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Cruise Report
POSEIDON 399/1

Lisbon - Faro - Las Palmas
5. 05 – 13. 05. 2010 / 14. 05. - 26. 05. 2010
Technical Report

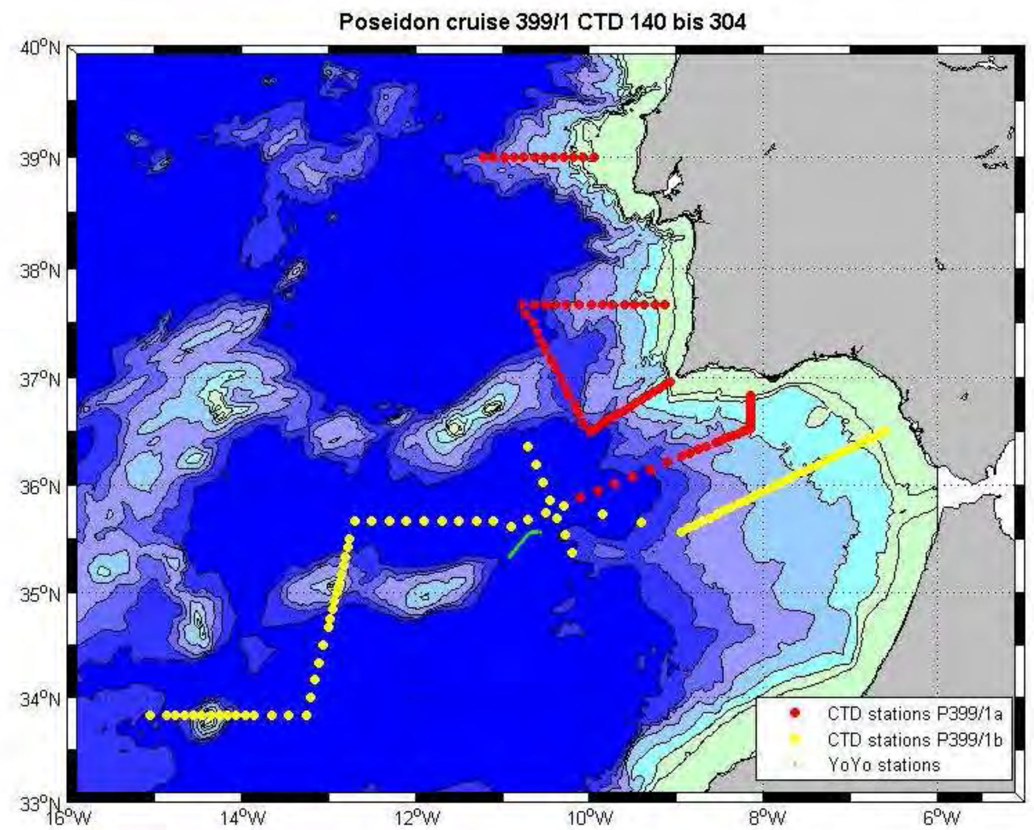
1. Aims of the cruise

The transit voyage of RV POSEIDON from Lisbon to Las Palmas during spring 2010 was used for practical student education. This “See- und Berufspraktikum” is part of the curriculum of the bachelor program at the University of Hamburg. The aim of the cruise was to familiarize students of physical oceanography, geophysics and meteorology with the work onboard a research vessel. Besides handling the instruments, the students also analysed and interpreted the measured data.

The scientific questions dealt with were:

- How does the Mediterranean Sea Water spread along the Iberian Peninsula? Can we identify different cores in the boundary undercurrent?
- How does the 3-dimensional structure of mesoscale salt lenses (MEDDIES) look like? How do they behave when encountering seamounts and which processes are responsible for their decay?
- What are the scales of surface temperature and salinity variability associated with fronts and upwelling patterns?

Based on literature studies and an analysis of historical data from the region we carried out a hydrographic survey of the Mediterranean outflow plume west of the Strait of Gibraltar and along the Iberian Peninsula. During a short port call in Faro the student crew changed. In all 13 students were able to take part in the expedition.



Cruise track of RV POSEIDON cruise P399 during 5. – 26. May 2010 with positions of conductivity – temperature – depths (CTD) profiles marked.

2. Cruise participants

Leg 1: 05.05. – 13.05.2010			Leg 2: 14.05. - 26.05.2010		
Dagmar Hainbucher	Chief scientist	IfM	Detlef Quadfasel	Chief scientist	IfM
Antje Müller-Michaelis	Scientist	IfM	Antje Müller-Michaelis	Scientist	IfM
Andreas Welsch	Scientist	IfM	Andreas Welsch	Scientist	IfM
Anthony Bosse	Student	IfM	Anthony Bosse	Student	IfM
Ulrike Drähne	Student	IfM	Leonie Esters	Student	IfM
Linnea Kemme	Student	IfM	Marius Kriegerowski	Student	IfM
Nikolaus Koopmann	Student	IfM	Vasco Müller	Student	IfM
Martin Moritz	Student	IfM	Florian Sprung	Student	IfM
Hanna Paulsen	Student	IfM	Hannah Teuteberg	Student	IfM
			Nele Tim	Student	IfM

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3. Narrative

Wednesday, 5th May 2010
Noon position: 38°37' N, 009°42' W
Wind: E 3 Bft., Air temperature: 15.6 ℃, Water temperature: 16.2℃

At 8 a.m. the scientific crew got a safety instruction by the first mate. At 9 a.m. RV POSEIDON left Lisbon and set course to the first CTD station at 39°00'N and 009°57' W. During the transit the students got practical instructions on how to take water samples for salinity and oxygen, how to read thermometers and other things needed to run the CTD. They also practiced taking bucket samples. These are needed for calibration of the thermosalinograph data. In addition, meteorological measurements were carried out with an Assman psychrometer and an anemometer. Watches started at noon with bucket samples and meteorological measurements. At 3 p.m. an emergency practice was executed followed by an instruction in live-saving equipment. At around 4 p.m. the first CTD station was reached. After leaving harbour most of the students got seasick, but all of them managed to do their duty and overcome their seasickness after a while.

Thursday, 6th May, 2010
Noon position: 39°00' N, 011°00 'W
Wind: NNW 5 Bft., Air temperature: 14.1 ℃, Water temperature: 15.8℃

During the night the first CTD section, north of Lisbon, was continued. The students felt well again and were in a good mood. During the 0-4 watch a group of dolphins was sighted. At 3 p.m. during the students' seminar we defined our scientific projects. We decided to put our focus on the Mediterranean undercurrent and on the calibration of the thermosalinograph.

One of the students lectured on how to measure humidity with the Assman psychrometer. At around 4 p.m. the students got a lecture on navigation by the second mate. The highlight of the lecture was that every student got the chance to steer the ship by hand. Also, at that time we finished our first section and set course to the second one, starting at 37°40' N and 009° 08' W. After dinner the students learned how to carry out the oxygen titration. Again a class of dolphins joined the vessel. During the night transit the students continued with their watches, taking bucket samples and meteorological measurements. Meanwhile, also the ADCP showed reasonable data.

Friday, 7th May 2010
Noon position: 37°40' N 009°29' W
Wind: NW 4 Bft., Air temperature: 15.9 °C, Water temperature: 16.9 °C

In the early morning we reached the first CTD position of section 2. This section kept us busy the whole day and the following night. We got slight problems with the communication to the bridge and winch because of a malfunctioning voice radio. Running the CTD close to the bottom got this way unusually exciting. But the electrician of the vessel did everything to fix the problem and at the end he was successful. We also started with the data analysis, plotting sections, profiles and TS diagrams and doing the first comparison of CTD and water samples. From the institute we received a satellite picture showing chlorophyll concentrations and indicating surface eddies in the region. During the regular seminar we discussed our first results.

Saturday, 8th May 2010
Noon position: 37°35' N, 010°43' W
Wind: S 7 Bft., Air temperature: 16.6 °C, Water temperature: 16.8 °C

In the morning we started with section 3, which is directly connected to section 2 and runs parallel to the coast from north to south. On this section we had hoped to find our first Meddy. Besides their watches, the students worked diligently on data analysis with respect to their scientific projects. In the seminar we talked about surface boundary layers. This subject is part of their regular lecture about regional oceanography at the institute. A scheduled knots lecture was postponed to the next day, because of important soccer news shown in TV at the same time. Even though it was a bit rainy and cold, the weather was good enough to carry out the measurements without any problems.

Sunday, 9th May 2010
Noon position: 36°40' N, 010°07' W
Wind: WSW 4-5 Bft., Air temperature: 17.4 °C, Water temperature: 17.2 °C

We continued section 3 and were happy that everything ran smoothly. Analyses of the data are also continuing. From a first sight of the results it seemed that we crossed a Meddy on section 3. At 11 a.m. we celebrated the traditional mass in the chief scientist's cabin where also some sherry was served. Later we took a group photo. At 3 p.m. our seminar was held and at 4:15 p.m. the knot lecture was given, with the result that afterwards all students were running around with a rope in their hands practicing knots. In late afternoon we reached the first station of section 4 at 36° 32' N and 009° 56 ' W, also directly connected to section 3. Section 4 runs from west to east towards the Portuguese coast and crosses the Mediterranean undercurrent.

Monday, 10th May 2010
Noon position: 36°51' N, 009°17' W
Wind: NW 2-3 Bft., Air temperature: 16.3 °C, Water temperature: 17.6 °C

Still on section 4, we crossed the highly frequented "freeway" along the Portuguese coast. At 4 p.m. the section was finished and we set course to section 5 starting at 36°50' N and 008° 09' W, which we reached at 10 p.m.. At the students seminar we talked about breaking waves, Ekman currents and geostrophy and tried to interpret our results. At 4 p.m. the students got a guided tour through the engine room. Meanwhile, they also learned how to use the salinometer. Topic of the day was the ash cloud from the Icelandic volcano Eyjafjallajökull and whether we will be able to get our flights back home on Friday or not.

Tuesday, 11th May 2010
Noon position: 36°29' N, 008°17' W
Wind: W 4 Bft., Air temperature: 16.4 °C, Water temperature: 18.2 °C

We continued on section 5 with a distance between stations of only about 3nm over the shelf edge and still investigated the Mediterranean undercurrent. Now routine is arising and the students carry out the CTD work much faster. Also, the data analysis progressed. We had actually found a Meddy on section 3 and in the boundary current were able to identify the upper and central cores. In the seminar we discussed our results. The weather was sunny and good for some short sunbaths during the short moments of relaxation. At 7:30 p.m. whales were sighted, but they were too far away to take photographs.

Wednesday, 12th May 2010
Noon position: 36°06' N, 009°25' W
Wind: WNW 3-4 Bft., Air temperature: 18.2 °C, Water temperature: 18.2 °C

Early in the morning, whales were sighted again. The CTD measurements continued along the fifth section up to a maximum depth of 2000 m. Also, the bucket sampling continued. Students were allowed to operate the winch and learned that it holds much danger for man and equipment, when handled the wrong way. After our afternoon seminar the students were busy with summarizing the final results for the cruise report. We had to stop the section with station 221 at around 10 p.m. in order to reach the port of Faro on schedule the next day. We celebrated our last station with some beer.

Thursday, 13th May 2010
Noon position: 36°50' N, 008°07' W
Wind: W 3 Bft., Air temperature: 17.3 °C, Water temperature: 17.7 °C

The last day of leg 1! Everyone was busy with writing up the results, cleaning the cabins and laboratories and storing data on the PCs. In the morning an emergency drill was carried out by the crew of POSEIDON. The vessel reached the port of Faro at 3 p.m.

Friday, 14th May 2010
In port: Faro

The students from the first leg disembarked after breakfast and the crew enjoyed a relatively quiet day. This came to an end when the scientific party for the second leg arrived during the late afternoon, eagerly waiting for the vessel to leave port. However, because of some planes being delayed, the last group of students only arrived shortly before midnight and the sailing had to be postponed until the high tide during the next morning.

Saturday, 15th May 2010
Noon position: 36°53' N, 007°41' W
Wind: NW 2 Bft., Air temperature: 17.1 °C, Water temperature: 17.6 °C

Same procedure as every student cruise: After breakfast the newly arrived students got a safety briefing and had a tour around the vessel. Poseidon sailed at 10 a.m., heading for the start position of a CTD section on the shelf outside Cadiz. During the transit the students practised bucket sampling, drawing samples from the rosette sampler and they made themselves familiar with the CTD data acquisition software. Also during the afternoon the safety course continued and everybody had to put on a survival suite. The first CTD station started at 6:30 p.m., in a water depth of 80 m. Already on the third station, at a depth of 200 m, we encountered the first signs of the Mediterranean outflow plume, a thin layer of water with salinities above 36.8. CTD watches continued throughout the night.

Sunday, 16th May 2010
Noon position: 36°04' N, 007°42' W
Wind: NNE 3 Bft., Air temperature: 16.8 °C, Water temperature: 18.3 °C

CTD watches continued. During the afternoon in the student seminar we had a look at the results from the first leg and started a discussion on what to do during this second leg. The plan was to add another section across the boundary current and then sail offshore in search for a Meddy. At 4 p.m. the Chief mate gave a course on navigation.

Monday, 17th May 2010
Noon position: 35°38' N, 008°47' W
Wind: NNE 5 Bft., Air temperature: 18.8 °C, Water temperature: 18.4 °C

During the night winds picked up and there were first signs of sea sickness with the students. Despite that, all showed up for their watches and worked hard on the data acquisition and data analysis. The end of the section was reached at 4 p.m. and we proceeded to the outer end of section 5 from the first leg. During the seminar we discussed a number of possible research projects, including the calibration of the various instruments, identifying the cores in the undercurrent, double diffusive structures at fronts and the decay of Meddies when they encounter sea mounts. The strategy was to do a detailed and high resolution survey of a Meddy, and then to proceed to the Ampére Seamount.

Tuesday, 18th May 2010
Noon position: 35°39' N, 010°47' W
Wind: N 6 Bft., Air temperature: 17.9 °C, Water temperature: 17.7 °C

During the 4-8 watch we indeed encountered a Meddy, and after crossing that with a westward heading, we turned north to run a meridional section across it. Data analysis continued and the results were reported during the afternoon seminar.

Wednesday, 19th May 2010
Noon position: 35°32' N, 010°17' W
Wind: N 4 Bft., Air temperature: 19.3 °C, Water temperature: 18.3 °C

The north-south section was finished during the afternoon and Poseidon proceeded to the south-western edge of the Meddy. From here we ran a high resolution YoYo CTD section towards north-east, heading into the wind. The ship was moving with a speed of about 1 knot and the YoYo profiling between 400 and 1700 m depth provided us with a temperature and salinity profile about every 600-800 m. While this was hard work for the winch drivers, scientists and students enjoyed to watch the rich structure with small vertical and horizontal scales at the edge of the Meddy.

Thursday, 20th May 2010
Noon position: 35°33' N, 010°40' W
Wind: NE 5 Bft., Air temperature: 19.9 °C, Water temperature: 18.1 °C

The YoYo section was run until 5 p.m. The students who were off-watch continued with data analysis and worked on their assigned projects. During the evening we proceeded to the outer end of the zonal section and continued westward with a station spacing of 10 miles.

Friday, 21st May 2010
Noon position: 35°40' N 012°07' W
Wind: NNE 4 Bft., Air temperature: 19.0 °C, Water temperature: 18.0 °C

We continued the 35°40' N section to north of the Ampére seamount and turned south at 6 p.m. to cross this submarine feature. Besides their watches students were busy with data analysis and data interpretation.

Saturday, 22nd May 2010
Noon position: 34°51' N, 012°57' W
Wind: NW 5 Bft., Air temperature: 17.7 °C, Water temperature: 18.3 °C

Just after breakfast we reached the Ampére seamount, but were slightly disappointed that there were no signs of a Meddy in the immediate vicinity. So, rather than doing the planned cross-section we continued southward to try our luck at the Seine seamount.

Sunday, 23rd May 2010
Noon position: 33°50' N, 013°51' W
Wind: W 4 Bft., Air temperature: 18.1 °C, Water temperature: 18.6 °C

Also here we did not sea any Meddies but continued the section across the seamount to the west. As a highlight, the bosun gave the students a course on how to do proper seamen knots, and like on the first leg, all of them went around with a piece of rope practicing Square knots, Bowline knots and many others.

Monday, 24th May 2010
Noon position: 33°32' N, 015°04' W
Wind: W 5 Bft., Air temperature: 18.2 °C, Water temperature: 18.5 °C

The last of 82 CTD stations during this leg finished at 9:30 a.m. and was appropriately celebrated with a bottle of champagne. Poseidon set course for Las Palmas and the instru-ments were washed, dismantled and stored in their boxes. The students continued working on their posters and were happy not having to get up for watches at night any more.

Tuesday, 25th May 2010
Noon position: 30°45' N, 015°11' W
Wind: N 3 Bft., Air temperature: 20.3 °C, Water temperature: 20.0 °C

With tail winds helping us maintaining a good speed, the captain decided that there was enough time for a boat drill. The rescue boat was put in the water and all students had a chance to go on a little tour around Poseidon. Seeing all the smiling faces really was a reward for the hard work during the previous week. After this trip, posters were finished and printed and arranged in the mess room for a vernissage to take place after dinner.

Wednesday, 26th May 2010
In port: Las Palmas

At 8:45 a.m. Poseidon picked up the pilot and was alongside at Catalina Pier at 9:18 a.m. The container was packed and just before lunch the work on cruise P399/1 ended.

