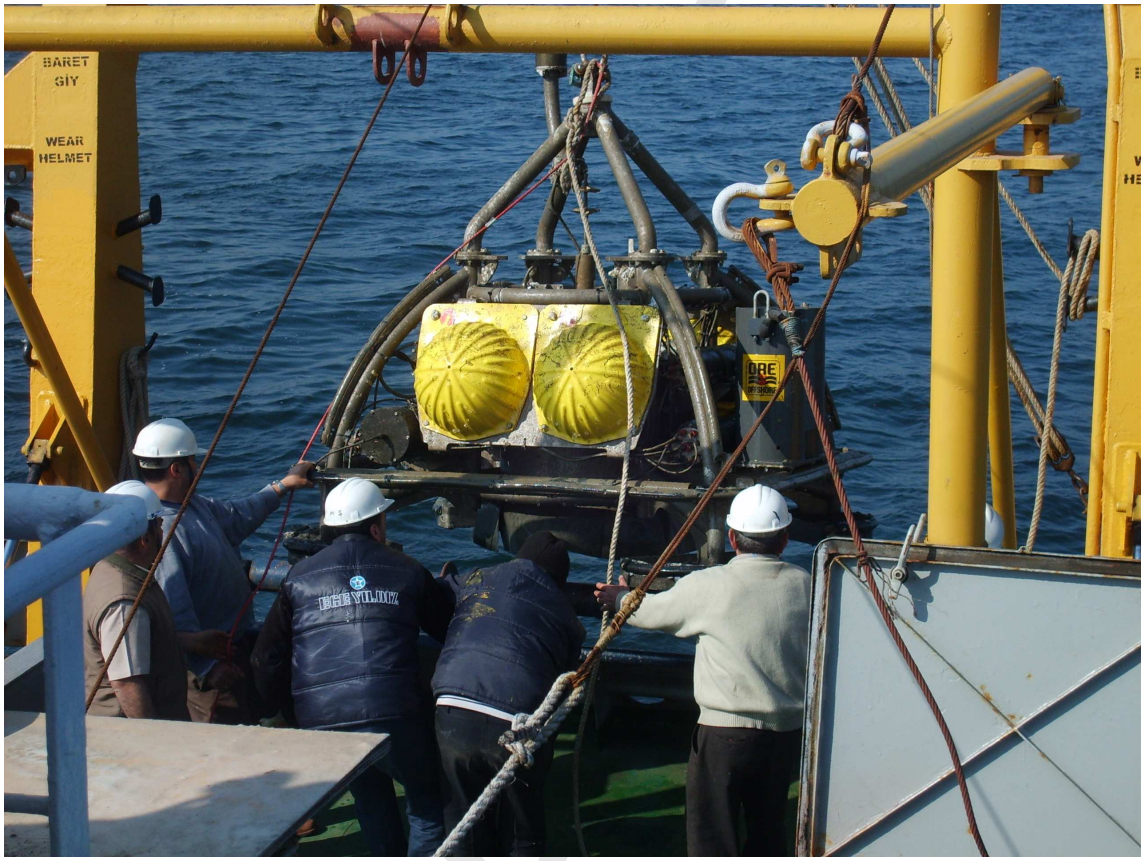

Figure 7: SN-4 being recovered.

