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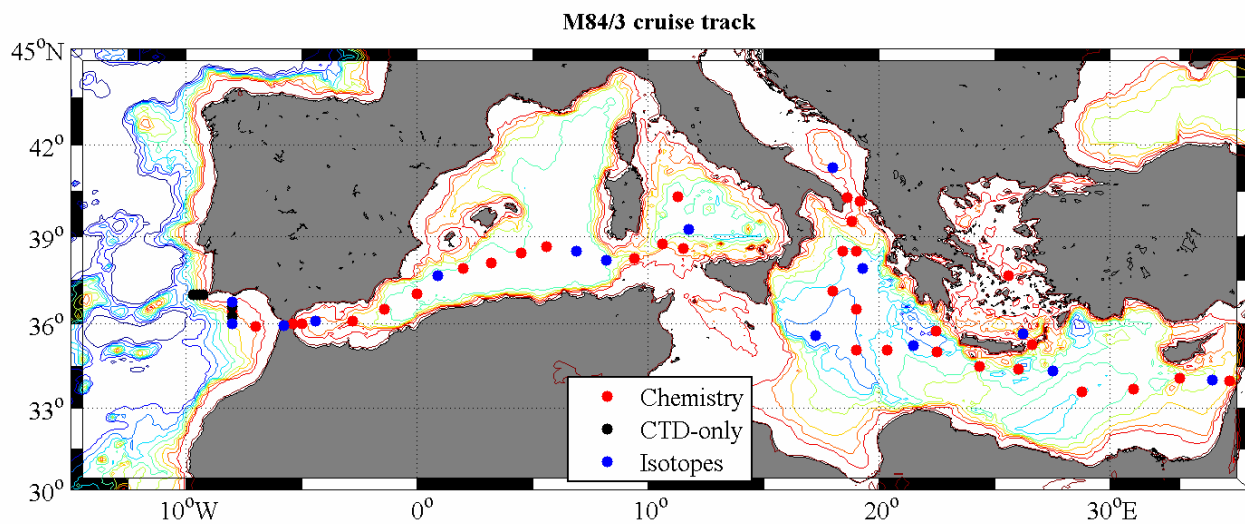


Short Cruise Report

RV Meteor Cruise M84/3

5. April - 28. April 2011
Istanbul (Turkey) – Vigo (Spain)

Chief Scientist: Toste Tanhua
Captain: Thomas Wunderlich



Objectives

The principal scientific objectives for M84/3 had two closely-linked components: understanding and documenting the large-scale Mediterranean water property distributions, their changes and drivers of those changes and addressing questions of a future Mediterranean Sea that will increase in dissolved inorganic carbon, might become more stratified and experience changes in circulation and ventilation processes due to global warming.

The main goals of the cruise were to:

- Acquire data for a (nearly) synoptic picture of property distribution across the whole Mediterranean Sea, including all major sub-basins.
- Use these physical and chemical data to determine changes in circulation and ventilation and to quantify changes in inventory and distribution of properties, particularly inorganic carbon, i.e. uptake of anthropogenic carbon.
- Fill in existing gaps in the knowledge of the carbonate system of the Mediterranean Sea, including its sub-basins. More accurate estimates of anthropogenic carbon will be made and the storage rate of carbon will be quantified.

The objectives of the main goals were achieved by measurements of physical parameters with CTD (including oxygen measurements) and by on-board measurements of oxygen by titration, nutrients (nitrate, nitrite, phosphate and silicate), dissolved inorganic carbon (DIC), total alkalinity, pH, and the transient tracers SF₆ and CFC-12. In addition were samples taken for the determination of Helium-3 and tritium, as well as for the carbon isotopes C-14 and C-13, for later shore-based analysis.