4. Technical information

CTD/Rosette

Altogether 164 standard hydrographic stations and one YoYo station were occupied during the cruise, running to a maximum depth of 2000m and employing a SeaBird SBE911plus CTD-O2 sonde, attached to a SeaBird carousel 12 bottle water sampler. A transmissiometer was also attached to the sonde. At all stations water samples were taken from 3-5 depth levels within the water column. The water samples were analysed onboard for salinity (always for 3 depth levels), using a Guildline Autosal salinometer and for oxygen using a Metrohn titroprocessor. One of the water bottles was also equipped with protected and unprotected reversing digital thermometers, providing temperature and pressure check values for the CTD sensors. Details on the calibration are shown on one of the posters.

Surface temperature and salinity

Underway temperature and salinity measurements were made with a SeaBird thermo-salinograph installed in the ship's port well. Details on the calibration are shown on one of the posters.

Current measurements

Underway current measurements were taken with a vessel-mounted 75 kHz Ocean Surveyor (ADCP) from RDI, covering approximately the top 500-800 m of the water column.

Meteorological observations

Meteorological measurements of humidity, wind speed, wind direction, air pressure and air temperature were made with the ship’s own meteorological system. This data and a lot more parameters (like navigation) were stored in the ships data system DATAVIS. The meteorological data was partly compared to measurements carried out by the students themselves.

5. Station list

See attachment

6. First Results

During the cruise and in the following seminar at the University of Hamburg the students reported their results in a series of posters (see attachment).

Dagmar Hainbucher and Detlef Quadfasel: Cruise objectives and work done
Vasco Müller and Anthony Bosse: Thermosalinograph calibration
Antje Müller-Michaelis and Andreas Welsch: CTD calibration
Marius Kriegerowski and Hannah Teuteberg: Meteorological measurements and calibration
Nele Tim, Lenie Esters and Florian Sprung: Cores of the undercurrent
Leonie Esters and Nikolaus Koopmann: Analysis of water masses
Martin Moritz, Hanna Paulsen and Florian Sprung: Geostrophy and volume transports
Nele Timm and Florian Sprung: Resoving Meddy scales
Vasco Müller and Anthony Bosse. Double Diffusion in Meddies
Vasco Müller and Anthony Bosse: Interleaving layers in Meddies
Linnea Kimme and Nele Timm: Scale analysis
Hannah Teuteberg and Marius Kriegerowski: How to detect Taylor columns?
Leonie Esters and Florian Sprung: How to navigate without GPS?

Acknowledgements

We like to thank Captain Matthias Günther and his crew of RV POSEIDON for their support of the measurement programme and for their patience with the students, most of whom had been on a research vessel for the first time in their career. Special thanks go to the first and second mate, Theo Giese and Jan Philipp Günther for giving lectures in navigation, to the boatswain Joachim Mischker for teaching knots and to the first engineer Hans Otto Stanger for his sightseeing tours through the engine room.

Financial support for the cruise was provided by the University of Hamburg and the European Commission within the Project THOR.

EXPO-CODE	Stat. No.	Cast No.	Type	Date	Time UTC	Code	POSITION Latitude		Longitude		Bottom depth	Max. press.	Bottom dist.
Pos399/1a	140	1	CTD	05.05.10	15:34:00	BE	38°59.960	N	009°57.022	W	226		
Pos399/1a	140	1	CTD	05.05.10	15:44:00	BO	38°59.948	N	009°56.994	W	227	224	11
Pos399/1a	140	1	CTD	05.05.10	15:58:00	EN	38°59.969	N	009°56.974	W	226		
Pos399/1a	141	1	CTD	05.05.10	17:03:03	BE	39°00.020	N	010°04.015	W	265		
Pos399/1a	141	1	CTD	05.05.10	17:15:00	BO	39°00.042	N	010°03.938	W	265	264	9
Pos399/1a	141	1	CTD	05.05.10	17:29:00	EN	39°00.028	N	010°03.926	W	266		
Pos399/1a	142	1	CTD	05.05.10	18:56:00	BE	39°00.016	N	010°10.986	W	328		
Pos399/1a	142	1	CTD	05.05.10	19:05:00	BO	38°59.999	N	010°10.946	W	326	326	10
Pos399/1a	142	1	CTD	05.05.10	19:19:00	EN	39°00.025	N	010°10.896	W	324		
Pos399/1a	143	1	CTD	05.05.10	20:18:00	BE	39°00.019	N	010°17.964	W	1308		
Pos399/1a	143	1	CTD	05.05.10	20:45:00	BO	38°59.958	N	010°17.798	W	1298	1281	
Pos399/1a	143	1	CTD	05.05.10	21:13:00	EN	38°59.976	N	010°17.663	W	1283		
Pos399/1a	144	1	CTD	05.05.10	22:08:00	BE	38°59.962	N	010°24.013	W	1427		
Pos399/1a	144	1	CTD	05.05.10	22:38:00	BO	38°59.856	N	010°23.982	W	1434	1446	19
Pos399/1a	144	1	CTD	05.05.10	23:09:00	EN	38°59.801	N	010°23.899	W	1438		
Pos399/1a	145	1	CTD	06.05.10	0:06:00	BE	38°59.917	N	010°30.986	W	1666		
Pos399/1a	145	1	CTD	06.05.10	0:39:00	BO	38°59.860	N	010°30.865	W	1661	1688	9
Pos399/1a	145	1	CTD	06.05.10	1:16:00	EN	38°59.780	N	010°30.811	W	1665		
Pos399/1a	146	1	CTD	06.05.10	2:11:00	BE	38°59.917	N	010°38.036	W	1954		
Pos399/1a	146	1	CTD	06.05.10	2:50:00	BO	38°59.850	N	010°37.952	W	1961	1997	9
Pos399/1a	146	1	CTD	06.05.10	3:33:00	EN	38°59.929	N	010°37.822	W	1951		
Pos399/1a	147	1	CTD	06.05.10	4:36:00	BE	38°59.995	N	010°45.010	W	2385		
Pos399/1a	147	1	CTD	06.05.10	5:23:00	BO	38°59.939	N	010°44.977	W	2385	2028	
Pos399/1a	147	1	CTD	06.05.10	6:05:00	EN	39°00.004	N	010°45.004	W	2382		
Pos399/1a	148	1	CTD	06.05.10	7:06:00	BE	38°59.981	N	010°52.004	W	2962		
Pos399/1a	148	1	CTD	06.05.10	7:46:00	BO	38°59.964	N	010°51.935	W	2951	2166	
Pos399/1a	148	1	CTD	06.05.10	8:29:00	EN	38°59.837	N	010°51.775	W	2924		
Pos399/1a	149	1	CTD	06.05.10	9:32:00	BE	38°59.816	N	010°58.767	W	3280		
Pos399/1a	149	1	CTD	06.05.10	10:10:00	BO	38°59.836	N	010°58.868	W	3225	2028	
Pos399/1a	149	1	CTD	06.05.10	10:42:00	EN	38°59.741	N	010°58.765	W	3188		
Pos399/1a	150	1	CTD	06.05.10	11:37:00	BE	38°59.904	N	011°05.998	W	3490		
Pos399/1a	150	1	CTD	06.05.10	12:12:00	BO	38°59.857	N	011°05.987	W	3458	2029	
Pos399/1a	150	1	CTD	06.05.10	12:50:00	EN	38°59.060	N	011°05.880	W	3463		
Pos399/1a	151	1	CTD	06.05.10	13:50:00	BE	38°59.910	N	011°12.930	W	3587		
Pos399/1a	151	1	CTD	06.05.10	14:22:00	BO	38°59.897	N	011°12.865	W	3584	2029	
Pos399/1a	151	1	CTD	06.05.10	14:57:00	EN	38°59.900	N	011°12.824	W	3586		
Pos399/1a	152	1	CTD	07.05.10	5:46:00	BE	37°40.061	N	009°07.990	W	352		
Pos399/1a	152	1	CTD	07.05.10	5:57:00	BO	37°40.067	N	009°07.913	W	351	350	11
Pos399/1a	152	1	CTD	07.05.10	6:15:00	EN	37°40.122	N	009°07.816	W	348		
Pos399/1a	153	1	CTD	07.05.10	7:13:00	BE	37°40.035	N	009°14.952	W	524		
Pos399/1a	153	1	CTD	07.05.10	7:31:00	BO	37°39.996	N	009°14.833	W	522	521	14
Pos399/1a	153	1	CTD	07.05.10	7:47:00	EN	37°39.973	N	009°14.732	W	520		
Pos399/1a	154	1	CTD	07.05.10	8:48:00	BE	37°39.980	N	009°21.997	W	625		
Pos399/1a	154	1	CTD	07.05.10	9:02:00	BO	37°39.913	N	009°21.962	W	626	621	20
Pos399/1a	154	1	CTD	07.05.10	9:19:00	EN	37°39.924	N	009°21.985	W	626		
Pos399/1a	155	1	CTD	07.05.10	10:16:00	BE	37°40.008	N	009°28.984	W	874		
Pos399/1a	155	1	CTD	07.05.10	10:37:00	BO	37°39.978	N	009°28.825	W	837	861	9
Pos399/1a	155	1	CTD	07.05.10	10:56:00	EN	37°40.000	N	009°28.722	W	827		
Pos399/1a	156	1	CTD	07.05.10	11:49:00	BE	37°39.930	N	009°35.910	W	1389		
Pos399/1a	156	1	CTD	07.05.10	12:17:00	BO	37°39.943	N	009°35.790	W	1380	1400	12
Pos399/1a	156	1	CTD	07.05.10	12:44:00	EN	37°39.973	N	009°35.759	W	1376		
Pos399/1a	157	1	CTD	07.05.10	13:40:00	BE	37°39.996	N	009°44.077	W	2292		
Pos399/1a	157	1	CTD	07.05.10	14:16:00	BO	37°40.018	N	009°44.066	W	2285	2025	

Pos399/1a	157	1	CTD	07.05.10	14:54:00	EN	37°40.082	N	009°44.084	W	2277		
Pos399/1a	158	1	CTD	07.05.10	15:50:00	BE	37°40.007	N	009°51.018	W	1968		
Pos399/1a	158	1	CTD	07.05.10	16:23:00	BO	37°40.111	N	009°50.986	W	1974	1967	42
Pos399/1a	158	1	CTD	07.05.10	17:02:00	EN	37°40.266	N	009°50.902	W	1972		
Pos399/1a	159	1	CTD	07.05.10	18:05:00	BE	37°40.028	N	009°59.000	W	2468		
Pos399/1a	159	1	CTD	07.05.10	18:42:00	BO	37°40.278	N	009°59.009	W	2487	2023	
Pos399/1a	159	1	CTD	07.05.10	19:20:00	EN	37°40.341	N	009°59.035	W	2494		
Pos399/1a	160	1	CTD	07.05.10	20:19:00	BE	37°39.997	N	010°07.012	W	2802		
Pos399/1a	160	1	CTD	07.05.10	20:55:00	BO	37°40.103	N	010°07.134	W	2812	2001	
Pos399/1a	160	1	CTD	07.05.10	21:33:00	EN	37°40.240	N	010°07.242	W	2822		
Pos399/1a	161	1	CTD	07.05.10	22:34:00	BE	37°40.014	N	010°16.008	W	3072		
Pos399/1a	161	1	CTD	07.05.10	23:09:00	BO	37°39.978	N	010°15.977	W	3072	2027	
Pos399/1a	161	1	CTD	07.05.10	23:43:00	EN	37°39.976	N	010°15.968	W	3074		
Pos399/1a	162	1	CTD	08.05.10	0:36:00	BE	37°40.020	N	010°23.069	W	3219		
Pos399/1a	162	1	CTD	08.05.10	1:11:00	BO	37°40.081	N	010°23.131	W	3227	2027	
Pos399/1a	162	1	CTD	08.05.10	1:50:00	EN	37°40.003	N	010°23.130	W	3226		
Pos399/1a	163	1	CTD	08.05.10	2:39:00	BE	37°39.988	N	010°29.954	W	3790		
Pos399/1a	163	1	CTD	08.05.10	3:16:00	BO	37°39.938	N	010°30.034	W	3794	2029	
Pos399/1a	163	1	CTD	08.05.10	4:00:00	EN	37°39.936	N	010°30.267	W	3810		
Pos399/1a	164	1	CTD	08.05.10	5:01:00	BE	37°39.997	N	010°38.063	W	4311		
Pos399/1a	164	1	CTD	08.05.10	5:38:00	BO	37°40.122	N	010°38.334	W	4320	2025	
Pos399/1a	164	1	CTD	08.05.10	6:18:00	EN	37°40.132	N	010°38.538	W	4359		
Pos399/1a	165	1	CTD	08.05.10	7:18:00	BE	37°39.978	N	010°45.978	W	5017		
Pos399/1a	165	1	CTD	08.05.10	7:56:00	BO	37°40.057	N	010°46.189	W	5016	2022	
Pos399/1a	165	1	CTD	08.05.10	8:32:00	EN	37°40.145	N	010°46.384	W	5031		
Pos399/1a	166	1	CTD	08.05.10	9:36:00	BE	37°35.038	N	010°42.980	W	4683		
Pos399/1a	166	1	CTD	08.05.10	10:11:00	BO	37°35.144	N	010°43.008	W	4681	2024	
Pos399/1a	166	1	CTD	08.05.10	10:47:00	EN	37°35.308	N	010°43.068	W	5000		
Pos399/1a	167	1	CTD	08.05.10	11:58:00	BE	37°30.036	N	010°38.960	W	4900		
Pos399/1a	167	1	CTD	08.05.10	12:32:00	BO	37°30.028	N	010°39.113	W	4883	2023	
Pos399/1a	167	1	CTD	08.05.10	13:08:00	EN	37°29.994	N	010°39.253	W	4852		
Pos399/1a	168	1	CTD	08.05.10	14:05:00	BE	37°25.115	N	010°35.906	W	4563		
Pos399/1a	168	1	CTD	08.05.10	14:38:00	BO	37°25.106	N	010°36.030	W	4561	2023	
Pos399/1a	168	1	CTD	08.05.10	15:20:00	EN	37°25.115	N	010°36.131	W	4569		
Pos399/1a	169	1	CTD	08.05.10	16:25:00	BE	37°19.957	N	010°32.970	W	4121		
Pos399/1a	169	1	CTD	08.05.10	17:01:00	BO	37°19.877	N	010°32.923	W	4081	2028	
Pos399/1a	169	1	CTD	08.05.10	17:42:00	EN	37°19.796	N	010°32.958	W	4075		
Pos399/1a	170	1	CTD	08.05.10	18:43:00	BE	37°14.998	N	010°29.988	W	3682		
Pos399/1a	170	1	CTD	08.05.10	19:20:00	BO	37°15.014	N	010°30.018	W	3682	2025	
Pos399/1a	170	1	CTD	08.05.10	19:50:00	EN	37°15.015	N	010°30.075	W	3681		
Pos399/1a	171	1	CTD	08.05.10	20:58:00	BE	37°09.990	N	010°25.996	W	3638		
Pos399/1a	171	1	CTD	08.05.10	21:31:00	BO	37°09.335	N	010°26.076	W	3628	2024	
Pos399/1a	171	1	CTD	08.05.10	22:05:00	EN	37°09.886	N	010°26.200	W	3614		
Pos399/1a	172	1	CTD	08.05.10	23:02:00	BE	37°04.990	N	010°23.018	W	3666		
Pos399/1a	172	1	CTD	08.05.10	23:39:00	BO	37°05.064	N	010°23.102	W	3662	2008	
Pos399/1a	172	1	CTD	09.05.10	0:10:00	EN	37°05.088	N	010°23.183	W	3648		
Pos399/1a	173	1	CTD	09.05.10	1:06:00	BE	37°00.047	N	010°19.984	W	3777		
Pos399/1a	173	1	CTD	09.05.10	1:41:00	BO	36°59.988	N	010°20.111	W	3767	2013	
Pos399/1a	173	1	CTD	09.05.10	2:22:00	EN	36°59.922	N	010°20.323	W	3760		
Pos399/1a	174	1	CTD	09.05.10	3:18:00	BE	36°54.982	N	010°16.990	W	3809		
Pos399/1a	174	1	CTD	09.05.10	3:55:00	BO	36°54.972	N	010°17.090	W	3812	2015	
Pos399/1a	174	1	CTD	09.05.10	4:33:00	EN	36°54.989	N	010°17.202	W	3807		
Pos399/1a	175	1	CTD	09.05.10	5:36:00	BE	36°50.014	N	010°13.993	W	3800		
Pos399/1a	175	1	CTD	09.05.10	6:13:00	BO	36°50.023	N	010°13.998	W	3802	2023	
Pos399/1a	175	1	CTD	09.05.10	6:51:00	EN	36°50.002	N	010°13.992	W	3800		