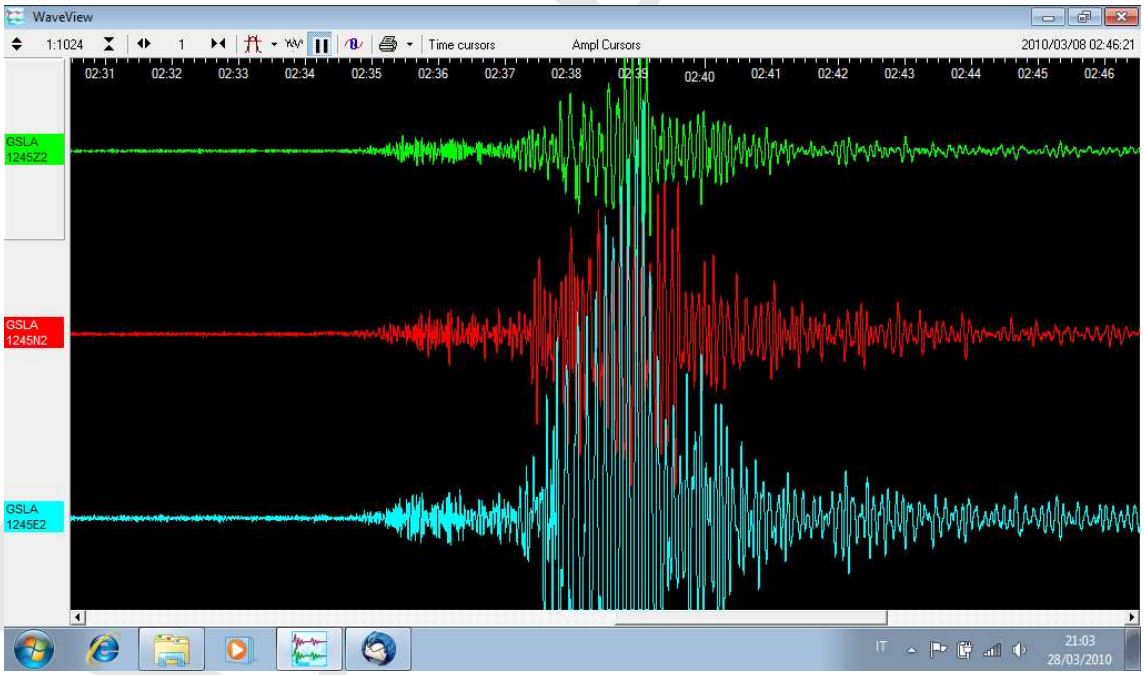

Figure 8: SN-4 seismic data.

4.3 SN-4 observatory deployment

The deployment of the INGV's SN-4 took place afternoon of 2010-03 31. Ship arrived around station at 10:00 local, and a moored buoy was deployed to help localizazione of mooring. A first attempt was not successful due to problems in acoustic release. The final destination was chosen to be very close to the NAF, on a flat bottom 150m depth just N of the steep EW striking valley merging a few hundred m to the W with the Izmit Canyon. The second one was successful (14:34 Local Time). System on bottom responded with tilt angles 9 and 12 °and heading 246 °. All other instrumentation behaviour was found to be normal. Figure 9 shows the localization on seabottom of the SN4 observatory.

