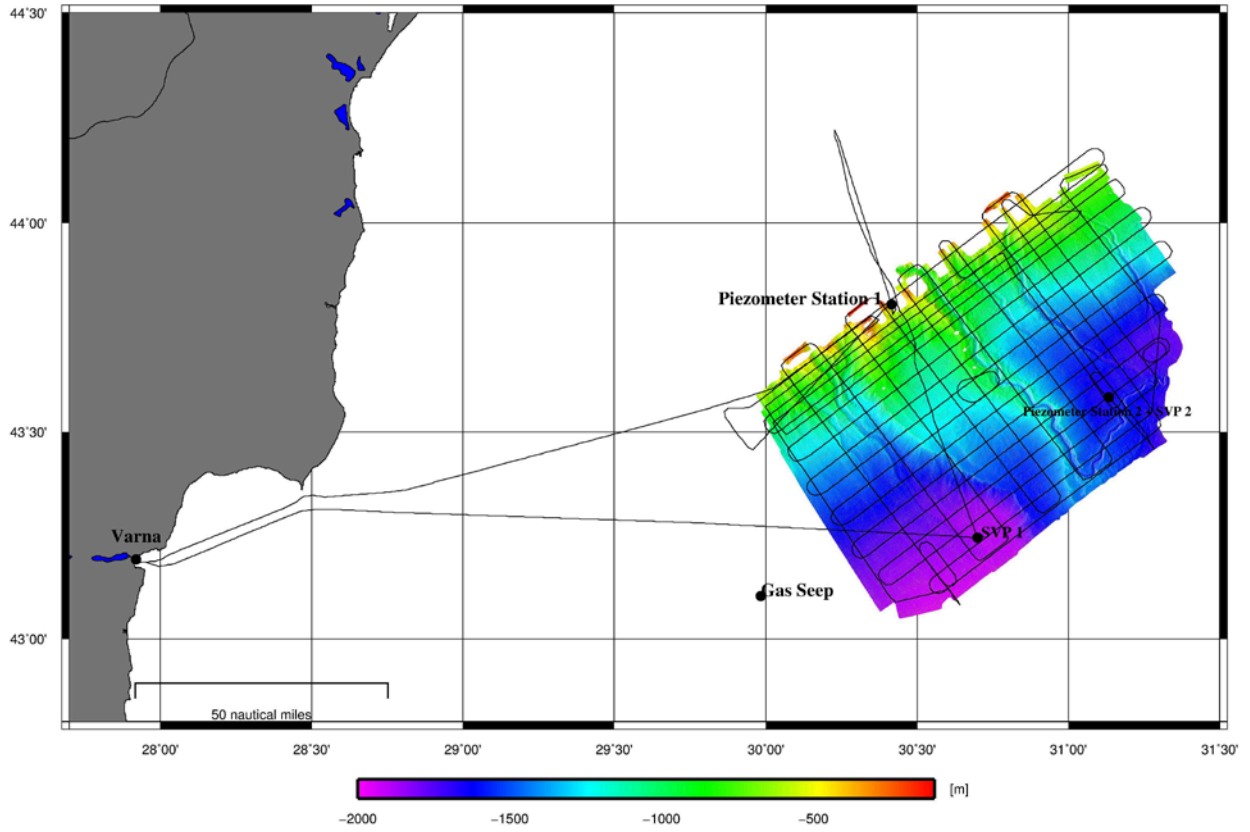


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Short Cruise Report
MARIA S. MERIAN – MSM34/1

Varna, Bulgaria – Varna, Bulgaria
09.12.2013 - 27.12.2013
Chief Scientist: Dr. Ingo Klaucke
Captain: Björn Maaß