Pos399/1a	176	1	CTD	09.05.10	7:54:00	BE	36°45.008	N	010°09.983	W	3756		
Pos399/1a	176	1	CTD	09.05.10	8:29:00	BO	36°45.112	N	010°09.892	W	3770	2024	
Pos399/1a	176	1	CTD	09.05.10	9:02:00	EN	36°45.162	N	010°09.876	W	3762		
Pos399/1a	177	1	CTD	09.05.10	10:05:00	BE	36°40.020	N	010°06.995	W	3259		
Pos399/1a	177	1	CTD	09.05.10	10:42:00	BO	36°40.217	N	010°06.872	W	3237	2021	
Pos399/1a	177	1	CTD	09.05.10	11:17:00	EN	36°40.373	N	010°06.780	W	3231		
Pos399/1a	178	1	CTD	09.05.10	12:20:00	BE	36°35.002	N	010°03.952	W	3695		
Pos399/1a	178	1	CTD	09.05.10	12:54:00	BO	36°35.021	N	010°03.907	W	3689	2025	
Pos399/1a	178	1	CTD	09.05.10	13:27:00	EN	36°35.029	N	010°03.918	W	3695		
Pos399/1a	179	1	CTD	09.05.10	14:16:00	BE	36°29.996	N	009°59.952	W	3971		
Pos399/1a	179	1	CTD	09.05.10	15:01:00	BO	36°30.019	N	009°59.992	W	3966	2027	
Pos399/1a	179	1	CTD	09.05.10	15:40:00	EN	36°30.038	N	010°00.020	W	3985		
Pos399/1a	180	1	CTD	09.05.10	16:34:00	BE	36°31.993	N	009°55.988	W	3657		
Pos399/1a	180	1	CTD	09.05.10	17:12:00	BO	36°32.015	N	009°56.056	W	3666	2025	
Pos399/1a	180	1	CTD	09.05.10	17:51:00	EN	36°32.068	N	009°56.088	W	3661		
Pos399/1a	181	1	CTD	09.05.10	18:40:00	BE	36°34.019	N	009°52.014	W	3867		
Pos399/1a	181	1	CTD	09.05.10	19:13:00	BO	36°34.081	N	009°52.014	W	3858	2030	
Pos399/1a	181	1	CTD	09.05.10	19:49:00	EN	36°34.116	N	009°52.036	W	3854		
Pos399/1a	182	1	CTD	09.05.10	20:39:00	BE	36°35.995	N	009°48.007	W	3913		
Pos399/1a	182	1	CTD	09.05.10	21:17:00	BO	36°36.157	N	009°48.018	W	3911	2023	
Pos399/1a	182	1	CTD	09.05.10	21:57:00	EN	36°36.308	N	009°48.071	W	3914		
Pos399/1a	183	1	CTD	09.05.10	22:48:00	BE	36°37.998	N	009°44.014	W	3207		
Pos399/1a	183	1	CTD	09.05.10	23:29:00	BO	36°38.110	N	009°44.166	W	3211	2023	
Pos399/1a	183	1	CTD	10.05.10	0:04:00	EN	36°38.442	N	009°44.318	W	3189		
Pos399/1a	184	1	CTD	10.05.10	0:52:00	BE	36°40.001	N	009°40.064	W	2869		
Pos399/1a	184	1	CTD	10.05.10	1:29:00	BO	36°40.250	N	009°40.223	W	2849	2020	
Pos399/1a	184	1	CTD	10.05.10	2:02:00	EN	36°40.460	N	009°40.478	W	2878		
Pos399/1a	185	1	CTD	10.05.10	2:59:00	BE	36°41.953	N	009°36.018	W	2185		
Pos399/1a	185	1	CTD	10.05.10	3:35:00	BO	36°42.065	N	009°36.210	W	2227	2023	
Pos399/1a	185	1	CTD	10.05.10	4:15:00	EN	36°42.251	N	009°36.395	W	2277		
Pos399/1a	186	1	CTD	10.05.10	5:04:00	BE	36°44.035	N	009°32.010	W	1575		
Pos399/1a	186	1	CTD	10.05.10	5:35:00	BO	36°44.106	N	009°32.128	W	1589	1616	19
Pos399/1a	186	1	CTD	10.05.10	6:06:00	EN	36°44.137	N	009°32.130	W	1588		
Pos399/1a	187	1	CTD	10.05.10	7:06:00	BE	36°46.002	N	009°28.022	W	1183		
Pos399/1a	187	1	CTD	10.05.10	7:30:00	BO	36°46.088	N	009°28.070	W	1183	1190	18
Pos399/1a	187	1	CTD	10.05.10	7:53:00	EN	36°46.123	N	009°28.072	W	1183		
Pos399/1a	188	1	CTD	10.05.10	8:44:00	BE	36°48.016	N	009°23.986	W	914		
Pos399/1a	188	1	CTD	10.05.10	9:04:00	BO	36°48.017	N	009°23.999	W	915	921	16
Pos399/1a	188	1	CTD	10.05.10	9:18:00	EN	36°48.042	N	009°23.974	W	913		
Pos399/1a	189	1	CTD	10.05.10	10:01:00	BE	36°50.005	N	009°19.950	W	806		
Pos399/1a	189	1	CTD	10.05.10	10:17:00	BO	36°49.897	N	009°19.955	W	806	805	18
Pos399/1a	189	1	CTD	10.05.10	10:33:00	EN	36°49.788	N	009°19.951	W	811		
Pos399/1a	190	1	CTD	10.05.10	11:16:00	BE	36°51.960	N	009°16.030	W			
Pos399/1a	190	1	CTD	10.05.10	11:29:00	BO	36°51.854	N	009°15.983	W	700	703	12
Pos399/1a	190	1	CTD	10.05.10	11:47:00	EN	36°51.766	N	009°15.936	W	704		
Pos399/1a	191	1	CTD	10.05.10	12:37:00	BE	36°53.970	N	009°11.999	W	667		
Pos399/1a	191	1	CTD	10.05.10	12:51:00	Bo	36°53.936	N	009°12.006	W	667	669	11
Pos399/1a	191	1	CTD	10.05.10	13:05:00	EN	36°53.873	N	009°11.974	W	666		
Pos399/1a	192	1	CTD	10.05.10	13:47:00	BE	36°56.008	N	009°08.003	W	611		
Pos399/1a	192	1	CTD	10.05.10	14:02:00	BO	36°56.016	N	009°07.904	W	605	612	9
Pos399/1a	192	1	CTD	10.05.10	14:16:00	EN	36°55.960	N	009°07.836	W	605		
Pos399/1a	193	1	CTD	10.05.10	14:53:00	BE	36°57.988	N	009°03.953	W	118		
Pos399/1a	193	1	CTD	10.05.10	15:01:00	BO	36°57.985	N	009°03.870	W	116	111	14
Pos399/1a	193	1	CTD	10.05.10	15:07:00	EN	36°57.978	N	009°03.836	W	115		
Pos399/1a	194	1	CTD	10.05.10	21:01:00	BE	36°50.035	N	008°08.947	W	102		

Pos399/1a	194	1	CTD	10.05.10	21:05:00	BO	36°50.059	N	008°08.910	W	105	97	12
Pos399/1a	194	1	CTD	10.05.10	21:11:00	EN	36°50.066	N	008°08.878	W	102		
Pos399/1a	195	1	CTD	10.05.10	21:47:00	BE	36°48.000	N	008°08.933	W	342		
Pos399/1a	195	1	CTD	10.05.10	21:56:00	BO	36°47.968	N	008°08.778	W	347	340	15
Pos399/1a	195	1	CTD	10.05.10	22:05:00	EN	36°47.946	N	008°08.672	W	351		
Pos399/1a	196	1	CTD	10.05.10	22:42:00	BE	36°46.002	N	008°09.032	W	700		
Pos399/1a	196	1	CTD	10.05.10	22:57:00	BO	36°45.942	N	008°08.970	W	705	703	13
Pos399/1a	196	1	CTD	10.05.10	23:13:00	EN	36°45.869	N	008°08.947	W	704		
Pos399/1a	197	1	CTD	10.05.10	23:44:00	BE	36°43.960	N	008°09.041	W	691		
Pos399/1a	197	1	CTD	11.05.10	0:01:00	BO	36°44.016	N	008°09.058	W	691	697	10
Pos399/1a	197	1	CTD	11.05.10	0:17:00	EN	36°44.046	N	008°09.038	W	692		
Pos399/1a	198	1	CTD	11.05.10	0:50:00	BE	36°41.975	N	008°09.008	W	743		
Pos399/1a	198	1	CTD	11.05.10	1:08:00	BO	36°41.990	N	008°08.915	W	744	751	9
Pos399/1a	198	1	CTD	11.05.10	1:25:00	EN	36°42.016	N	008°08.838	W	745		
Pos399/1a	199	1	CTD	11.05.10	2:06:00	BE	36°40.001	N	008°08.994	W	763		
Pos399/1a	199	1	CTD	11.05.10	2:24:00	BO	36°40.030	N	008°08.906	W	164	769	10
Pos399/1a	199		CTD	11.05.10	2:42:00	EN	36°40.020	N	008°08.826	W	164		
Pos399/1a	200	1	CTD	11.05.10	3:17:00	BE	36°37.998	N	008°09.007	W	799		
Pos399/1a	200	1	CTD	11.05.10	3:34:00	BO	36°38.035	N	008°08.851	W	798	777	38
Pos399/1a	200	1	CTD	11.05.10	3:52:00	EN	36°38.039	N	008°08.701	W	801		
Pos399/1a	201	1	CTD	11.05.10	4:29:00	BE	36°36.042	N	008°09.095	W	895		
Pos399/1a	201	1	CTD	11.05.10	4:49:00	BO	36°36.070	N	008°09.078	W	896	906	8
Pos399/1a	201	1	CTD	11.05.10	5:09:00	EN	36°36.088	N	008°09.036	W	895		
Pos399/1a	202	1	CTD	11.05.10	5:49:00	BE	36°34.009	N	008°08.999	W	942		
Pos399/1a	202	1	CTD	11.05.10	6:10:00	BO	36°34.082	N	008°08.886	W	942	955	8
Pos399/1a	202	1	CTD	11.05.10	6:30:00	EN	36°34.151	N	008°08.802	W	939		
Pos399/1a	203	1	CTD	11.05.10	7:08:00	BE	36°32.020	N	008°08.946	W	1026		
Pos399/1a	203	1	CTD	11.05.10	7:29:00	BO	36°32.101	N	008°08.818	W	1012	1027	15
Pos399/1a	203	1	CTD	11.05.10	7:48:00	EN	36°32.168	N	008°08.724	W	1005		
Pos399/1a	204	1	CTD	01.05.10	8:28:00	BE	36°31.007	N	008°11.933	W	1164		
Pos399/1a	204	1	CTD	11.05.10	8:50:00	BO	36°31.025	N	008°11.951	W	1162	1081	12
Pos399/1a	204	1	CTD	11.05.10	9:12:00	EN	36°31.050	N	008°11.920	W	1160		
Pos399/1a	205	1	CTD	11.05.10	9:52:00	BE	36°30.006	N	008°14.994	W	1324		
Pos399/1a	205	1	CTD	11.05.10	10:18:00	BO	36°30.028	N	008°14.959	W	1323	1334	18
Pos399/1a	205	1	CTD	11.05.10	10:39:00	EN	36°30.029	N	008°14.892	W	1321		
Pos399/1a	206	1	CTD	11.05.10	10:41:00	BE	36°28.982	N	008°17.964	W	1366		
Pos399/1a	206	1	CTD	11.05.10	11:39:00	BO	36°29.724	N	008°17.935	W	1369	1390	10
Pos399/1a	206	1	CTD	11.05.10	12:03:00	EN	36°29.059	N	008°17.897	W	1374		
Pos399/1a	207	1	CTD	11.05.10	12:36:00	BE	36°27.986	N	008°20.978	W	1392		
Pos399/1a	207	1	CTD	11.05.10	13:03:00	BO	36°27.994	N	008°20.963	W	1390	1403	11
Pos399/1a	207	1	CTD	11.05.10	13:26:00	EN	36°27.997	N	008°20.971	W	1398		
Pos399/1a	208	1	CTD	11.05.10	14:01:00	BE	36°26.980	N	008°23.970	W	1504		
Pos399/1a	208	1	CTD	11.05.10	14:27:00	BO	36°27.029	N	008°23.983	W	1507	1532	9
Pos399/1a	208	1	CTD	11.05.10	14:52:00	EN	36°27.046	N	008°24.007	W	1508		
Pos399/1a	209	1	CTD	11.05.10	15:26:00	BE	36°25.997	N	008°26.990	W	1705		
Pos399/1a	209	1	CTD	11.05.10	16:00:00	BO	36°26.024	N	008°26.980	W	1690	1697	
Pos399/1a	209	1	CTD	11.05.10	16:33:00	EN	36°26.052	N	008°26.968	W	1679		
Pos399/1a	210	1	CTD	11.05.10	17:11:00	BE	36°24.990	N	008°29.992	W	1940		
Pos399/1a	210	1	CTD	11.05.10	17:46:00	BO	36°25.061	N	008°29.923	W	1908	1902	
Pos399/1a	210	1	CTD	11.05.10	18:23:00	EN	36°25.085	N	008°29.826	W	1897		
Pos399/1a	211	1	CTD	11.05.10	19:10:00	BE	36°23.990	N	008°33.019	W	2464		
Pos399/1a	211	1	CTD	11.05.10	19:45:00	BO	36°24.049	N	008°32.953	W	2461	2026	
Pos399/1a	211	1	CTD	11.05.10	20:14:00	EN	36°24.061	N	008°32.891	W	2438		
Pos399/1a	212	1	CTD	11.05.10	21:13:00	BE	36°21.986	N	008°39.018	W	2753		
Pos399/1a	212	1	CTD	11.05.10	21:47:00	BO	36°22.103	N	008°38.938	W	2720	2026	

Pos399/1a	212	1	CTD	11.05.10	22:27:00	EN	36°22.204	N	008°38.939	W	2717		
Pos399/1a	213	1	CTD	11.05.10	23:18:00	BE	36°20.006	N	008°45.013	W	2882		
Pos399/1a	213	1	CTD	11.05.10	23:53:00	BO	36°20.272	N	008°44.881	W	2877	2022	
Pos399/1a	213	1	CTD	12.05.10	0:23:00	EN	36°20.435	N	008°44.879	W	2887		
Pos399/1a	214	1	CTD	12.05.10	1:18:00	BE	36°17.999	N	008°50.966	W	3014		
Pos399/1a	214	1	CTD	12.05.10	1:54:00	BO	36°18.166	N	008°50.922	W	3030	2023	
Pos399/1a	214	1	CTD	12.05.10	2:29:00	EN	36°18.367	N	008°50.902	W	3046		
Pos399/1a	215	1	CTD	12.05.10	3:29:00	BE	36°16.019	N	008°56.917	W	2872		
Pos399/1a	215	1	CTD	12.05.10	4:05:00	BO	36°16.097	N	008°56.702	W	2861	2021	
Pos399/1a	215	1	CTD	12.05.10	4:34:00	EN	36°16.088	N	008°56.542	W	2864		
Pos399/1a	216	1	CTD	12.05.10	5:58:00	BE	36°13.026	N	009°05.982	W	3377		
Pos399/1a	216	1	CTD	12.05.10	6:37:00	BO	36°13.002	N	009°05.814	W	3361	2025	
Pos399/1a	216	1	CTD	12.05.10	7:11:00	EN	36°12.889	N	009°05.560	W	3335		
Pos399/1a	217	1	CTD	12.05.10	8:50:00	BE	36°08.976	N	009°18.000	W	4010		
Pos399/1a	217	1	CTD	12.05.10	9:25:00	BO	36°09.012	N	009°17.890	W	4006	2026	
Pos399/1a	217	1	CTD	12.05.10	10:00:00	EN	36°09.080	N	009°17.740	W	4007		
Pos399/1a	218	1	CTD	12.05.10	11:34:00	BE	36°04.998	N	009°29.982	W	4062		
Pos399/1a	218	1	CTD	12.05.10	12:10:00	BO	36°05.009	N	009°29.977	W	4066	2026	
Pos399/1a	218	1	CTD	12.05.10	12:42:00	EN	36°05.004	N	009°29.995	W	4064		
Pos399/1a	219	1	CTD	12.05.10	14:07:00	BE	36°01.008	N	009°42.000	W	4305		
Pos399/1a	219	1	CTD	12.05.10	14:41:00	BO	36°01.054	N	009°42.072	W	4301	2027	
Pos399/1a	219	1	CTD	12.05.10	15:16:00	EN	36°01.134	N	009°42.083	W	4291		
Pos399/1a	220	1	CTD	12.05.10	16:51:00	BE	35°57.017	N	009°53.990	W	4482		
Pos399/1a	220	1	CTD	12.05.10	17:27:00	BO	35°57.091	N	009°54.102	W	4481	2028	
Pos399/1a	220	1	CTD	12.05.10	18:01:00	EN	35°57.161	N	009°53.918	W	4476		
Pos399/1a	221	1	CTD	12.05.10	19:37:00	BE	35°53.002	N	010°06.006	W	4622		
Pos399/1a	221	1	CTD	12.05.10	20:10:00	BO	35°53.038	N	010°06.066	W	4617	2025	
Pos399/1a	221	1	CTD	12.05.10	20:41:00	EN	35°53.003	N	010°06.120	W	4612		
Pos399/1b	222	1	CTD	15.05.10	17:24:00	BE	36°29.963	N	006°36.930	W	86		
Pos399/1b	222	1	CTD	15.05.10	17:29:00	BO	36°29.958	N	006°36.918	W	86	85	7
Pos399/1b	222	1	CTD	15.05.10	17:37:00	EN	36°29.953	N	006°36.853	W	85		
Pos399/1b	223	1	CTD	15.05.10	18:31:00	BE	36°28.002	N	006°41.980	W	149		
Pos399/1b	223	1	CTD	15.05.10	18:38:00	BO	36°27.998	N	006°41.958	W	148	145	8
Pos399/1b	223	1	CTD	15.05.10	18:45:00	EN	36°27.995	N	006°41.966	W	148		
Pos399/1b	224	1	CTD	15.05.10	19:41:00	BE	36°25.970	N	006°46.974	W	322		
Pos399/1b	224	1	CTD	15.05.10	19:49:00	BO	36°25.968	N	006°46.956	W	316	324	10
Pos399/1b	224	1	CTD	15.05.10	20:00:00	EN	36°25.968	N	006°46.950	W	322		
Pos399/1b	225	1	CTD	15.05.10	20:47:00	BE	36°23.945	N	006°51.991	W	439		
Pos399/1b	225	1	CTD	15.05.10	20:57:00	BO	36°23.939	N	006°51.977	W	439	443	9
Pos399/1b	225	1	CTD	15.05.10	21:09:00	EN	36°23.927	N	006°51.976	W	439		
Pos399/1b	226	1	CTD	15.05.10	21:56:00	BE	36°21.977	N	006°56.999	W	460		
Pos399/1b	226	1	CTD	15.05.10	22:07:00	BO	36°21.972	N	006°56.944	W	461	443	9
Pos399/1b	226	1	CTD	15.05.10	22:18:00	EN	36°21.971	N	006°56.960	W	461		
Pos399/1b	227	1	CTD	15.05.10	23:00:00	BE	36°19.970	N	007°02.010	W	712		
Pos399/1b	227	1	CTD	15.05.10	23:17:00	BO	36°19.962	N	007°02.032	W	708	716	11
Pos399/1b	227	1	CTD	15.05.10	23:36:00	EN	36°19.992	N	007°02.051	W	740		
Pos399/1b	228	1	CTD	16.05.10	0:23:00	BE	36°17.972	N	007°06.992	W	720		
Pos399/1b	228	1	CTD	16.05.10	0:39:00	BO	36°18.050	N	007°06.900	W	711	724	11
Pos399/1b	228	1	CTD	16.05.10	0:56:00	EN	36°18.130	N	007°06.812	W	709		
Pos399/1b	229	1	CTD	16.05.10	1:45:00	BE	36°15.972	N	007°11.981	W	847		
Pos399/1b	229	1	CTD	16.05.10	2:05:00	BO	36°16.013	N	007°11.953	W	853	849	12
Pos399/1b	229	1	CTD	16.05.10	2:25:00	EN	36°16.026	N	007°11.942	W	851		
Pos399/1b	230	1	CTD	16.05.10	3:17:00	BE	36°14.003	N	007°16.994	W	869		
Pos399/1b	230	1	CTD	16.05.10	3:36:00	BO	36°14.020	N	007°16.908	W	869	873	13
Pos399/1b	230	1	CTD	16.05.10	3:54:00	EN	36°14.070	N	007°16.811	W	868		