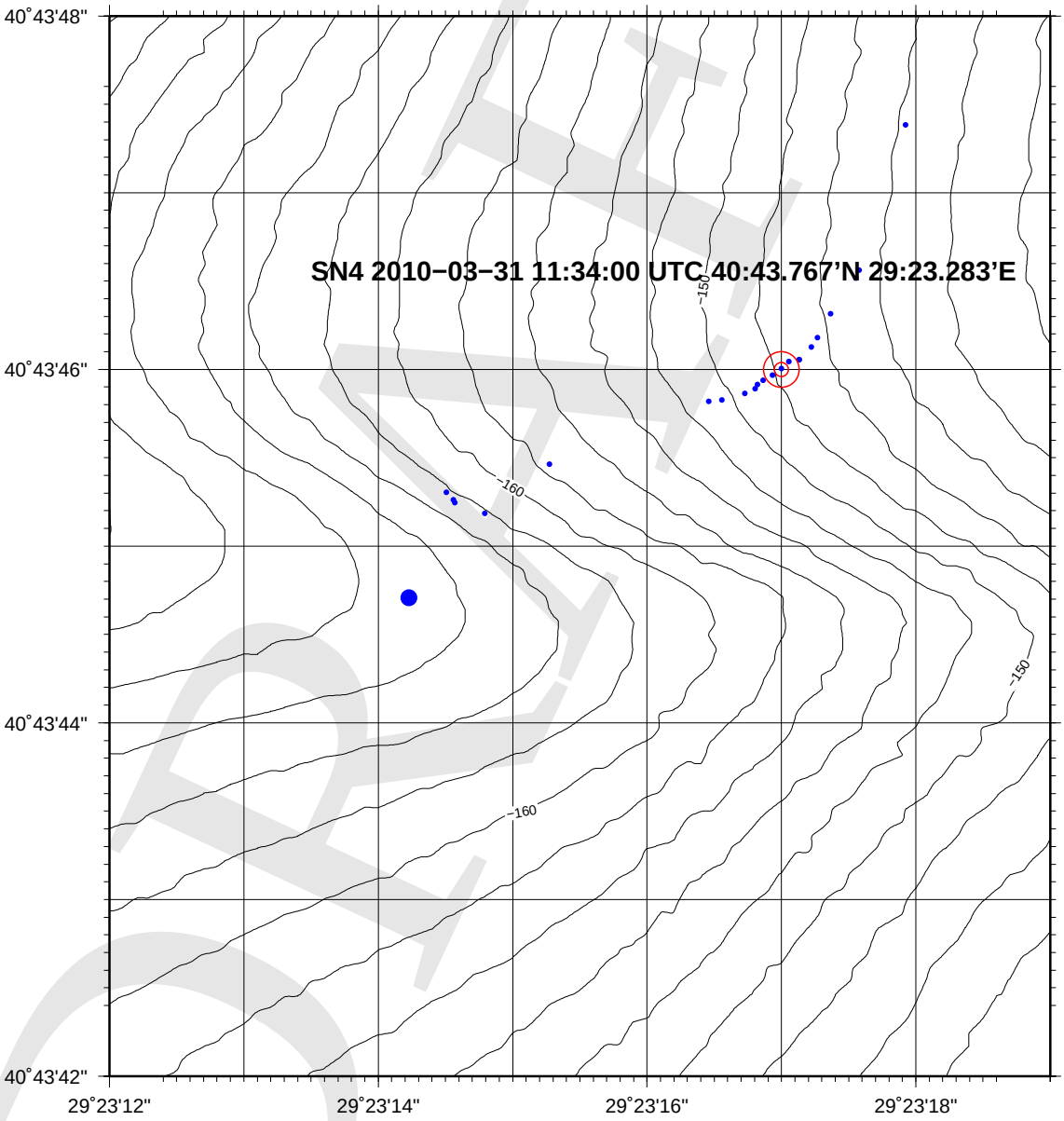

Figure 9: SN-4 localization. Blue point are GPS positions (5m ahead of SN4

5 First results, recommendations and Concluding Remarks

References

[Beal *et al.*, 2009] Beal, E. J., House, C. H., & Orphan, V. J. 2009. Manganese- and iron-dependent marine methane oxidation. *Science*, **325**(184–187).

[Bortoluzzi *et al.*, 2001a] Bortoluzzi, G., Gasperini, L., Ligi, M., Bonatti, E., Capotondi, L., Blasi, A., Marozzi, G., A.Magagnoli, Busetti, M., Serpi, G., Cormier, M. H., McHugh, C., Seeber, L., Ryan, W. B. F., Cagatay, N., Emre, O., Sarikavak, K., Imren, C., Okay, N., Eris, K., Hacioglu, E., Simsek, M., Bais, A., & Scotto di Vettimo, P. 2001a. *Geophysical and geological studies in the sea of Marmara. Report on morphobathymetric, seismic and coring investigations during cruise M2001 with R/V Urania.* Tech. rept. 70. IGM-CNR.