Cruise track and stations



Objectives

Gas hydrates have been the focus of scientific and economic interest for the past 15-20 years, mainly because the amount of carbon stored in gas hydrates is much greater than in other carbon reservoirs. Several countries including Japan, Korea and India have launched vast research programs dedicated to the exploration for gas hydrate resources and ultimately the exploitation of the gas hydrates for methane. The German SUGAR project that is financed by the Ministry of Education and Research (BmBF) and the Ministry of Economics (BmWi) aims at developing technology to exploit gas hydrate resources by injecting and storing CO₂ instead of methane in the hydrates. This approach includes techniques to locate and quantify hydrate reservoirs, drill into the reservoir, extract methane from the hydrates by replacing it with CO₂, and monitor the thus formed CO₂-hydrate reservoir. Numerical modeling has shown that any exploitation of the gas hydrates can only be successful, if sufficient hydrate resources are present within permeable reservoirs such as sandy or gravelly deposits. The ultimate goal of the SUGAR project being a field test of the technology developed within the project, knowledge of a suitable test site becomes crucial. Within European waters only the Norwegian margin and the Danube deep-sea fan show clear geophysical evidence for large gas hydrate accumulations, but only the Danube deep-sea fan most likely contains gas hydrates within sandy deposits. The main objective of cruise MSM34, therefore, is locating and characterizing suitable gas hydrate deposits on the Danube deep-sea fan.