Pos399/1b	231	1	CTD	16.05.10	4:45:00	BE	36°12.048	N	007°22.003	W	861		
Pos399/1b	231	1	CTD	16.05.10	5:04:00	BO	36°12.089	N	007°21.966	W	862	868	10
Pos399/1b	231	1	CTD	16.05.10	5:26:00	EN	36°12.108	N	007°21.917	W	859		
Pos399/1b	232	1	CTD	16.05.10	6:18:00	BE	36°10.007	N	007°27.019	W	997		
Pos399/1b	232	1	CTD	16.05.10	6:38:00	BO	36°10.038	N	007°26.977	W	994	1006	10
Pos399/1b	232	1	CTD	16.05.10	7:00:00	EN	36°10.055	N	007°26.933	W	992		
Pos399/1b	233	1	CTD	16.05.10	7:55:00	BE	36°07.992	N	007°31.988	W	1036		
Pos399/1b	233	1	CTD	16.05.10	8:16:00	BO	36°08.022	N	007°31.916	W	1036	1046	13
Pos399/1b	233	1	CTD	16.05.10	8:32:00	EN	36°08.033	N	007°31.876	W	1019		
Pos399/1b	234	1	CTD	16.05.10	9:21:00	BE	36°06.030	N	007°37.052	W	1167		
Pos399/1b	234	1	CTD	16.05.10	9:46:00	BO	36°06.038	N	007°37.093	W	1164	1165	8
Pos399/1b	234	1	CTD	16.05.10	10:05:00	EN	36°06.044	N	007°37.070	W	1161		
Pos399/1b	235	1	CTD	16.05.10	10:35:00	BE	36°03.990	N	007°41.988	W	1107		
Pos399/1b	235	1	CTD	16.05.10	11:13:00	BO	36°03.967	N	007°41.897	W	1111	1117	9
Pos399/1b	235	1	CTD	16.05.10	11:33:00	EN	36°03.970	N	007°41.884	W	1104		
Pos399/1b	236	1	CTD	16.05.10	12:20:00	BE	36°02.010	N	007°47.046	W	1172		
Pos399/1b	236	1	CTD	16.05.10	12:43:00	BO	36°01.984	N	007°47.021	W	1172	1187	11
Pos399/1b	236	1	CTD	16.05.10	13:04:00	EN	36°01.968	N	007°46.982	W	1178		
Pos399/1b	237	1	CTD	16.05.10	13:52:00	BE	35°59.963	N	007°52.026	W	1375		
Pos399/1b	237	1	CTD	16.05.10	14:18:00	BO	35°59.946	N	007°52.015	W	1371	1387	12
Pos399/1b	237	1	CTD	16.05.10	14:42:00	EN	35°59.925	N	007°52.003	W	1372		
Pos399/1b	238	1	CTD	16.05.10	15:26:00	BE	35°58.019	N	007°57.001	W	1496		
Pos399/1b	238	1	CTD	16.05.10	15:55:00	BO	35°57.978	N	007°57.036	W	1536	1531	20
Pos399/1b	238	1	CTD	16.05.10	16:23:00	EN	35°58.004	N	007°57.025	W	1481		
Pos399/1b	239	1	CTD	16.05.10	17:16:00	BE	35°56.093	N	008°02.005	W	1648		
Pos399/1b	239	1	CTD	16.05.10	17:47:00	BO	35°56.008	N	008°01.956	W	1637	1638	40
Pos399/1b	239	1	CTD	16.05.10	18:17:00	EN	35°56.034	N	008°01.912	W	1635		
Pos399/1b	240	1	CTD	16.05.10	19:11:00	BE	35°53.980	N	008°06.991	W	1831		
Pos399/1b	240	1	CTD	16.05.10	19:44:00	BO	35°53.928	N	008°07.038	W	1836	1860	8
Pos399/1b	240	1	CTD	16.05.10	20:13:00	EN	35°53.940	N	008°07.036	W	1839		
Pos399/1b	241	1	CTD	16.05.10	20:58:00	BE	35°51.979	N	008°12.006	W	2085		
Pos399/1b	241	1	CTD	16.05.10	21:33:00	BO	35°51.913	N	008°11.976	W	2083	2054	
Pos399/1b	241	1	CTD	16.05.10	22:03:00	EN	35°51.930	N	008°11.981	W	2085		
Pos399/1b	242	1	CTD	16.05.10	22:51:00	BE	35°49.978	N	008°17.006	W	2113		
Pos399/1b	242	1	CTD	16.05.10	23:25:00	BO	35°49.973	N	008°17.003	W	2052	2076	
Pos399/1b	242	1	CTD	16.05.10	23:57:00	EN	35°50.018	N	008°16.990	W	2110		
Pos399/1b	243	1	CTD	17.05.10	0:40:00	BE	35°47.966	N	008°21.990	W	2210		
Pos399/1b	243	1	CTD	17.05.10	1:18:00	BO	35°47.975	N	008°21.962	W	2211	2077	
Pos399/1b	243	1	CTD	17.05.10	1:50:00	EN	35°47.986	N	008°21.922	W	2209		
Pos399/1b	244	1	CTD	17.05.10	2:36:00	BE	35°45.966	N	008°26.977	W	2371		
Pos399/1b	244	1	CTD	17.05.10	3:14:00	BO	35°45.977	N	008°26.886	W		2079	
Pos399/1b	244	1	CTD	17.05.10	3:47:00	EN	35°45.979	N	008°26.813	W	2366		
Pos399/1b	245	1	CTD	17.05.10	4:44:00	BE	35°43.984	N	008°31.984	W	2518		
Pos399/1b	245	1	CTD	17.05.10	5:20:00	BO	35°43.982	N	008°31.934	W	2514	2080	
Pos399/1b	245	1	CTD	17.05.10	5:53:00	EN	35°43.958	N	008°31.912	W	2516		
Pos399/1b	246	1	CTD	17.05.10	6:49:00	BE	35°42.013	N	008°36.952	W	2601		
Pos399/1b	246	1	CTD	17.05.10	7:25:00	BO	35°41.952	N	008°36.691	W	2608	2073	
Pos399/1b	246	1	CTD	17.05.10	8:01:00	EN	35°41.849	N	008°36.530	W	2610		
Pos399/1b	247	1	CTD	17.05.10	8:50:00	BE	35°40.007	N	008°42.006	W	2802		
Pos399/1b	247	1	CTD	17.05.10	9:22:00	BO	35°39.984	N	008°41.806	W	2792	2065	
Pos399/1b	247	1	CTD	17.05.10	9:50:00	EN	35°39.986	N	008°41.635	W	2785		
Pos399/1b	248	1	CTD	17.05.10	10:51:00	BE	35°38.034	N	008°46.998	W	2914		
Pos399/1b	248	1	CTD	17.05.10	11:26:00	BO	35°38.076	N	008°46.856	W	2909	2072	
Pos399/1b	248	1	CTD	17.05.10	11:57:00	EN	35°38.026	N	008°46.764	W	2910		
Pos399/1b	249	1	CTD	17.05.10	12:46:00	BE	35°35.995	N	008°52.008	W	3018		

Pos399/1b	249	1	CTD	17.05.10	13:22:00	BO	35°36.053	N	008°51.905	W	2992	2075
Pos399/1b	249	1	CTD	17.05.10	13:54:00	EN	35°36.113	N	008°51.804	W	2991	
Pos399/1b	250	1	CTD	17.05.10	14:48:00	BE	35°34.002	N	008°57.078	W	3211	
Pos399/1b	250	1	CTD	17.05.10	15:24:00	BO	35°34.063	N	008°56.898	W	3201	2076
Pos399/1b	250	1	CTD	17.05.10	16:02:00	EN	35°34.126	N	008°56.676	W		
Pos399/1b	251	1	CTD	17.05.10	19:15:00	BE	35°38.990	N	009°24.034	W	3899	
Pos399/1b	251	1	CTD	17.05.10	19:53:00	BO	35°38.962	N	009°24.066	W	3839	2075
Pos399/1b	251	1	CTD	17.05.10	20:26:00	EN	35°38.982	N	009°24.036	W	3838	
Pos399/1b	252	1	CTD	17.05.10	23:26:00	BE	35°43.991	N	009°50.990	W	4390	
Pos399/1b	252	1	CTD	18.05.10	0:04:00	BO	35°44.008	N	009°51.022	W	4404	2078
Pos399/1b	252	1	CTD	18.05.10	0:34:00	EN	35°44.012	N	009°51.026	W	4400	
Pos399/1b	253	1	CTD	18.05.10	3:35:00	BE	35°48.990	N	010°18.049	W	4639	
Pos399/1b	253	1	CTD	18.05.10	4:10:00	BO	35°48.990	N	010°18.046	W	4656	2079
Pos399/1b	253	1	CTD	18.05.10	4:43:00	EN	35°48.997	N	010°18.065	W	4638	
Pos399/1b	254	1	CTD	18.05.10	6:31:00	BE	35°44.986	N	010°29.990	W	4755	
Pos399/1b	254	1	CTD	18.05.10	7:05:00	BO	35°44.940	N	010°29.934	W	4757	2077
Pos399/1b	254	1	CTD	18.05.10	7:37:00	EN	35°44.887	N	010°29.910	W	4770	
Pos399/1b	255	1	CTD	18.05.10	9:09:00	BE	35°40.982	N	010°42.006	W	4989	
Pos399/1b	255	1	CTD	18.05.10	9:43:00	BO	35°40.896	N	010°41.897	W	4817	2076
Pos399/1b	255	1	CTD	18.05.10	10:16:00	EN	35°40.894	N	010°41.889	W	4817	
Pos399/1b	256	1	CTD	18.05.10	11:49:00	BE	35°36.996	N	010°53.972	W	4813	
Pos399/1b	256	1	CTD	18.05.10	12:24:00	BO	35°36.924	N	010°53.664	W	4887	2065
Pos399/1b	256	1	CTD	18.05.10	12:59:00	EN	35°36.869	N	010°53.443	W	4823	
Pos399/1b	257	1	CTD	18.05.10	20:17:00	BE	36°21.996	N	010°42.017	W	4750	
Pos399/1b	257	1	CTD	18.05.10	20:47:00	BO	36°21.990	N	010°42.022	W	4753	2075
Pos399/1b	257	1	CTD	18.05.10	21:16:00	EN	36°22.032	N	010°42.036	W	4752	
Pos399/1b	258	1	CTD	18.05.10	22:54:00	BE	36°12.000	N	010°37.004	W	4785	
Pos399/1b	258	1	CTD	18.05.10	23:30:00	BO	36°12.030	N	010°37.000	W	4785	2078
Pos399/1b	258	1	CTD	18.05.10	23:59:00	EN	36°12.050	N	010°37.002	W	4793	
Pos399/1b	259	1	CTD	19.05.10	1:33:00	BE	36°01.994	N	010°31.998	W	4801	
Pos399/1b	259	1	CTD	19.05.10	2:12:00	BO	36°02.006	N	010°32.010	W		2079
Pos399/1b	259	1	CTD	19.05.10	2:44:00	EN	36°01.986	N	010°32.014	W	4809	
Pos399/1b	260	1	CTD	19.05.10	4:22:00	BE	35°51.955	N	010°27.025	W	4602	
Pos399/1b	260	1	CTD	19.05.10	5:01:00	BO	35°51.926	N	010°26.993	W		2077
Pos399/1b	260	1	CTD	19.05.10	5:38:00	EN	35°51.960	N	010°27.029	W	4775	
Pos399/1b	261	1	CTD	19.05.10	7:25:00	BE	35°42.006	N	010°21.967	W	4598	
Pos399/1b	261	1	CTD	19.05.10	7:58:00	BO	35°41.984	N	010°21.877	W	4442	2075
Pos399/1b	261	1	CTD	19.05.10	8:31:00	EN	35°41.939	N	010°21.832	W	4531	
Pos399/1b	262	1	CTD	19.05.10	10:07:00	BE	35°31.997	N	010°17.008	W	3805	
Pos399/1b	262	1	CTD	19.05.10	10:37:00	BO	35°31.955	N	010°17.044	W	3820	2078
Pos399/1b	262	1	CTD	19.05.10	11:08:00	EN	35°31.985	N	010°16.979	W	3808	
Pos399/1b	263	1	CTD	19.05.10	12:41:00	BE	35°21.997	N	010°12.006	W	3981	
Pos399/1b	263	1	CTD	19.05.10	13:15:00	BO	35°22.004	N	010°12.047	W	3984	2077
Pos399/1b	263	1	CTD	19.05.10	13:46:00	EN	35°22.602	N	010°12.020	W	3983	
Pos399/1b	264	1	CTD	19.05.10	18:04:00	BE	35°19.974	N	010°54.994	W		
Pos399/1b	264	1	CTD	19.05.10	18:44:00	BO	35°20.078	N	010°54.761	W		2062
Pos399/1b	264	1	CTD	19.05.10	19:08:00	EN	35°20.322	N	010°54.528	W		
Pos399/1b	264	2	CTD	19.05.10	19:10:00	BE	35°20.364	N	010°54.498	W		
Pos399/1b	264	2	CTD	19.05.10	19:31:00	BO	35°20.647	N	010°54.253	W		1717
Pos399/1b	264	2	CTD	19.05.10	19:51:00	EN	35°20.936	N	010°54.013	W		
Pos399/1b	264	3	CTD	19.05.10	19:53:00	BE	35°21.005	N	010°53.987	W		
Pos399/1b	264	3	CTD	19.05.10	20:16:00	BO	35°21.342	N	010°53.641	W		1719
Pos399/1b	264	3	CTD	19.05.10	20:45:00	EN	35°21.617	N	010°53.299	W		
Pos399/1b	264	4	CTD	19.05.10	20:58:00	BE	35°21.626	N	010°53.197	W		
Pos399/1b	264	4	CTD	19.05.10	21:34:00	BO	35°22.124	N	010°52.794	W		2074