Several additional and complementary measurement and sampling programs were carried out during the cruise:

- A sampling program for the surface distribution of persistent organic pollutants (POPs), which was augmented by sampling for measurements of Polyfluorooctansulfonate (PFOS) on 6 depth profiles.
- Samples for the determination of dissolved barium were taken at all stations.
- Large volume samples for determination of Ra were taken from surface waters at several stations and extra CTD casts for large volume sampling were taken at 7 stations.
- Samples for determination of microbiological community structure were taken at all stations in surface and bottom waters, for stations in the Ionian/Adriatic area additional samples in the intermediate waters were taken. The microbiological community structure will be evaluated as tool for characterization of water masses.
- Samples for determination of the isotopic composition, abundance and size of coccolithophores were taken at all stations.
- Aerosol sampling was carried out during the whole cruise; filters were changed once daily.
- Incubation experiments for nitrogen fixation were carried out for 6 positions during the cruise.
- Samples for determination of mercury were taken on 12 stations.
- Samples for determination of neodymium isotopes were taken on 13 stations.

Narrative

The Meteor left the Haydarpacha port in Istanbul in the morning of April 5, 2011. At noon on April 6 a test CTD cast was carried out in the Aegean Sea where several groups took samples to test their instrument performance. The first ordinary station was carried out in the deep Crete basin early morning of April 7.

April 7 – 18, CTD work in the Eastern Mediterranean Sea

From here on the Meteor sailed into the Levantine basin and moved towards the eastern extreme of the Mediterranean Sea with CTD stations at regular intervals. We reached the easternmost stations around noon on April 11 just off the coast of Beirut. The Meteor now worked its way westward, occupying a CTD station roughly every 8 hours. On April 14 we reached our westernmost position in the Eastern Mediterranean, where we occupied a station that was worked during the GEOSECS experiment in 1978. Due to the political situation in Tunisia and Libya, we could not continue our track as planned through the strait of Sicily. We occupied a meridional section from the central Ionian Sea to the deep basin of the Adriatic Sea.

On April 13 we sampled a brine lake at position N 35° 13.8' and E 21° 28.8'; this brine lake is known as lake Atalante. The brine started abruptly at 3517 dB and our deepest recording is at 3553 dB, which was approximately 20 meters above the bottom. It thus seems that the brine lake was about 55 meters deep at this position. We measured a salinity of 160 with the salinometer. On April 18 we passed through the strait of Messina.

April 19 – 24, CTD work in the Western Mediterranean Sea

On April 19 we resumed the CTD work with four stations in the Tyrrhenian Sea. From here on the Meteor moved along the section towards the Strait of Gibraltar with a full depth CTD roughly every 8 hours. We passed the Strait of Gibraltar on April 25 and then continued our section at roughly 36° N to 8°W. Here we made a short section towards the coast of Portugal. Due to the short distance between stations, the chemistry program sampled only 3 out of 5 stations on this section. Finally, we occupied a zonal section along 37° N from the coast of Portugal (Cabo Sao Vicente). This section consisted of 4 stations at which only measurements from the CTD sonde were taken.

Summary

All the goals of the cruise were met. We occupied 61 CTD stations in the Mediterranean Sea, including stations in all major sub-basins, and in the Mediterranean Outflow in the Gulf of Cadiz. On 47 of these stations samples were measured for the core parameters of repeat hydrography, and on several additional stations were samples taken for on-shore measurements of carbon isotopes (15 stations), helium isotopes (25 stations) and tritium (15 stations). Seven of the 61 CTD stations were "second casts" on the same position for determination of Barium-isotopes

Acknowledgements

We would like to thank captain Thomas Wunderlich, his officers and crew on the RV Meteor for their support of our measurement program and for creating a very friendly and professional work atmosphere on board. The ship time was provided by the German Science Foundation (DFG) within the core program METEOR/MERIAN. Financial support for the cruise was supported by a grant from the Senatskommission für Ozeanographie der DFG and from the Spanish Ministry of Science and Innovation "Accion Complementaria" CTM2010-12244-E. We gratefully acknowledge this support.