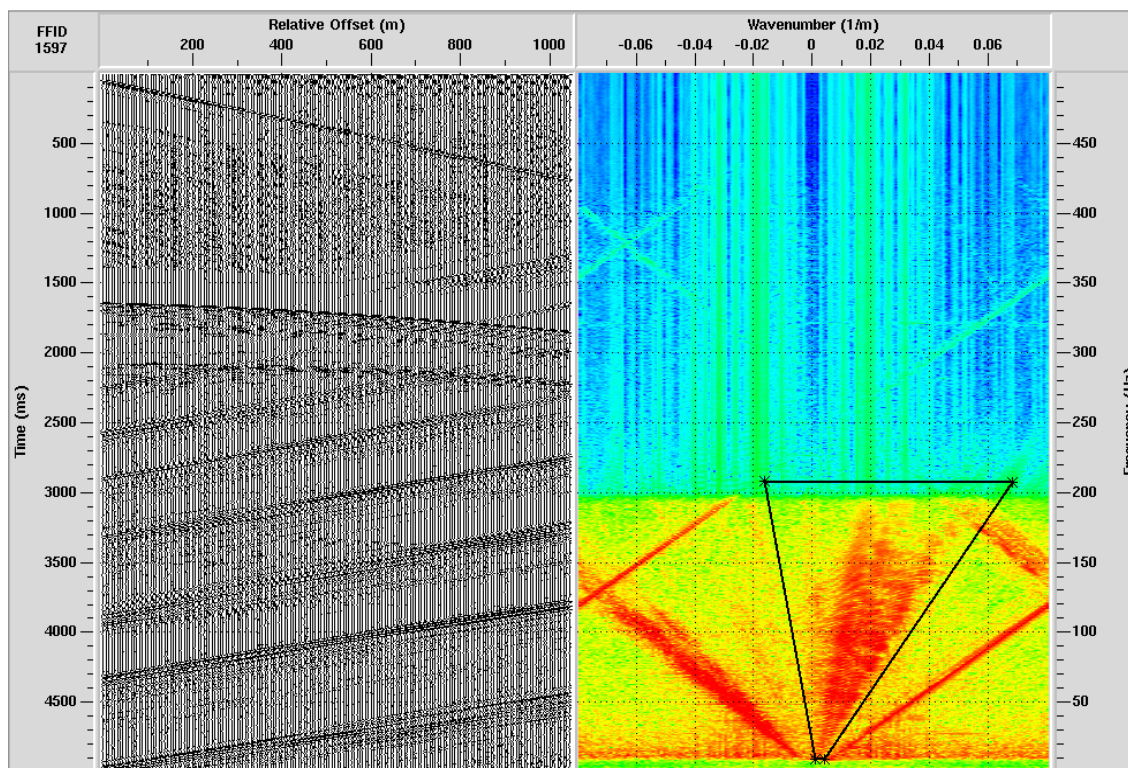
Narrative

The first leg of RV MARIA S. MERIAN cruise MSM34 had a bumpy start due to delays in shipping equipment from Izmir, Turkey to Varna, Bulgaria and difficulties for parts of the scientific party to join the ship on time. The outlook for the cruise was also tarnished by the presence of the CGG Symphony (an industry 3D seismic acquisition vessel) in the working area. However, by the late afternoon of December 8, 2013 16 scientist from Germany, France, Turkey and Bulgaria had boarded the ship and all equipment had been loaded. We were ready to leave on the morning of December 9, but a problem with one of the pod propulsion delayed departure until the evening. At 05:00 on December 10, 2013 we reached our first station and deployed a sound velocity probe in order to obtain a sound velocity profile for the EM122 multibeam system. The subsequent multibeam and Parasound profile towards the locations of the first piezometer deployment had to be stopped at mid-way due to deteriorating weather conditions. Average winds of force 7-8 with gusts of force 9 did not allow collecting useful data and all operations were stopped for 24 hours.

By the early morning of December 11 the weather conditions had improved and following a safety and abandon ship drill at 10:30, a first attempt to deploy the piezometer at was carried out at mid-day. This test run intended to determine the possible length of the piezometer was successful and the actual piezometer pipe equipped with sensors was installed on the deployment frame. By 19:30 the first piezometer of the cruise was deployed and RV MARIA S. MERIAN headed towards the starting point of our first seismic profile. At 22:00 the 1050-m long streamer of our Turkish colleagues was deployed and at 01:00 on December 12 we started recording our first seismic profile. Unfortunately, the EM122 multibeam system stopped working properly in the early morning hours of December 12 and it took until the evening before the problem could be fixed. Seismic recording continued smoothly until 12:00 on December 16, when a strange signal on the hydrophone of the airgun urged us to bring the airgun back on deck for verification. After replacement of the airgun umbilical, seismic recording resumed at 16:30 and continued until December 18 at 14:30 when the airgun showed signs of leakage. In order to save