Pos399/1b	264	4	CTD	19.05.10	21:59:00	EN	35°22.486	N	010°52.524	W	
Pos399/1b	264	5	CTD	19.05.10	22:01:00	BE	35°22.526	N	010°52.500	W	
Pos399/1b	264	5	CTD	19.05.10	22:23:00	BO	35°22.896	N	010°52.160	W	1750
Pos399/1b	264	5	CTD	19.05.10	22:44:00	EN	35°23.162	N	010°51.860	W	
Pos399/1b	264	6	CTD	19.05.10	22:47:00	BE	35°23.191	N	010°51.833	W	
Pos399/1b	264	6	CTD	19.05.10	23:09:00	BO	35°23.551	N	010°51.454	W	1717
Pos399/1b	264	6	CTD	19.05.10	23:28:00	EN	35°23.820	N	010°51.196	W	
Pos399/1b	264	7	CTD	19.05.10	23:29:00	BE	35°23.848	N	010°51.172	W	
Pos399/1b	264	7	CTD	19.05.10	23:53:00	BO	35°24.254	N	010°50.762	W	1719
Pos399/1b	264	7	CTD	20.05.10	0:12:00	EN	35°24.547	N	010°50.473	W	
Pos399/1b	264	8	CTD	20.05.10	0:13:00	BE	35°24.581	N	010°50.444	W	
Pos399/1b	264	8	CTD	20.05.10	0:35:00	BO	35°24.964	N	010°50.034	W	1697
Pos399/1b	264	8	CTD	20.05.10	1:00:00	EN	35°25.314	N	010°49.622	W	
Pos399/1b	264	9	CTD	20.05.10	1:02:00	BE	35°25.316	N	010°49.646	W	
Pos399/1b	264	9	CTD	20.05.10	1:36:00	BO	35°25.866	N	010°49.156	W	2075
Pos399/1b	264	9	CTD	20.05.10	1:59:00	EN	35°26.183	N	010°48.852	W	
Pos399/1b	264	10	CTD	20.05.10	2:00:00	BE	35°26.204	N	010°48.830	W	
Pos399/1b	264	10	CTD	20.05.10	2:21:00	BO	35°26.548	N	010°48.487	W	1719
Pos399/1b	264	10	CTD	20.05.10	2:40:00	EN	35°26.814	N	010°48.236	W	
Pos399/1b	264	11	CTD	20.05.10	2:41:00	BE	35°26.834	N	010°48.222	W	
Pos399/1b	264	11	CTD	20.05.10	3:04:00	BO	35°27.221	N	010°47.827	W	1740
Pos399/1b	264	11	CTD	20.05.10	3:32:00	EN	35°27.336	N	010°47.560	W	
Pos399/1b	264	12	CTD	20.05.10	3:34:00	BE	35°27.336	N	010°47.525	W	
Pos399/1b	264	12	CTD	20.05.10	4:11:00	BO	35°27.644	N	010°47.170	W	1721
Pos399/1b	264	12	CTD	20.05.10	4:31:00	EN	35°27.902	N	010°46.954	W	
Pos399/1b	264	13	CTD	20.05.10	4:35:00	BE	35°27.962	N	010°46.909	W	
Pos399/1b	264	13	CTD	20.05.10	4:58:00	BO	35°28.327	N	010°46.633	W	1735
Pos399/1b	264	13	CTD	20.05.10	5:28:00	EN	35°28.745	N	010°46.249	W	
Pos399/1b	264	14	CTD	20.05.10	5:31:00	BE	35°28.738	N	010°46.224	W	
Pos399/1b	264	14	CTD	20.05.10	6:09:00	BO	35°29.344	N	010°45.644	W	2073
Pos399/1b	264	14	CTD	20.05.10	6:38:00	EN	35°29.813	N	010°45.238	W	
Pos399/1b	264	15	CTD	20.05.10	6:41:00	BE	35°29.868	N	010°45.185	W	
Pos399/1b	264	15	CTD	20.05.10	7:00:00	BO	35°30.185	N	010°44.844	W	1720
Pos399/1b	264	15	CTD	20.05.10	7:30:00	EN	35°30.781	N	010°44.316	W	
Pos399/1b	264	16	CTD	20.05.10	7:32:00	BE	35°30.829	N	010°44.272	W	
Pos399/1b	264	16	CTD	20.05.10	7:51:00	BO	35°31.194	N	010°43.892	W	1718
Pos399/1b	264	16	CTD	20.05.10	8:13:00	EN	35°31.523	N	010°43.548	W	
Pos399/1b	264	17	CTD	20.05.10	8:15:00	BE	35°31.558	N	010°43.513	W	
Pos399/1b	264	17	CTD	20.05.10	8:40:00	BO	35°32.065	N	010°43.031	W	1728
Pos399/1b	264	17	CTD	20.05.10	9:05:00	EN	35°32.492	N	010°42.586	W	
Pos399/1b	264	18	CTD	20.05.10	9:07:00	BE	35°32.531	N	010°42.504	W	
Pos399/1b	264	18	CTD	20.05.10	9:29:00	BO	35°32.970	N	010°42.080	W	1717
Pos399/1b	264	18	CTD	20.05.10	9:59:00	EN	35°33.331	N	010°41.567	W	
Pos399/1b	264	19	CTD	20.05.10	10:01:00	BE	35°33.329	N	010°41.551	W	
Pos399/1b	264	19	CTD	20.05.10	10:40:00	BO	35°33.752	N	010°40.488	W	2053
Pos399/1b	264	19	CTD	20.05.10	11:08:00	EN	35°33.984	N	010°39.907	W	
Pos399/1b	264	20	CTD	20.05.10	11:09:00	BE	35°33.995	N	010°39.882	W	
Pos399/1b	264	20	CTD	20.05.10	11:37:00	BO	35°34.027	N	010°39.114	W	1716
Pos399/1b	264	20	CTD	20.05.10	12:00:00	EN	35°34.142	N	010°38.598	W	
Pos399/1b	264	21	CTD	20.05.10	12:01:00	BE	35°34.153	N	010°38.562	W	
Pos399/1b	264	21	CTD	20.05.10	12:27:00	BO	35°34.132	N	010°37.850	W	1717
Pos399/1b	264	21	CTD	20.05.10	12:45:00	EN	35°34.133	N	010°37.406	W	
Pos399/1b	264	22	CTD	20.05.10	12:46:00	BE	35°34.132	N	010°37.367	W	
Pos399/1b	264	22	CTD	20.05.10	13:06:00	BO	35°34.109	N	010°36.826	W	1718
Pos399/1b	264	22	CTD	20.05.10	13:24:00	EN	35°34.074	N	010°36.456	W	
Pos399/1b	264	23	CTD	20.05.10	13:25:00	BE	35°34.073	N	010°36.432	W	

Pos399/1b	264	23	CTD	20.05.10	13:47:00	BO	35°34.012	N	010°35.914	W		1716	
Pos399/1b	264	23	CTD	20.05.10	14:09:00	EN	35°34.000	N	010°35.412	W			
Pos399/1b	264	24	CTD	20.05.10	14:17:00	BE	35°34.004	N	010°35.363	W			
Pos399/1b	264	24	CTD	20.05.10	14:50:00	BO	35°33.966	N	010°34.716	W		2073	
Pos399/1b	264	24	CTD	20.05.10	15:13:00	EN	35°33.954	N	010°34.114	W			
Pos399/1b	264	25	CTD	20.05.10	15:14:00	BE	35°33.954	N	010°34.109	W			
Pos399/1b	264	25	CTD	20.05.10	15:38:00	BO	35°33.930	N	010°33.474	W		1739	
Pos399/1b	264	25	CTD	20.05.10	16:06:00	EN	35°33.890	N	010°32.904	W			
Pos399/1b	265	1	CTD	20.05.10	19:49:00	BE	35°40.002	N	011°05.982	W	4822		
Pos399/1b	265	1	CTD	20.05.10	20:23:00	BO	35°39.998	N	011°05.731	W	4822	2073	
Pos399/1b	265	1	CTD	20.05.10	20:55:00	EN	35°39.978	N	011°05.491	W	4823		
Pos399/1b	266	1	CTD	20.05.10	22:32:00	BE	35°40.008	N	011°17.928	W	4818		
Pos399/1b	266	1	CTD	20.05.10	22:04:00	BO	35°39.990	N	011°17.717	W	4818	2073	
Pos399/1b	266	1	CTD	20.05.10	23:33:00	EN	35°39.893	N	011°17.440	W	4819		
Pos399/1b	267	1	CTD	21.05.10	1:04:00	BE	35°39.978	N	011°29.903	W	4817		
Pos399/1b	267	1	CTD	21.05.10	1:41:00	BO	35°39.814	N	011°29.429	W	4812	2058	
Pos399/1b	267	1	CTD	21.05.10	2:14:00	EN	35°39.631	N	011°28.931	W	4818		
Pos399/1b	268	1	CTD	21.05.10	3:51:00	BE	35°40.000	N	011°41.906	W	4822		
Pos399/1b	268	1	CTD	21.05.10	4:26:00	BO	35°39.943	N	011°41.291	W	4832	2042	
Pos399/1b	268	1	CTD	21.05.10	5:03:00	EN	35°39.838	N	011°40.547	W	4786		
Pos399/1b	269	1	CTD	21.05.10	6:50:00	BE	35°39.962	N	011°53.940	W	4820		
Pos399/1b	269	1	CTD	21.05.10	7:27:00	BO	35°39.796	N	011°53.600	W	4819	2068	
Pos399/1b	269	1	CTD	21.05.10	8:03:00	EN	35°39.630	N	011°53.365	W	4819		
Pos399/1b	270	1	CTD	21.05.10	9:36:00	BE	35°40.034	N	012°06.088	W	4822		
Pos399/1b	270	1	CTD	21.05.10	10:09:00	BO	35°39.947	N	012°05.923	W	4832	2073	
Pos399/1b	270	1	CTD	21.05.10	10:39:00	EN	35°39.853	N	012°05.783	W	4786		
Pos399/1b	271	1	CTD	21.05.10	12:10:00	BE	35°40.051	N	012°17.958	W	4821		
Pos399/1b	271	1	CTD	21.05.10	12:44:00	BO	35°39.958	N	012°17.806	W	4822	2074	
Pos399/1b	271	1	CTD	21.05.10	13:14:00	EN	35°39.870	N	012°17.682	W	4821		
Pos399/1b	272	1	CTD	21.05.10	14:48:00	BE	35°39.982	N	012°29.970	W	4821		
Pos399/1b	272	1	CTD	21.05.10	15:22:00	BO	35°39.814	N	012°29.598	W	4821	2051	
Pos399/1b	272	1	CTD	21.05.10	15:57:00	EN	35°39.816	N	012°29.096	W	4824		
Pos399/1b	273	1	CTD	21.05.10	17:39:00	BE	35°40.022	N	012°41.933	W	4820		
Pos399/1b	273	1	CTD	21.05.10	18:14:00	BO	35°39.936	N	012°41.425	W	4821	2042	
Pos399/1b	273	1	CTD	21.05.10	18:45:00	EN	35°39.838	N	012°41.058	W	4822		
Pos399/1b	274	1	CTD	21.05.10	20:21:00	BE	35°29.968	N	012°44.940	W	4295		
Pos399/1b	274	1	CTD	21.05.10	20:46:00	BO	35°29.798	N	012°44.838	W	4240	2061	
Pos399/1b	274	1	CTD	21.05.10	21:09:00	EN	35°29.680	N	012°44.722	W	4240		
Pos399/1b	275	1	CTD	21.05.10	21:59:00	BE	35°24.992	N	012°46.420	W	4002		
Pos399/1b	275	1	CTD	21.05.10	22:30:00	BO	35°24.806	N	012°46.003	W	4015	2043	
Pos399/1b	275	1	CTD	21.05.10	22:58:00	EN	35°24.534	N	012°45.689	W	4008		
Pos399/1b	276	1	CTD	21.05.10	23:48:00	BE	35°19.950	N	012°47.980	W	3301		
Pos399/1b	276	1	CTD	21.05.10	0:21:00	BO	35°19.588	N	012°47.412	W	3273	1975	
Pos399/1b	276	1	CTD	21.05.10	0:50:00	EN	35°19.252	N	012°47.000	W	3245		
Pos399/1b	277	1	CTD	22.05.10	1:40:00	BE	35°14.989	N	012°49.528	W	2780		
Pos399/1b	277	1	CTD	22.05.10	2:11:00	BO	35°14.783	N	012°49.028	W	2865	2036	
Pos399/1b	277	1	CTD	22.05.10	2:42:00	EN	35°14.473	N	012°48.606	W	3019		
Pos399/1b	278	1	CTD	22.05.10	3:36:00	BE	35°09.947	N	012°50.880	W	2542		
Pos399/1b	278	1	CTD	22.05.10	4:11:00	BO	35°09.598	N	012°50.184	W	2490	1980	
Pos399/1b	278	1	CTD	22.05.10	4:43:00	EN	35°09.234	N	012°49.530	W	2409		
Pos399/1b	279	1	CTD	22.05.10	5:45:00	BE	35°04.964	N	012°52.381	W	897		
Pos399/1b	279	1	CTD	22.05.10	6:06:00	BO	35°04.937	N	012°52.098	W	1039	994	
Pos399/1b	279	1	CTD	22.05.10	6:27:00	EN	35°05.004	N	012°51.989	W	1079		
Pos399/1b	280	1	CTD	22.05.10	7:09:00	BE	35°02.975	N	012°53.052	W	98		
Pos399/1b	280	1	CTD	22.05.10	7:13:00	BO	35°02.953	N	012°53.052	W	98	95	8

Pos399/1b	280	1	CTD	22.05.10	7:16:00	EN	35°02.954	N	012°53.066	W	98		
Pos399/1b	281	1	CTD	22.05.10	8:01:00	BE	34°59.960	N	012°54.007	W	1861		
Pos399/1b	281	1	CTD	22.05.10	8:28:00	BO	34°59.898	N	012°54.066	W	1881	1620	
Pos399/1b	281	1	CTD	22.05.10	8:49:00	EN	34°59.832	N	012°54.052	W	1934		
Pos399/1b	282	1	CTD	22.05.10	9:38:00	BE	34°54.977	N	012°55.530	W	3527		
Pos399/1b	282	1	CTD	22.05.10	10:04:00	BO	34°54.894	N	012°55.546	W	3543	2077	
Pos399/1b	282	1	CTD	22.05.10	10:26:00	EN	34°54.822	N	012°55.591	W	3553		
Pos399/1b	283	1	CTD	22.05.10	11:20:00	BE	34°50.004	N	012°56.965	W	4173		
Pos399/1b	283	1	CTD	22.05.10	11:52:00	BO	34°50.018	N	012°56.947	W	4176	2079	
Pos399/1b	283	1	CTD	22.05.10	12:12:00	EN	34°50.006	N	012°56.994	W	4168		
Pos399/1b	284	1	CTD	22.05.10	13:03:00	BE	34°44.978	N	012°58.512	W	4406		
Pos399/1b	284	1	CTD	22.05.10	13:32:00	BO	34°44.966	N	012°58.470	W	4405	2080	
Pos399/1b	284	1	CTD	22.05.10	13:53:00	EN	34°44.981	N	012°58.458	W	4404		
Pos399/1b	285	1	CTD	22.05.10	14:42:00	BE	34°40.001	N	013°00.026	W	4407		
Pos399/1b	285	1	CTD	22.05.10	15:18:00	BO	34°40.073	N	013°00.112	W	4413	2082	
Pos399/1b	285	1	CTD	22.05.10	15:52:00	EN	34°40.126	N	013°00.143	W	4417		
Pos399/1b	286	1	CTD	22.05.10	17:24:00	BE	34°29.986	N	013°03.001	W	4407		
Pos399/1b	286	1	CTD	22.05.10	18:00:00	BO	34°30.090	N	013°02.970	W	4409	2077	
Pos399/1b	286	1	CTD	22.05.10	18:30:00	EN	34°30.137	N	013°02.866	W	4408		
Pos399/1b	287	1	CTD	22.05.10	21:03:00	BE	34°19.990	N	013°06.008	W	4408		
Pos399/1b	287	1	CTD	22.05.10	21:32:00	BO	34°19.979	N	013°05.965	W	4409	2075	
Pos399/1b	287	1	CTD	22.05.10	21:57:00	EN	34°20.016	N	013°05.926	W	4441		
Pos399/1b	288	1	CTD	22.05.10	23:31:00	BE	34°09.996	N	013°09.014	W	4406		
Pos399/1b	288	1	CTD	23.05.10	0:02:00	BO	34°09.988	N	013°09.014	W	4406	2078	
Pos399/1b	288	1	CTD	23.05.10	0:20:00	EN	34°10.048	N	013°09.006	W	4406		
Pos399/1b	289	1	CTD	23.05.10	1:44:00	BE	33°59.981	N	013°12.014	W	4406		
Pos399/1b	289	1	CTD	23.05.10	2:14:00	BO	33°59.981	N	013°12.005	W	4407	2078	
Pos399/1b	289	1	CTD	23.05.10	2:37:00	EN	34°00.022	N	013°12.013	W	4406		
Pos399/1b	290	1	CTD	23.05.10	4:02:00	BE	33°49.986	N	013°15.037	W	4407		
Pos399/1b	290	1	CTD	23.05.10	4:32:00	BO	33°50.101	N	013°15.042	W	4413	2080	
Pos399/1b	290	1	CTD	23.05.10	4:58:00	EN	33°50.211	N	013°15.054	W	4405		
Pos399/1b	291	1	CTD	23.05.10	6:24:00	BE	33°50.033	N	013°27.016	W	4411		
Pos399/1b	291	1	CTD	23.05.10	6:59:00	BO	33°50.154	N	013°27.082	W	4411	2051	
Pos399/1b	291	1	CTD	23.05.10	7:22:00	EN	33°50.254	N	013°27.109	W	4413		
Pos399/1b	292	1	CTD	23.05.10	8:46:00	BE	33°49.990	N	013°39.028	W	4412		
Pos399/1b	292	1	CTD	23.05.10	9:18:00	BO	33°49.996	N	013°38.993	W	4429	2076	
Pos399/1b	292	1	CTD	23.05.10	9:38:00	EN	33°49.999	N	013°38.996	W	4413		
Pos399/1b	293	1	CTD	23.05.10	10:57:00	BE	33°50.004	N	013°51.018	W	4414		
Pos399/1b	293	1	CTD	23.05.10	11:25:00	BO	33°49.984	N	013°51.066	W	4413	2077	
Pos399/1b	293	1	CTD	23.05.10	11:46:00	EN	33°49.958	N	013°51.052	W	4414		
Pos399/1b	294	1	CTD	23.05.10	12:31:00	BE	33°49.996	N	013°56.994	W	4412		
Pos399/1b	294	1	CTD	23.05.10	13:04:00	BO	33°49.974	N	013°57.018	W	4412	2078	
Pos399/1b	294	1	CTD	23.05.10	13:28:00	EN	33°49.991	N	013°56.976	W	4412		
Pos399/1b	295	1	CTD	23.05.10	14:12:00	BE	33°49.986	N	014°03.010	W	3760		
Pos399/1b	295	1	CTD	23.05.10	14:46:00	BO	33°50.011	N	014°02.940	W	3749	2079	
Pos399/1b	295	1	CTD	23.05.10	15:18:00	EN	33°50.045	N	014°02.987	W	3756		
Pos399/1b	296	1	CTD	23.05.10	16:10:00	BE	33°49.992	N	014°09.010	W	3472		
Pos399/1b	296	1	CTD	23.05.10	16:46:00	BO	33°50.039	N	014°08.976	W	3454	2080	
Pos399/1b	296	1	CTD	23.05.10	17:16:00	EN	33°50.040	N	014°08.995	W	3455		
Pos399/1b	297	1	CTD	23.05.10	18:09:00	BE	33°49.997	N	014°15.012	W	2553		
Pos399/1b	297	1	CTD	23.05.10	18:43:00	BO	33°50.045	N	014°14.952	W	2617	2080	
Pos399/1b	297	1	CTD	23.05.10	19:05:00	EN	33°50.022	N	014°14.938	W	2699		
Pos399/1b	298	1	CTD	23.05.10	20:02:00	BE	33°49.991	N	014°20.993	W	218		
Pos399/1b	298	1	CTD	23.05.10	20:08:00	BO	33°49.988	N	014°20.966	W	218	217	10
Pos399/1b	298	1	CTD	23.05.10	20:12:00	EN	33°49.988	N	014°20.966	W	217		