Cruise participants

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3. Vanessa Cardin	CTD	OGS
4. Andreas Welsch	CTD	IfM-ZMAW
5. Udo Hübner	CTD	IfM-ZMAW
6. Ilse Büns	O2, nutrients	IfM-ZMAW
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8. Giuseppe Civitarece	O2, nutrients	OGS
9. Marta Álvarez	Carbon/bacterial DNA	IEO
10. Inigo Hueso	Carbon	IEO
11. Ludger Mintrop	Carbon	Marianda
12. Carlos Colmenero	Carbon	IEO
13. Gaston Schaller	Carbon isotopes	CAU
14. Boie Bogner	Tracers	IFM-GEOMAR
15. Tim Stöven	Tracers	IFM-GEOMAR
16. Henner Bieligk	Tracers	IFM-GEOMAR
17. Rolf Schneider	POPs	IOW
18. Eike Hümpel	He3/H3 sampling	IFM-GEOMAR
19. Eleni Stathopoulou	Mercury	LEC-NKUA
20. Valenti Rodellas	Radium Isotopes	UAB
21. Mor Feldman	Radium Isotopes	BIU
22. Paolo Montagna	Nd-Isotopes	LDEO
23. Ángela Oviedo Sabogal	Coccolithophores	UAB
24. Francesca Mapelli	Microbiology	DISTAM
25. Giuseppe Merlino	Microbiology	DISTAM
26. Eyal Rahav	Aerosol/N2 fixation	IOLR
27. Adi Levi	Aerosol/N2 fixation	IOLR
28. Robert Brünjes	Tracers / Barium	IFM-GEOMAR
29. Andreas Raeke	Weather technician	DWD
30. Harald Rentsch	Meteorology	DWD

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OGS

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IOLR	Bar-Ilan University Ramat Gan, Israel
LDEO	Lamont-Doherty Earth Observatory USA
UAB	Universitat Autònoma de Barcelona Barcelona, Spain
IEO	Instituto español de oceanografía La Coruna, Spain
DISTAM	Università degli Studi di Milano Dipartimento di Scienze e Tecnologie Alimentari e Microbiologiche Milano, Italy
LEC-NKUA	Laboratory of Environmental Chemistry Faculty of Chemistry National & Kapodistrian University of Athens Athens, Greece
BIU	Hebrew University of Jerusalem Jerusalem, Israel
DWD	Deutscher Wetterdienst Hamburg, Germany

List of stations

STAT. NO	CAST TYPE	DATE ddmmyy	TIME UTC	POSITION		BOTTOM DEPTH	Samples																				
				LATITUDE	LONGITUDE		He3	He	CFC	O2	C14	DIC	pH	Alk	Nut	H3	Ba	Sal	Ra	PFOS	Hg	TM	Nd	DNA	Coc	Bio	
287	CTD	060411	1127	37	40.00 N 25	35.99 E	799		1	1	1		1		1	1		1	1	1				1	1	1	1
288	CTD	070411	0222	35	38.99 N 26	13.00 E	2248	1	1	1	1	1		1	1		1	1			1	1		1		1	1
289	CTD	070411	0655	35	16.45 N 26	36.21 E	815			1	1		1		1	1		1	1	1					1		1
290	CTD	070411	1449	34	19.99 N 27	29.99 E	2567	1		1	1	1	1	1	1	1	1	1	1							1	1
291	CTD	080411	2128	34	03.99 N 32	59.99 E	2454			1	1		1	1	1	1		1	1		1	1	1			1	1
292	CTD	090411	1014	33	59.39 N 35	10.35 E	1631			1	1		1	1	1	1		1	1					1		1	1
293	CTD	090411	1544	33	59.99 N 34	25.21 E	1984	1		1	1	1	1	1	1	1	1	1	1							1	1
294	CTD	100411	1059	33	42.00 N 31	00.00 E	2411			1	1		1	1	1	1		1	1				1			1	1
295	CTD	100411	0001	33	34.80 N 28	46.21 E	2858													1							
296	CTD	110411	0217	33	34.80 N 28	46.20 E	2860		1	1	1		1	1	1	1		1	1				1	1		1	1
297	CTD	110411	1828	34	23.94 N 26	01.11 E	4092			1	1		1	1	1	1		1	1				1	1		1	1
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311	CTD	160411	10.23	40	16.99 N 18	35.99 E	138			1	1					1										1	1
312	CTD	160411	1711	41	14.99 N 17	59.98 E	1074													1							
313	CTD	160411	1842	41	14.99 N 17	59.98 E	1074	1		1	1	1	1	1	1	1	1	1	1				1	1		1	1
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