time, the airgun was replaced with a spare GI-gun and seismic data acquisition resumed at 17:30. Two days later, on December 20 the seismic gear was recovered at 12:45 was recovered for a change of batteries in the bird system. The afternoon and early evening was then used to deploy the second piezometer station that was installed in a location where gas hydrates are expected to be close the the seafloor. By 23:30 the piezometer station was successfully completed and we started a short bathymetry survey to allow the CGG Symphony to move away from our survey area.

At 12:30 on December 21 we redeployed the seismic equipment under perfect weather conditions for seismic acquisition. A loose connection in the acquisition electronics slightly delayed the beginning of the next profile so that we eventually came quite close to the CGG Symphony the next morning. Luckily, although interferences became very strong, they could still be filtered out. By December 24, 12:00 we had completed our preliminary lines and could add several additional lines that appeared to be necessary after initial inspection of the seismic data. With seismic data acquisition still going on, we all celebrated Christmas Eve with a nice special evening program prepared by the crew with a little help of the scientific party. Seismic acquisition was finished on December 26 at 08:00 after 2200 line kilometers of high-resolution and high-quality seismic profiling. By 9:30 the seismic gear was back on deck and we finished our scientific program with a couple of bathymetry and Parasound profiles dedicated at filling some remaining gaps in the bathymetry grid. At 22:00 we had to leave the study area and arrived in time to meet the pilot at 08:00 on December 27 at the entrance to the the port of Varna. By 09:00 RV MARIA S. MERIAN had berthed at the pier and by 12:00 the equipment of our colleagues from IFREMER, Brest and SeisLab, Izmir had been loaded onto two trucks waiting at the pier. That was the end of the first leg of cruise MSM34, which was extremely successful, as all goals have been fully achieved.



FK-plot of the seismic data acquired during MSM34/1 cruise showing the clear separation between seismic interferences and the signal (within black triangle)

Acknowledgements

The scientists of RV MARIA S. MERIAN cruise MSM34/1 would like to thank captain Björn Maaß and his crew for the warm welcome and their assistance during the cruise. The assistance of the Leitstelle Deutsche Forschungsschiffe is also acknowledged.