Pos399/1b	299	1	CTD	23.05.10	21:07:00	BE	33°49.993	N	014°26.982	W	2225	
Pos399/1b	299	1	CTD	23.05.10	21:39:00	BO	33°50.004	N	014°26.948	W	2214	2075
Pos399/1b	299	1	CTD	23.05.10	22:03:00	EN	33°49.991	N	014°26.894	W	2140	
Pos399/1b	300	1	CTD	23.05.10	22:55:00	BE	33°50.006	N	014°32.984	W	3650	
Pos399/1b	300	1	CTD	23.05.10	23:27:00	BO	33°49.991	N	014°32.972	W	3673	2076
Pos399/1b	300	1	CTD	23.05.10	23:46:00	EN	33°50.017	N	014°33.001	W	3666	
Pos399/1b	301	1	CTD	24.05.10	0:45:00	BE	33°49.990	N	014°38.989	W	4011	
Pos399/1b	301	1	CTD	24.05.10	1:24:00	BO	33°50.004	N	014°39.043	W	4012	2076
Pos399/1b	301	1	CTD	24.05.10	1:51:00	EN	33°50.044	N	014°38.999	W	4013	
Pos399/1b	302	1	CTD	24.05.10	2:55:00	BE	33°49.994	N	014°44.975	W	4042	
Pos399/1b	302	1	CTD	24.05.10	3:27:00	BO	33°50.002	N	014°44.938	W	4052	2076
Pos399/1b	302	1	CTD	24.05.10	3:51:00	EN	33°50.011	N	014°44.980	W	4037	
Pos399/1b	303	1	CTD	24.05.10	4:59:00	BE	33°50.000	N	014°50.994	W	4049	
Pos399/1b	303	1	CTD	24.05.10	5:26:00	BO	33°49.984	N	014°51.014	W	4048	2079
Pos399/1b	303	1	CTD	24.05.10	5:50:00	EN	33°50.004	N	014°50.956	W	4049	
Pos399/1b	304	1	CTD	24.05.10	7:45:00	BE	33°49.968	N	015°03.012	W	3993	
Pos399/1b	304	1	CTD	24.05.10	8:17:00	BO	33°49.968	N	015°03.035	W	3993	2076
Pos399/1b	304	1	CTD	24.05.10	8:44:00	EN	33°49.980	N	015°03.007	W	3987	

POSEIDON CRUISE 399/1

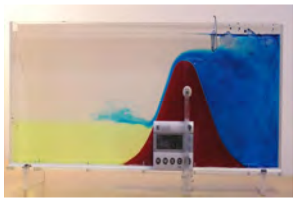
Cruise Objectives and Work done

Dagmar Hainbucher & Detlef Quadfasel
University of Hamburg

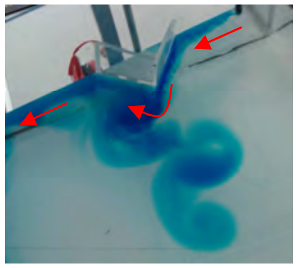
Objectives

Cooling and evaporation creates dense deep water in the European Mediterranean. Part of this dense water exits into the North Atlantic via the Strait of Gibraltar and sinks down the continental slope to depths between 600 and 1500 m. Strong mixing with ambient takes place during this descent, reducing the temperature, salinity and density contrast of the sinking plume. Part of this 'Mediterranean Water' flows north as a deep boundary current, part of it is transferred into the interior Atlantic by ways of meso-scale salt lenses (MEDDIES). During RV POSEIDON cruise P399 -1 we studied the Portuguese Undercurrent, the structure and dynamics of the Meddies and their decay by smaller scale processes and their interaction with seamounts. The cruise was part of the student education programme of the KlimaCampus at the University of Hamburg.

Laboratory tank experiments can be used to illustrate and study the dynamics of fluids.



Dense water (blue) spills over the shallow sill separating two basins. The sinking stops, when the depth level corresponding to the plume's density is reached.

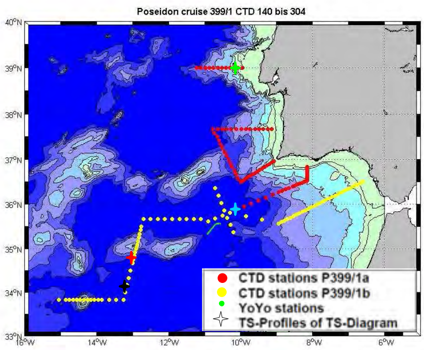


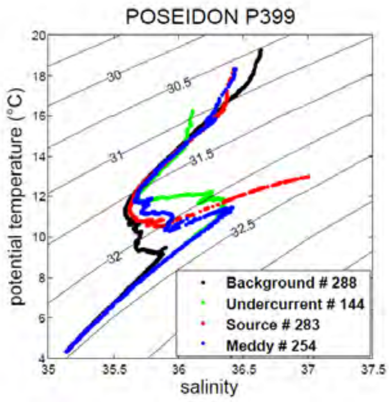
A buoyancy driven boundary current sheds eddies into the interior basin when encountering a topographic obstacle.

Work Done

The crew: 16 Scientists and students from Hamburg and Paris took part in the two legs of the cruise.

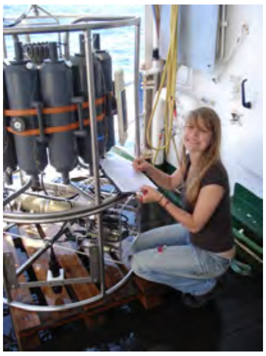
Location of hydrographic stations during the cruise. Also underway measurements of currents, surface temperature and salinity and meteorological parameters were taken.



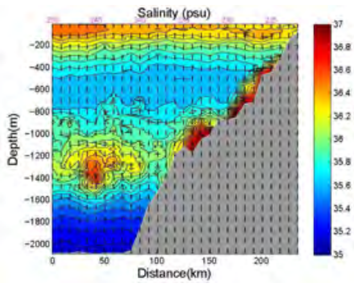


A temperature – salinity diagram shows the spreading and mixing of the Mediterranean water in the North Atlantic.

Taking water samples and reading reversing thermometers for the calibration of the Conductivity-Temperature-Depth sonde (CTD) must be fun.



Safety exercises



Vertical distribution of salinity along the southern section in the Gulf of Cadiz, showing the high salinity plume on the continental slope and an isolated salt lens or Meddy.

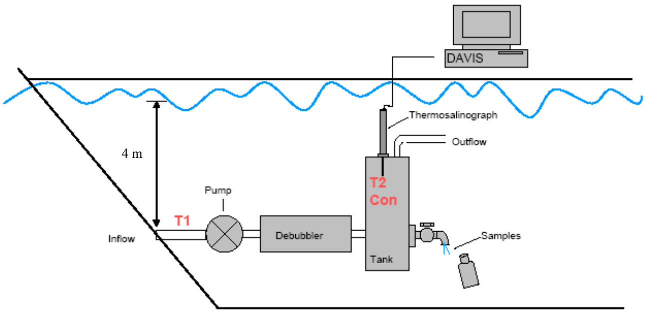
POSEIDON CRUISE P399/1

Thermosalinograph Calibration

Vasco Müller, University of Hamburg
Anthony Bosse, ENS Cachan/UPMC

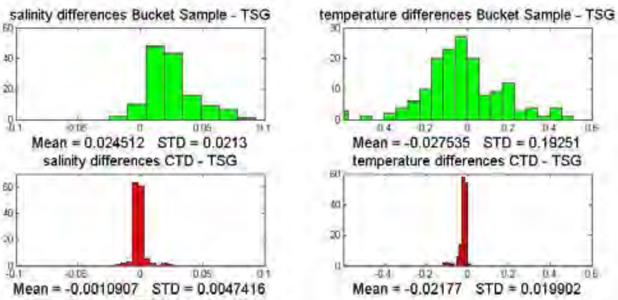
What is a Thermosalinograph?

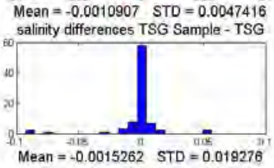
The thermosalinograph (TSG) is used to measure sea surface temperature and salinity. In order to check if the collected data are correct, it has to be calibrated with bucket samples, with TSG Samples and with data at 7 meters from the „Conductivity, Temperature and Depth“ sonde (CTD).



Statistics

Dispersion of the differences between Bucket Samples / CTD / TSG Samples and TSG data

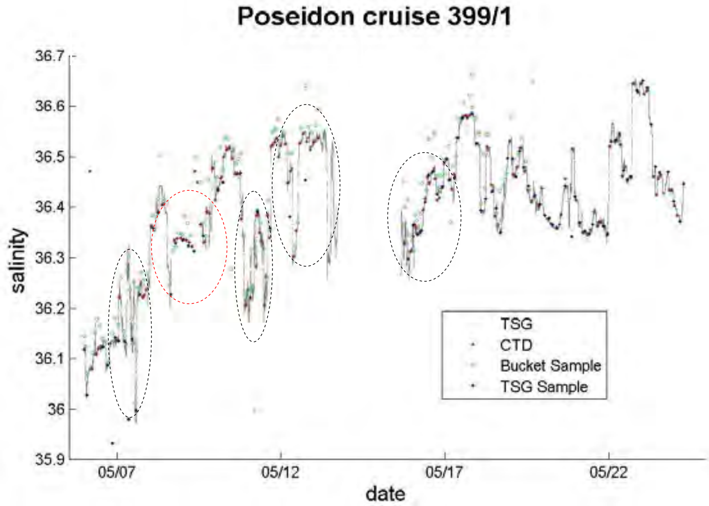




CTD and TSG measurements correspond very well and much better than the bucket sample data.

Hence we decided not to take bucket samples anymore. We have more CTD data then TSG samples and therefore a much better statistic. So we decided to calibrate the TSG with CTD data.

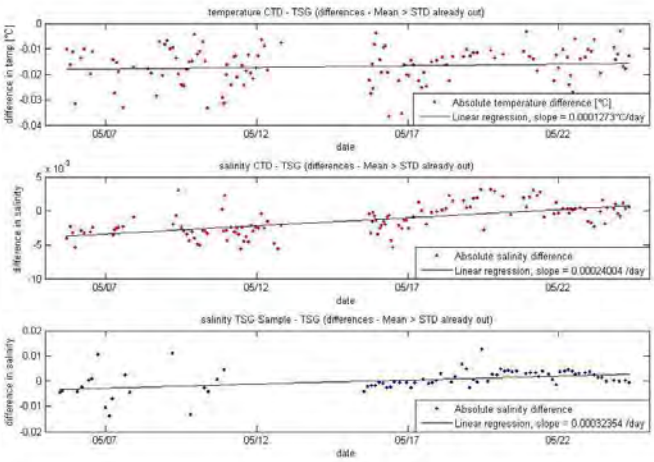
Time series of surface salinity



: strong small scale fluctuations in temperature (not shown) and salinity in areas close to the coast.

: salinity out of range because of conductivity probe contamination.

Linear trend of the difference between TSG and CTD data and TSG samples and TSG data



The trend in temperature difference (+0,004°C/month) is neglectable in comparison with the mean value (-0,022°C) and the STD (0,020°C).

The trend in salinity difference (+0,007/month) is significant compared to the STD (0,005) and the mean value (–0,001). This trend is confirmed by the TSG Samples (+0.010/ month). So the TSG should probably be cleaned every month in order to keep the quality of the measurement.

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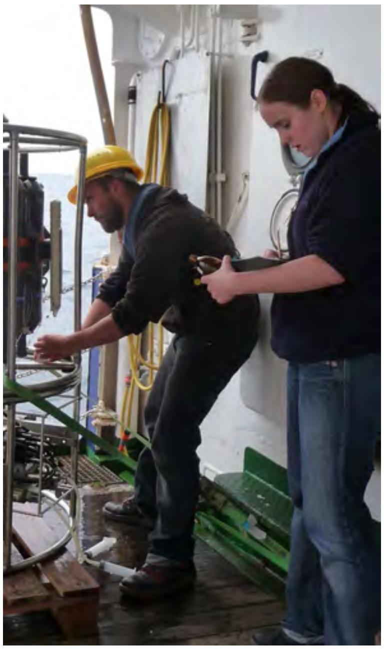
POSEIDON CRUISE 399/1

CTD Calibration

Antje Mueller-Michaelis & Andreas Welsch
University of Hamburg



Taking water samples from the rosette

CTD

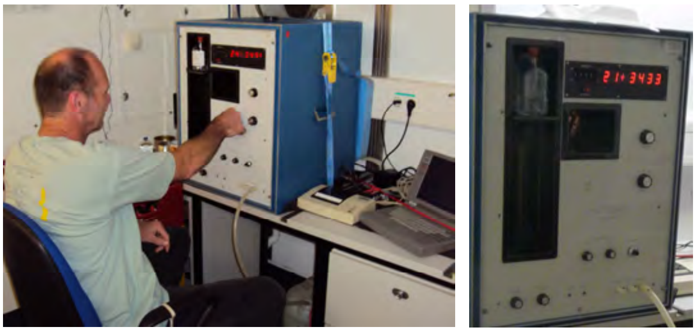
The Conductivity-Temperature-Depth (CTD) probe was the main instrument for our measurements during P399/1, where more than 160 CTD stations were realized.

The CTD sonde is attached to a rosette with watersamplers, reversing thermometers and reversing pressure measures. During the down- and upcasts the sonde measures depth profiles of temperature, conductivity, pressure and oxygen. The conductivity is used to calculate the salinity.

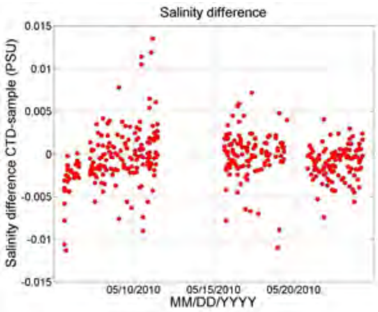
The reversing thermometers and pressure measures provide reference temperature and pressure. Additionally, the rosette is stopped at several depths, where water samples are taken. These are afterwards analyzed to determine the salinity and the oxygen content. This is to detect and – if necessary - correct sensor offsets or sensor drifts of the CTD sonde.

Chemical reagents have to be added carefully to the oxygen water samples

Salinometer

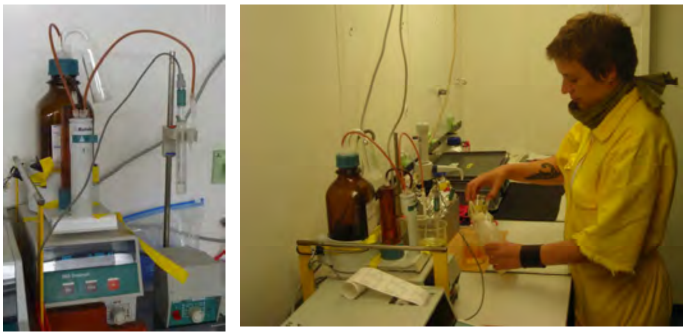


The salinity of the water samples is determined by means of a Salinometer (Guidline Autosal Model 8400A)

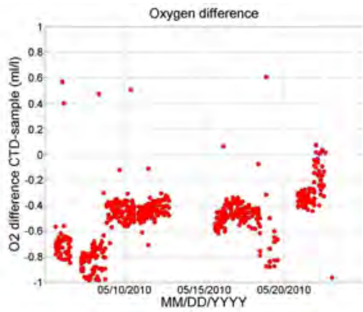


The salinity measured by the sensor of the CTD and the salinometer agree well.

Oxygen Titration



The previously prepared water samples pass through the chemical process of titration to determine the content of oxygen (Metrohm 686 Titroprocessor / Metrohm 665 Dosimat)



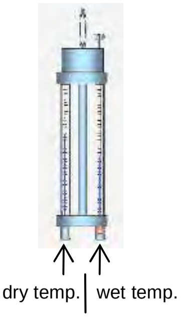
The oxygen titration revealed a sensor offset of about -0.5 ml/l. The variation is presumably due to usage of an old pipette. This will be corrected to determine the definite CTD sensor offset.

POSEIDON CRUISE 399/1 Meteorological measurements and calibration

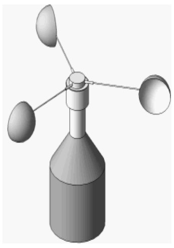
Marius Kriegerowski & Hannah Teuteberg, University of Hamburg

Used measuring instruments

Psychrometer:



Anemometer:

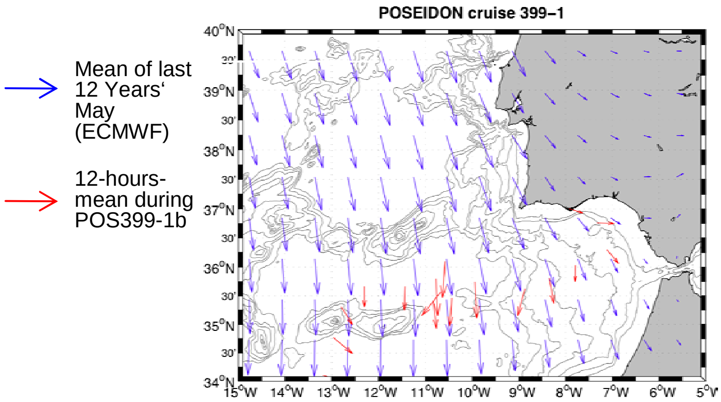


A psychrometer was used to determine the relative humidity. It consists of two thermometers; one includes a dry bulb and the other one a bulb that is kept wet to measure the wet temperature.