[Bortoluzzi *et al.*, 2001b] Bortoluzzi, G., Polonia, A., Cormier, M. H., Cagatay, N., Bonatti, E., Seeber, L., Blasi, A., Fabretti, P., Penitenti, D., Omer, E., Kurt, H., Ozer, N., Tok, B., Satici, F., Bartolini, E., Boschetti, A., & Catarinelli, A. 2001b. *Geophysical and geological studies in the sea of Marmara. Report on morphobathymetric, seismic, and coring investigations during cruise marmara2000 with R/V Odin Finder.* Tech. rept. 69. IGM-CNR.

[Bortoluzzi *et al.*, 2005] Bortoluzzi, G., Gasperini, L., Cagatay, N., Gorur, N., Angeletti, L., Bellucci, L. G., Drago, F., Ferrante, V., Marozzi, G., Colautti, W., Sugan, M., Akcer, S., I., I. Caner, Damci, E., Eris, K., Kurt, H., Ocal, F., Sarikavak, K., Basmaci, A. H., Kaskati, M. T:, Simsek, B., Gitto, D., & Raggiri, F. 2005. *Report on the morphobathymetric, geophysical, oceanographic, coring and dredging investigations during cruise MARM05 aboard R/V Urania.* Tech. rept. 98. ISMAR-CNR.

[Brown *et al.*, 2008] Brown, A. Pernthaler A. E. Dekas C. T., Goffredi, S. K., Embaye, T., & Orphan, V. J. 2008. Diverse syntrophic partnerships from deep-sea methane vents revealed by direct cell capture and metagenomics. *Proc. Natl. Acad. Sci. USA*, **105**, 7052–7057.

[Ettwig *et al.*, 2010] Ettwig, K. F., Butler, M. K., Le Paslier, D., Pelletier, E., Mangenot, S., M. M. Kuypers, M.M., Schreiber, F., Dutilh, B. E., Zedelius, J., de Beer, Dirk, Gloerich, Jolein, Wessels, Hans J. C. T., van Alen, Theo, Luesken, Francisca, Wu, Ming L., van de Pas-Schoonen, Katinka T., Op den Camp, Huub J. M., Janssen-Megens, Eva M., Francoijs, Kees-Jan, Stunnenberg, Henk, Weissenbach, Jean, Jetten, Mike S. M., & Strous, Marc. 2010. Nitrite-driven anaerobic methane oxidation by oxygenic bacteria. *Nature*, **464**, 543–548.

[Favali & Beranzoli, 2009] Favali, P., & Beranzoli, L. 2009. The GEOSTAR Technology. *ESO NEWS.*

[Gasperini *et al.*, 2009] Gasperini, L., Geli, L., Favali, P., Cagatay, N., Gorur, N., Bortoluzzi, G., Del Bianco, F., Kuruoglu, E., Romano, S., Etiope, G., Innocenzi, L., Marinaro, G., Approioul, R., Le Piver, D., Pelleau, P., Roudaut, M., Acar, D., Akarsu, E., Akkok, R., Biltekin, D., Can, A., Elbeck, S., Ozmaral, A., Ozeren, S., Sancar, E., Ulgen, U. B., Cefalogli, L., & Veditti, V. 2009. *Marm2009: marine geological study Of The North Anatolian Fault beneath The Sea Of Marmara. Ec Esonet Marmara Demo Mission, R/V Urania, 2009-09-23, 2009-10-12, Cruise Report.* Tech. rept. ISMAR-CNR.

[Jorgensen & Boetius, 2007] Jorgensen, B. B., & Boetius, A. 2007. Feast and famine–microbial life in the deep-sea bed. *Nat. Rev. Microbiol.*, **5**(770–781).

[Quaiser *et al.*, 2010] Quaiser, A., Zivanovic, Y., Moreira, D., & LÓpez-Garıa, P. 2010. Comparative metagenomics of bathypelagic plankton and bottom sediment from the Sea of Marmara. *ISME J.* submitted.

[Wessel & Smith, 1995] Wessel, P., & Smith, W. H. F. 1995. New version of the Generic Mapping Tool released. *EOS Trans. AGU*, 329.