List of participants

#	Name	Expertise	Institute
1	Klaucke, Ingo	Chief scientist	GEOMAR
2	Hoffmann, Jasper	Bathymetry	GEOMAR
3	Schroeder, Henning	Parasound	GEOMAR
4	Zander, Timo	Seismic Interpretation	GEOMAR
5	Ferrant, Anthony	Geotechnics	IFREMER
6	Roudaut, Mickael	Geotechnics	IFREMER
7	Bayol, Efe	Seismic	IMST-Seislab
8	Barin, Burcu	Seismic	IMST-Seislab
9	Duymaz, Sermet	Seismic	IMST-Seislab
10	Dondurur, Derman	Seismic	IMST-Seislab
11	Cifci, Günay	Seismic	IMST-Seislab
12	Atgin, Orhan	Seismic	IMST-Seislab
13	Nasif, Aslihan	Seismic	IMST-Seislab
14	Kücük, Hilmi Mert	Seismic	IMST-Seislab
15	Özel, Özkan	Seismic	IMST-Seislab
16	Vasilev, Atanas	Observer Bulgaria	IO-BAS

Institute

GEOMAR	Helmholtz-Zentrum für Ozeanforschung Kiel
IFREMER	Institut Francais pour la Recherche et l'Exploitation de la Mer, Brest
IMST-Seislab	Institute of Marine Science and Technology, Dokuz-Eylül University, Izmir
IO-BAS	Institute of Oceanography, Bulgarian Academy of Science, Varna

Station list

Station	Seismik	Date	Time	PositionLat	PositionLon	Depth [m]	Gear
MSM34/894-1		10.12.2013	03:08	43° 14,76' N	30° 41,89' E	1893,9	Schallprofilsonde
MSM34/895-1		10.12.2013	04:52	43° 14,76' N	30° 41,89' E	1897,8	MB und ParaSound Start
MSM34/895-1		10.12.2013	06:10	43° 21,09' N	30° 38,75' E	1767,3	MB und ParaSound End
MSM34/896-1		11.12.2013	10:09	43° 48,39' N	30° 24,91' E	391,9	Piezometer_Probe
MSM34/896-1		11.12.2013	16:24	43° 48,40' N	30° 24,92' E	397	Piezometer
MSM34/897-1	Profile-01	11.12.2013	22:57	43° 34,24' N	29° 58,16' E	688,8	Seismic reflection profile
MSM34/897-1		12.12.2013	12:00	44° 9,81' N	31° 2,86' E	519,5	Seismic reflection profile
MSM34/897-1	Profile-02	12.12.2013	13:12	44° 7,79' N	31° 5,58' E	620,9	Seismic reflection profile
MSM34/897-1		13.12.2013	02:22	43° 32,53' N	30° 0,92' E	850,5	Seismic reflection profile
MSM34/897-1	Profile-03	13.12.2013	03:24	43° 30,37' N	30° 3,13' E	1028,4	Seismic reflection profile
MSM34/897-1		13.12.2013	16:43	44° 5,65' N	31° 7,77' E	780,1	Seismic reflection profile
MSM34/897-1	Profile-04	13.12.2013	18:13	44° 3,60' N	31° 10,17' E	922,8	Seismic reflection profile
MSM34/897-1		14.12.2013	07:15	43° 28,30' N	30° 5,55' E	1187,1	Seismic reflection profile
MSM34/897-1	Profile-05	14.12.2013	08:24	43° 26,33' N	30° 8,15' E	1275,1	Seismic reflection profile
MSM34/897-1		14.12.2013	21:26	44° 1,57' N	31° 12,71' E	989,9	Seismic reflection profile
MSM34/897-1	Profile-06	14.12.2013	22:34	43° 59,33' N	31° 14,79' E	1146,5	Seismic reflection profile
MSM34/897-1		15.12.2013	11:40	43° 23,63' N	30° 9,81' E	1386,2	Seismic reflection profile
MSM34/897-1	Profile-07	15.12.2013	12:50	43° 21,42' N	30° 11,94' E	1474,2	Seismic reflection profile
MSM34/897-1		16.12.2013	02:00	43° 56,98' N	31° 17,02' E	1170,9	Seismic reflection profile
MSM34/897-1	Profile-08	16.12.2013	02:57	43° 54,86' N	31° 19,46' E	1273,3	Seismic reflection profile
MSM34/897-1		16.12.2013	10:26	43° 34,72' N	30° 42,43' E	1185,2	Seismic reflection profile
MSM34/897-1	Profile-08b	16.12.2013	14:26	43° 36,48' N	30° 45,61' E	990,3	Seismic reflection profile
MSM34/897-1		16.12.2013	20:54	43° 19,23' N	30° 14,49' E	1569,1	Seismic reflection profile
MSM34/897-1	Profile-09	16.12.2013	22:00	43° 17,05' N	30° 16,66' E	1624,5	Seismic reflection profile
MSM34/897-1		17.12.2013	10:09	43° 49,25' N	31° 15,46' E	1612,1	Seismic reflection profile
MSM34/897-1	Profile-10	17.12.2013	11:14	43° 47,14' N	31° 17,72' E	1661,7	Seismic reflection profile
MSM34/897-1		17.12.2013	23:36	43° 14,34' N	30° 18,02' E	1700,1	Seismic reflection profile
MSM34/897-1	Profile-11	18.12.2013	00:39	43° 12,40' N	30° 20,61' E	1778,8	Seismic reflection profile
MSM34/897-1		18.12.2013	12:08	43° 42,83' N	31° 16,07' E	1738,8	Seismic reflection profile
MSM34/897-1	Profile-12	18.12.2013	13:14	43° 40,99' N	31° 18,85' E	1743,8	Seismic reflection profile
MSM34/897-1		18.12.2013	13:25	43° 40,51' N	31° 17,95' E	1731,6	Seismic reflection profile
MSM34/897-1		18.12.2013	15:32	43° 40,81' N	31° 18,49' E	1730,6	Seismic reflection profile
MSM34/897-1		19.12.2013	02:42	43° 10,41' N	30° 23,38' E	1820,6	Seismic reflection profile
MSM34/897-1	Profile-13	19.12.2013	03:39	43° 8,34' N	30° 25,74' E	1858	Seismic reflection profile