We used an anemometer to measure wind speed. It consists of three small cups that are mounted on horizontal arms at a vertical axis.

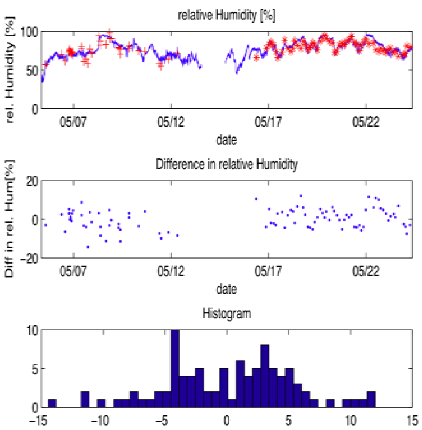
The winddirection was gauged with the assistance of a manual compass.

Comparing wind direction



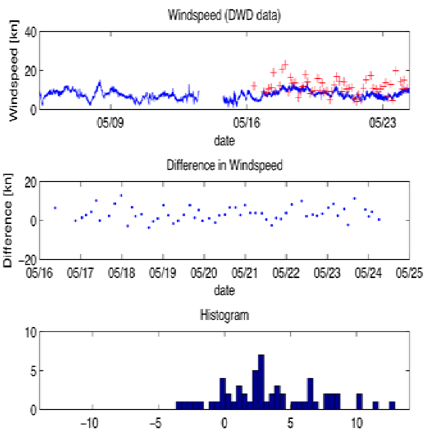
In the research area of POS399-1b,the Azores High is the most influential factor affecting on the winddirection, causing a north-west dominated wind.
This corresponds to the measurements of the meteorological system, mounted aboard.

Humidity



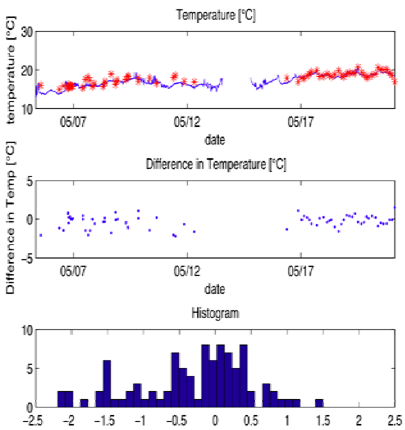
Mean= 0.14, Std= 5.26

Windspeed



Mean= 3.45, Std= 3.68

Temperature



Mean=-0.29, Std=0.79

We compared our meteorological measurements to those which we received from the onboard weatherstation to calibrate the latter. The large differences in each of the compared datasets and the strong scattering, which is apparent from the histogram, implies that either our measurements or the datavis measurements contain defects. Thus it is hardly possible to determine an offset of the datavis data.
Especially the measured windspeed, which is sometimes twice as big as the datavis windspeed implies a systematic mistake deriving from handling the anemometer erroniously.

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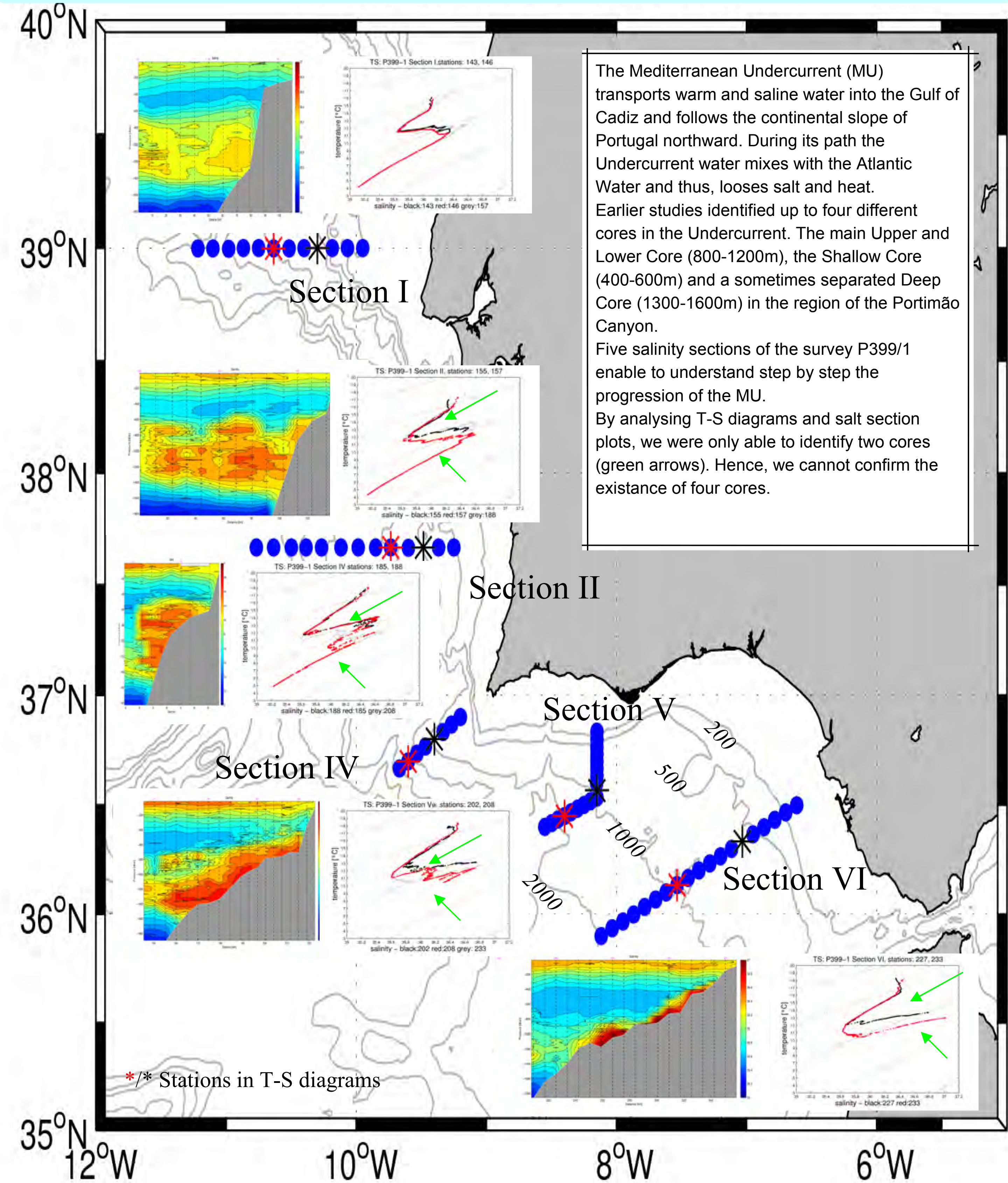
POSEIDON CRUISE 399/1

Cores of the Undercurrent

Nele Tim, Leonie Esters, Florian Sprung
University of Hamburg



The Mediterranean Undercurrent (MU) transports warm and saline water into the Gulf of Cadiz and follows the continental slope of Portugal northward. During its path the Undercurrent water mixes with the Atlantic Water and thus, looses salt and heat.

Earlier studies identified up to four different cores in the Undercurrent. The main Upper and Lower Core (800-1200m), the Shallow Core (400-600m) and a sometimes separated Deep Core (1300-1600m) in the region of the Portimão Canyon.

Five salinity sections of the survey P399/1 enable to understand step by step the progression of the MU.

By analysing T-S diagrams and salt section plots, we were only able to identify two cores (green arrows). Hence, we cannot confirm the existance of four cores.

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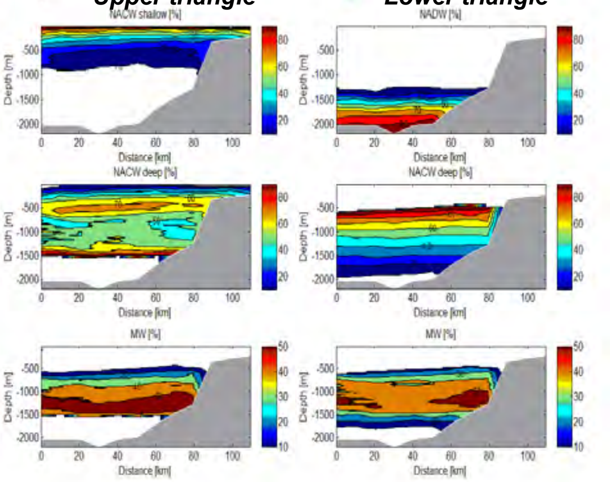
POSEIDON CRUISE 399/1

Analysis of water masses

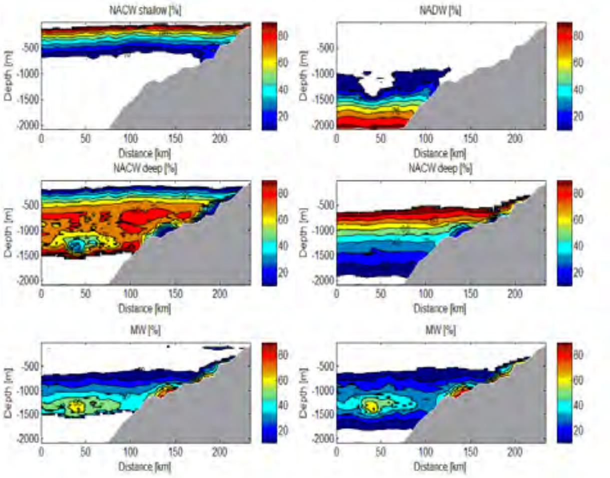
Leonie Esters & Nikolaus Koopmann
University of Hamburg

P399-1
Section VI & I
Upper triangle

P399-1
Section VI & I
Lower triangle



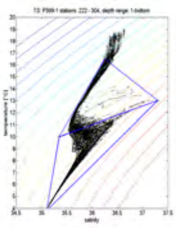
Section I - upper and lower triangle



Section – upper and lower triangle

The plots show the calculated fractions of each of the three assumed source water types, interpolated over one entire CTD-section.

P399-1
Stations 222-304



The plot is a T-S-diagram of all stations with blue triangles of water mixture.

Water-mass-analysis

Water-mass-analysis is a method to investigate the composition of the water body in the area of interest. It is hypothesized that the relevant water is simply a linear mixture of three or more water masses. Once the relation between temperature and salinity has been visualized via a TS-diagram, it becomes possible to connect points, representing the assumed source water types, to form a triangle. All data within this triangle can be regarded as a mixture of the three waters and the quantitative fractions can be calculated.

The math behind this is simply a system of linear equations:

$$x_1 + x_2 + x_3 = 1$$
$$T_1x_1 + T_2x_2 + T_3x_3 = T_{observed}$$
$$S_1x_1 + S_2x_2 + S_3x_3 = S_{observed}$$

This system can be extended to an arbitrary number of tracers. The first equation represents the law of conservation of mass.

Definitions

water mass: a body of water with specific physical properties.

water type: point in a T-S-diagram

source water type: water mass definition points

tracer:different parameters in the ocean to track water masses, for example temperature, salinity and FCKW.

North Atlantic Deep Water

The NADW is a cold, high density bottom water with its origin in the Labrador and Greenland Sea. It spreads over the entire topography of the North Atlantic.

Mediterranean Water

The MW is formed in the Mediterranean Sea. It is characterized by warm temperatures and high salinities, because of strong evaporation in the source area. The MW reaches the North Atlantic by passing the strait of Gibraltar.

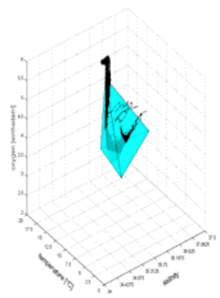
North Atlantic Central Water

The NACW is located at around 200m deph in the North Atlantic Ocean. It is a mixture of waters from different layers with vertical homogeneous water properties.

Our results

The TS-diagram at the top of the poster shows that an assumption of only three source water types (SWT) would not be sufficient. Hence we put great effort into an attempt to expand our model to a third tracer (oxygen), in order to solve for a fourth SWT (plot on the right). This turned out to be unpractical for our analysis, since oxygen values fluctuate strongly even on small scales.
Limited to two dimensions we resolved the problem by sketching out two triangles. The effect is that we get **two** sets of plots, concentrating either on the upper or the lower water column.
The results satisfy our expectations that each SWT has its maximum in the depth literature attributes it to.Sharp maxima of MW can be seen along the undercurrent with values around 80% to the west of the Strait of Gibraltar, extending to our northernmost section with values of still more than 50%. Expectedly locations where meddies were detected, as in section IV, also feature large parts of MW.

P399-1
stations 222-304



By adding a third tracer (oxygen), a TS-diagram becomes a “TSO-diagram“.

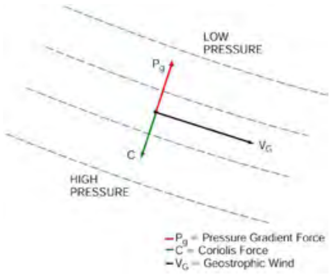
POSEIDON CRUISE 399/1

Geostrophy & Volume Transport

Martin Moritz, Hanna Paulsen, Florian Sprung
University of Hamburg

What is Geostrophy?

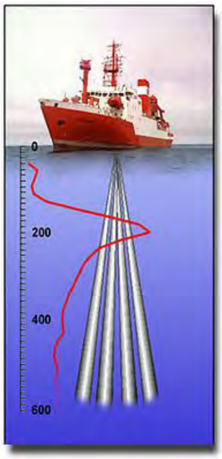
Water moving in the direction of a horizontal pressure gradient is deflected immediately to the right (Northern Hemisphere) or to the left (Southern Hemisphere) by the Corioslis Force. Once these two forces (Coriolis Force - Pressure Gradient Force) are exactly balanced the flow is called geostrophic. Geostrophic currents are characterized by movement along isobars with higher pressure on the right (Northern Hemisphere) or on the left (Southern Hemisphere). As the geostrophic equilibrium neglects frictional effects, it is a good approximation for the inner ocean.



What is a ADCP?

(Acoustic Doppler Current Profiler)

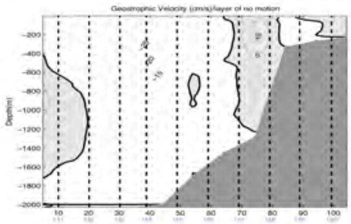
The ADCP is an instrument which uses sound to measure current velocities. It emits sound at a fixed frequency and receives echoes which return from small passively floating particles (for example plankton), which scatter the sound in all directions.
The frequency of the reflected sound is Doppler shifted according to the direction of movement of the scatterers. The current speed can be determined, as it is proportional to the Doppler shift. Depending on frequency an ADCP can meassure up to 800m. In our case we used a 75 kHz ADCP (about 700m). Higher frequencies are of short range but have a higher accuracy.
Our ADCP was fixed on the ship´s hull, so the recorded velocities had to be corrected in order to remove the velocity of the ship from the ADCP data.



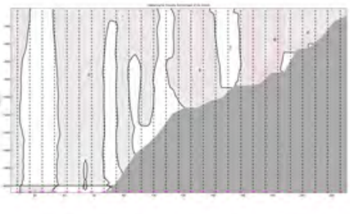
The baroclinic horizontal pressure gradient force is produced by variations in the density field. We calculated this density field with the CTD-data from our cruise. Knowing the coriolis force (dependents on latitude) and the horizontal pressure gradient force, the vertical geostrophic velocity shear flow can be computed. Finally, for calculating the absolute velocitites the shear flow has to be corrected with the ADCP data.

Theoretical geostrophic flow

Using Matlab programs we calculated the geostrophic flow which resulted from the CTD data.



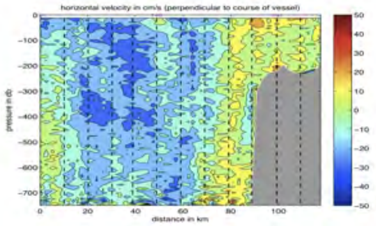
Section 1



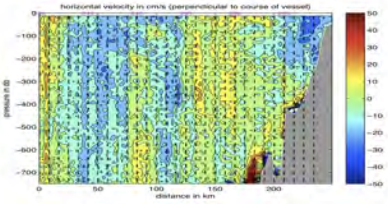
Section 6

ADCP profiles

We received absolute velocities from the ADCP measurements and averaged them between 200 and 500m.



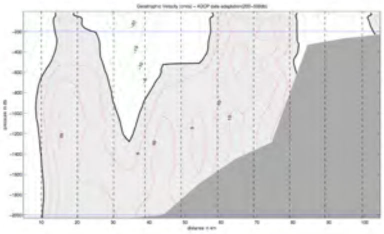
Section 1



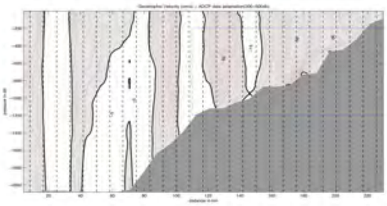
Section 6

Adapted geostrophic flow

Finally we corrected the theoretical flow with the ADCP velocities.