Station list

MSM34/897-1		19.12.2013	14:10	43° 36,71' N	31° 17,29' E	1666,1	Seismic reflection profile
MSM34/897-1	Profile-14	19.12.2013	14:30	43° 38,03' N	31° 17,27' E	1673	Seismic reflection profile
MSM34/897-1		19.12.2013	21:45	44° 3,99' N	30° 50,12' E	343,9	Seismic reflection profile
MSM34/897-1		19.12.2013	22:07	44° 4,25' N	30° 48,16' E	254,3	MB und ParaSound Start
MSM34/897-1		19.12.2013	23:03	44° 1,75' N	30° 43,49' E	188,2	MB und ParaSound End
MSM34/897-1	Profile-15	19.12.2013	23:30	44° 0,09' N	30° 43,70' E	337,2	Seismic reflection profile
MSM34/897-1		20.12.2013	05:35	43° 38,18' N	31° 6,64' E	1642,1	Seismic reflection profile
MSM34/897-1	Profile-15b	20.12.2013	08:31	43° 37,85' N	31° 6,98' E	1650,7	Seismic reflection profile
MSM34/897-1		20.12.2013	10:42	43° 30,07' N	31° 15,04' E	1624,1	Seismic reflection profile
MSM34/898-1		20.12.2013	13:19	43° 34,98' N	31° 7,95' E	1648,5	Piezometer_Probe
MSM34/898-1		20.12.2013	20:05	43° 34,98' N	31° 7,95' E	1648,1	Piezometer
MSM34/899-1		20.12.2013	23:54	43° 55,75' N	30° 46,44' E	687,5	MB und ParaSound Start
MSM34/899-1		21.12.2013	10:30	43° 7,23' N	30° 36,50' E	1934,2	MB und ParaSound End
MSM34/900-1	Profile-20	21.12.2013	12:05	43° 8,53' N	30° 34,83' E	1912,9	Seismic reflection profile
MSM34/900-1		21.12.2013	13:14	43° 12,66' N	30° 30,58' E	1848,6	Seismic reflection profile
MSM34/900-1		21.12.2013	15:36	43° 8,64' N	30° 34,71' E	1910,5	Seismic reflection profile
MSM34/900-1		22.12.2013	00:00	43° 38,88' N	30° 3,52' E	529,7	Seismic reflection profile
MSM34/900-1	Profile-19	22.12.2013	01:27	43° 42,08' N	30° 10,32' E	458,3	Seismic reflection profile
MSM34/900-1		22.12.2013	09:49	43° 11,91' N	30° 41,41' E	1891,1	Seismic reflection profile
MSM34/900-1	Profile-21	22.12.2013	11:17	43° 15,77' N	30° 47,36' E	1879,3	Seismic reflection profile
MSM34/900-1		22.12.2013	19:38	43° 45,71' N	30° 16,01' E	379,3	Seismic reflection profile
MSM34/900-1	Profile-18	22.12.2013	21:01	43° 48,55' N	30° 22,87' E	200,4	Seismic reflection profile
MSM34/900-1		23.12.2013	05:11	43° 19,14' N	30° 53,39' E	1611,1	Seismic reflection profile
MSM34/900-1	Profile-22	23.12.2013	06:20	43° 21,49' N	30° 57,88' E	1480,7	Seismic reflection profile
MSM34/900-1		23.12.2013	14:33	43° 50,79' N	30° 27,13' E	551,9	Seismic reflection profile
MSM34/900-1	Profile-17	23.12.2013	15:46	43° 53,28' N	30° 31,52' E	833,8	Seismic reflection profile
MSM34/900-1		24.12.2013	00:05	43° 23,39' N	31° 2,56' E	1369,4	Seismic reflection profile
MSM34/900-1	Profile-16	24.12.2013	01:22	43° 26,96' N	31° 8,06' E	1510,8	Seismic reflection profile
MSM34/900-1		24.12.2013	09:42	43° 57,03' N	30° 36,88' E	409,3	Seismic reflection profile
MSM34/900-1	Profile-23	24.12.2013	11:32	43° 52,63' N	30° 40,79' E	893,7	Seismic reflection profile
MSM34/900-1		24.12.2013	16:44	44° 6,72' N	31° 6,66' E	701,2	Seismic reflection profile
MSM34/900-1	Profile-24	24.12.2013	18:45	44° 4,31' N	30° 59,19' E	679,4	Seismic reflection profile
MSM34/900-1		24.12.2013	23:41	43° 46,81' N	31° 17,91' E	1673,8	Seismic reflection profile
MSM34/900-1	Profile-25	24.12.2013	23:53	43° 45,95' N	31° 18,16' E	1705	Seismic reflection profile
MSM34/900-1		25.12.2013	02:44	43° 33,14' N	31° 16,59' E	1639,6	Seismic reflection profile

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MSM34/900-1	Profile-26	25.12.2013	02:56	43° 32,42' N	31° 15,89' E	1661,7	Seismic reflection profile
MSM34/900-1		25.12.2013	11:38	43° 8,94' N	30° 33,08' E	1893,6	Seismic reflection profile
MSM34/900-1	Profile-27	25.12.2013	12:36	43° 7,16' N	30° 35,65' E	1936,2	Seismic reflection profile
MSM34/900-1		25.12.2013	21:11	43° 30,37' N	31° 17,70' E	1685,1	Seismic reflection profile
MSM34/900-1	Profile-28	25.12.2013	21:31	43° 31,71' N	31° 18,11' E	1665,3	Seismic reflection profile
MSM34/900-1		26.12.2013	05:59	44° 2,01' N	30° 47,08' E	448,2	Seismic reflection profile
MSM34/901-1		26.12.2013	08:47	44° 1,09' N	31° 2,15' E	784,6	MB und ParaSound Start
MSM34/901-1		26.12.2013	20:00	43°41,18' N	30° 10,73 E	522,2	MB und ParaSound End