Section 1



Section 6

Volume transport

Using the adapted velocities we calculated the volume transport by integrating over the width and depth (blue box). We computed a transport of 9 Sv (10^6 m³/s) for section 6 and 5 Sv for section 1. The decrease in transport could be explained by the loss of Mediterranean water through detaching Meddies.
The assumption of geostrophy does not consider friction, tides and internal waves.
Therefore, it might be concluded that our results are only an approximation which fails espacially on the shelf.

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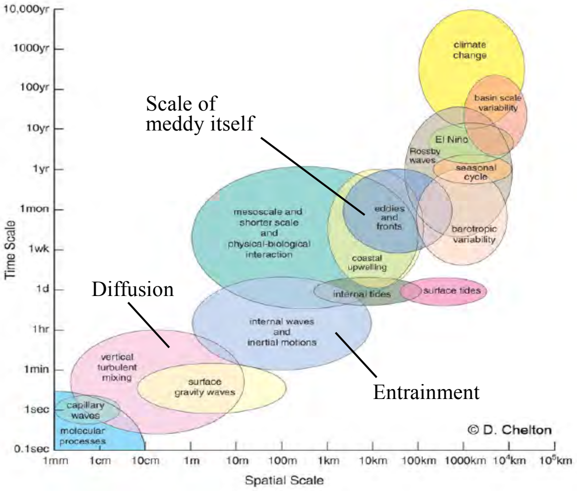
POSEIDON CRUISE P399/1

Resolving Meddy scales

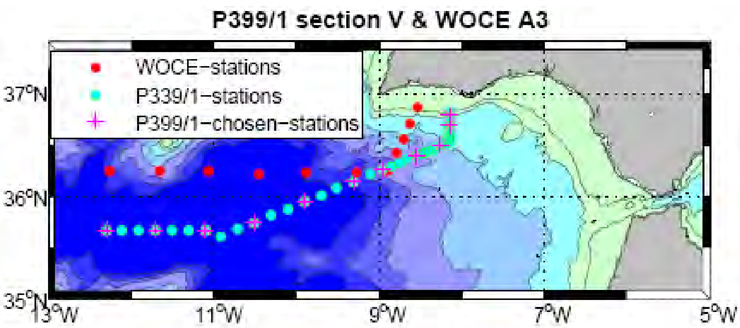
Nele Tim & Florian Sprung
University of Hamburg

Before measuring ocean processes it is necessary to think about the scales of phenomena that will be resolved. Mathematics tells us that we need to sample not less than two points in a period to resolve a signal.
In physical oceanography we distinguish time and spatial scales.

During our survey P399/1 we explored Mediterranean Water Eddies (Meddies) in depths between 500 and 1600m that transport salt into the North Atlantic Ocean.
If there is a poor resolution the complex structure of the Meddy gets easily lost, as you can see on the following three salt sections at the bottom.

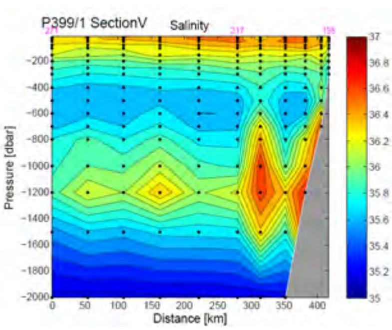


Ocean processes are linked to distinct scale ranges, e. g. Meddies show phenomena from cm to km and from seconds to months.



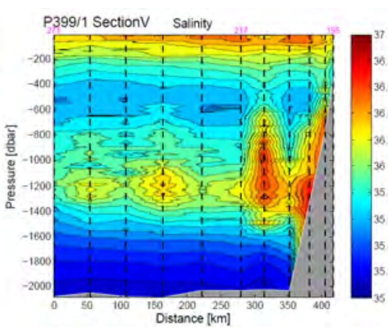
To illustrate the importance of resolution we have compared a section from 1993 done during the World Ocean Circulation Experiment (WOCE) with one of our sections. The profiles were done in 25nm distance and are marked with red dots.
More or less we chose every third station from our data.

Nansen's method with poor vertical and horizontal resolution



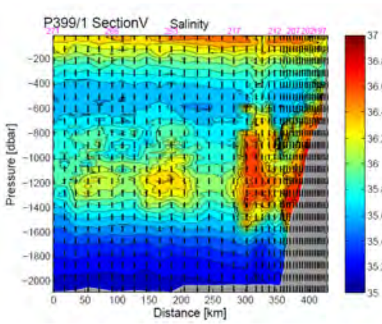
First, we constructed a data set, imagining how Nansen did it 100 years ago. Therefore, we chose the WOCE horizontal resolution and selected only values at the traditional *standard depths*.

WOCE with poor horizontal and high vertical resolution



The results of WOCE might have looked like this: They used Conductivity-Temperature-Depth sondes (CTD) with a good vertical resolution. However, interpolation over 25nm still causes non existant signals that appear to be flat and wide.

P399/1 with high resolution, vertical and horizontal



Finally, our data shows that you need also good horizontal resolution to reveal for example assymmetry. As a result, you can see the Meddy structure more detailed.

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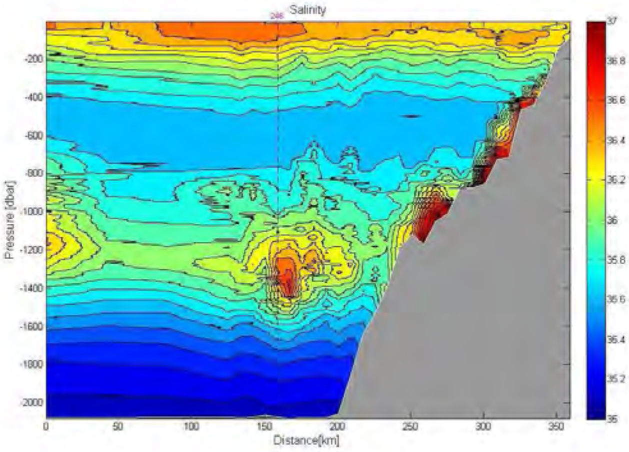
POSEIDON CRUISE 399/1

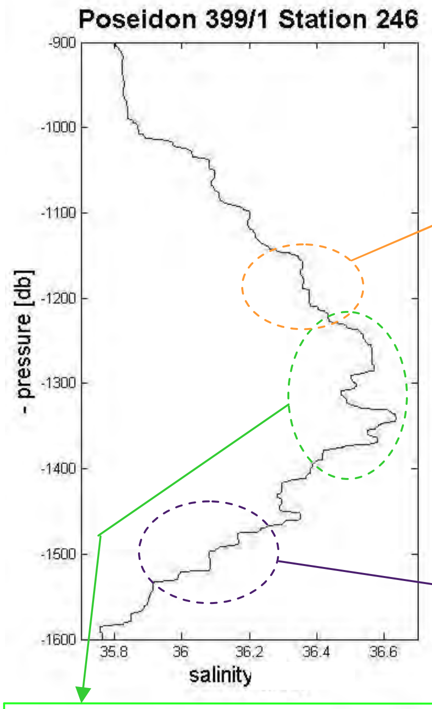
Double Diffusion in Meddies

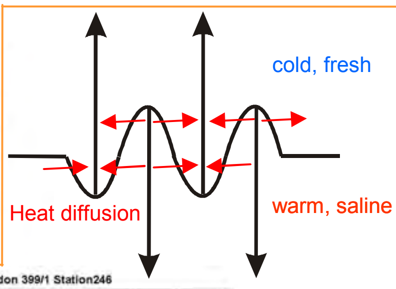
Vasco Müller, University of Hamburg
Anthony Bosse, ENS Cachan/UPMC



Section 6 of the Cruise where a Meddy was found.

The molecular diffusion of temperature is about 100 times faster than diffusion of salinity. This can lead to mixing processes in areas with strong vertical or horizontal gradients. There are three different types of double diffusive ('DD') processes which are described in the following example of a Meddy we found during our cruise.

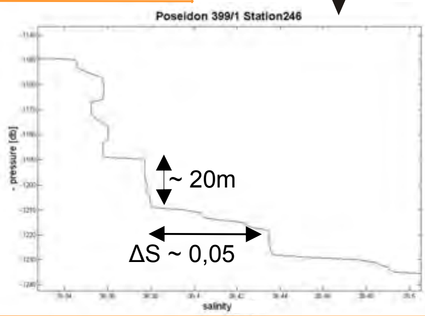


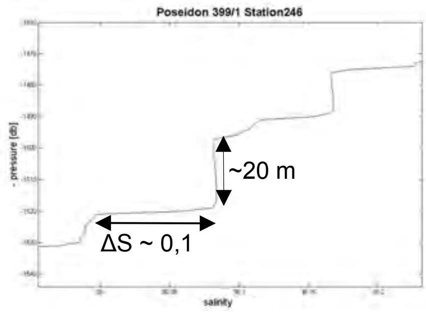


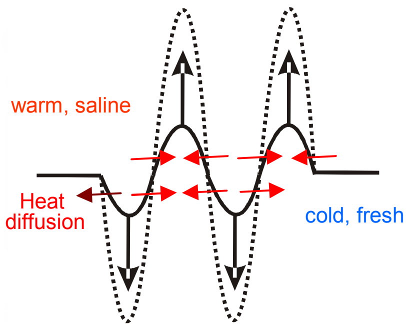
Steps in salinity caused by DD convection

If there is a disturbance of the horizontal boundary between warm, saline water below and colder, fresher water above, heat diffuses horizontally from warm to cold areas (red arrows).

The now cold, saline water sinks due to its increased density and the warm, fresh water rises due to its decreased density (black arrows). This movement results in convection within the two layers, however no water is exchanged across the boundary.





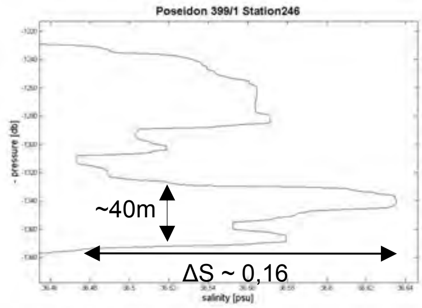


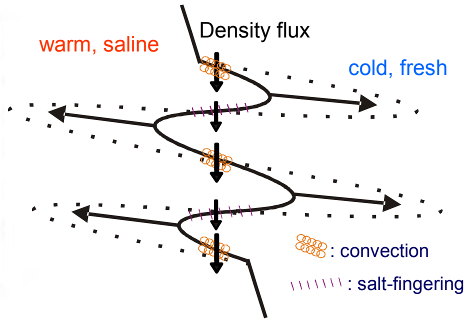
Steps in salinity caused by salt fingers

In this case (warm, saline water above and cold, fresh water below) heat diffuses, resulting in further rising and sinking of the disturbance (black arrows). There is an exchange of water between the two layers in form of so called salt-fingers. This causes mixing of the water and thereby steps in the salinity profile.

Interleaving layers caused by DD intrusions

When a vertical boundary is disturbed, diffusive convection and salt-fingering can occour. When the two phenomena are not equally strong the density of the disturbance changes, leading to a horizontal density gradient. The resulting horizontal advection causes the intrusions to grow to a size with an order of magnitude of km.





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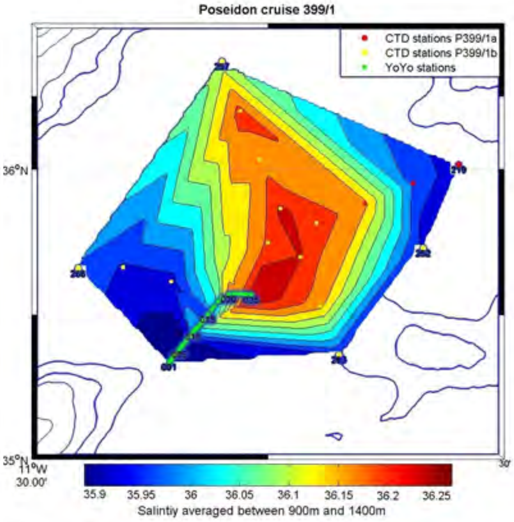
POSEIDON CRUISE 399/1

Interleaving layers in Meddies

Vasco Müller, University of Hamburg
Anthony Bosse, ENS Cachan/UPMC

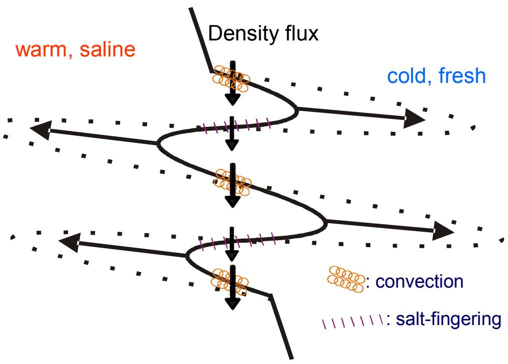
How can we manage to observe interleaving?

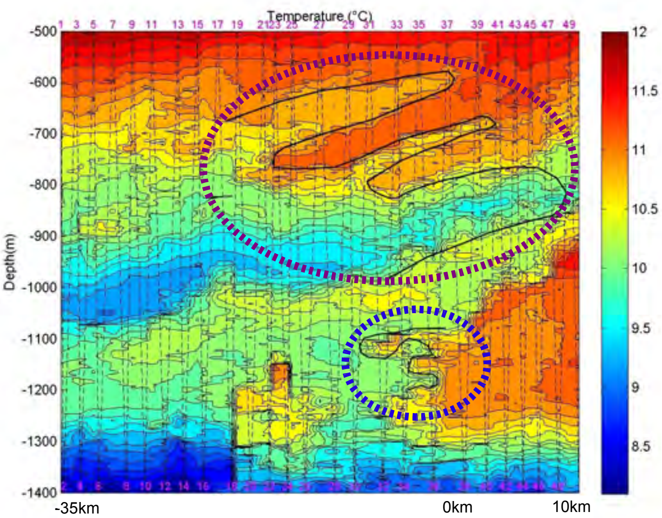
During the cruise we performed horizontal high resolution measurements with the „yoyo" - technique. The CTD was heaved and veered between 400 m and 1700 m, while moving with 1-2 knots. This resulted in a station spacing of less than 1 km and enabled us to see small scale structures like double diffusive (DD) interleaving at the margins of the Meddy with a length scale of order 1 km (see blue circle on figures below).
We also observed larger scale interleaving above the Meddy with a length scale of order 10 km (see magenta circle on figures below).

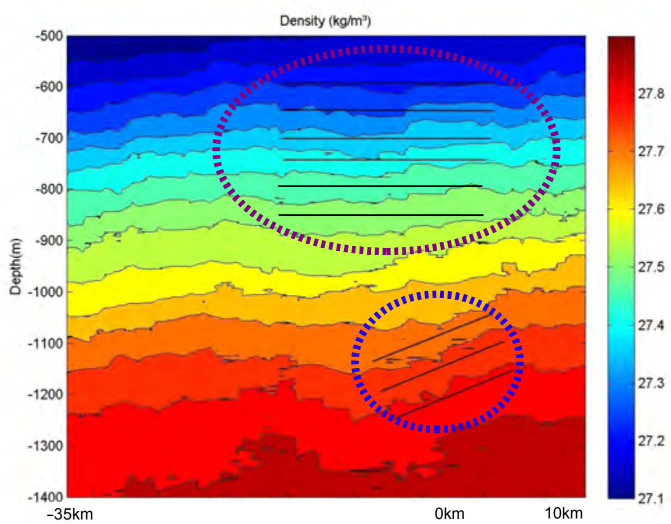


The interleaving process

.
DD-convection can appear where cold, fresh water lies above warm, saline water. In the inverse case (warm, saline above cold, fresh) salt fingers are formed (see poster „Double Diffusion in Meddies").
When a vertical boundary between warm, saline water on one side and colder, fresher water on the other is disturbed, both phenomena can occur and lead to a downward density flux. Usually one of the fluxes is higher than the other resulting in a horizontal density gradient that causes advection and growth of the intrusions.
If the salt-fingering density flux dominates, the warm, saline intrusions become less dense as they extend toward fresher and colder water and slope upward.
If the DD-convection density flux is dominant, the warm, saline intrusions become denser and slope downward into fresher and colder water (like in the scheme).







Isopycnals are horizontal and the warm saline intrusions slope downward into fresher and colder water. It is likely that in this case DD-convection dominates over salt-fingering.

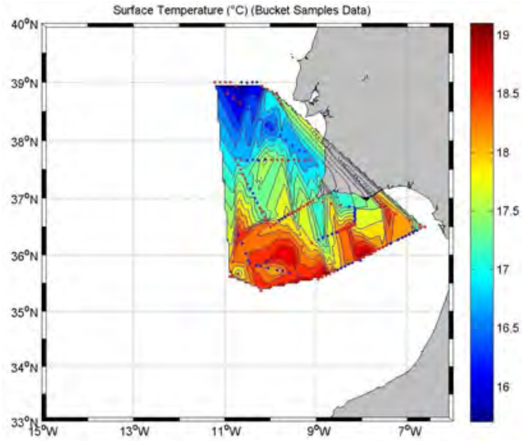
Isopycnals slope upward while the intrusions are horizontal. This means that the warn, saline intrusions become less dense as they move towards colder and fresher water. It is likely that in this case salt-fingering dominates over DD-convection.

POSEIDON CRUISE 399/1

Scale Analysis

Linnea Kemme & Nele Tim, University of Hamburg
Anthony Bosse, ENS Cachan/UPMC

During the cruise sea surface temperature and salinity were measured with a Thermosalinograph (TSG). Data were collected every 10 sec. Here, we took only every 40th value into account in order to avoid a too big data set. Therefore, the mean distance between two data points of the TSG is about 700m. We also collected bucket samples (BS) which give us another set of data, with a mean distance of about 13km.

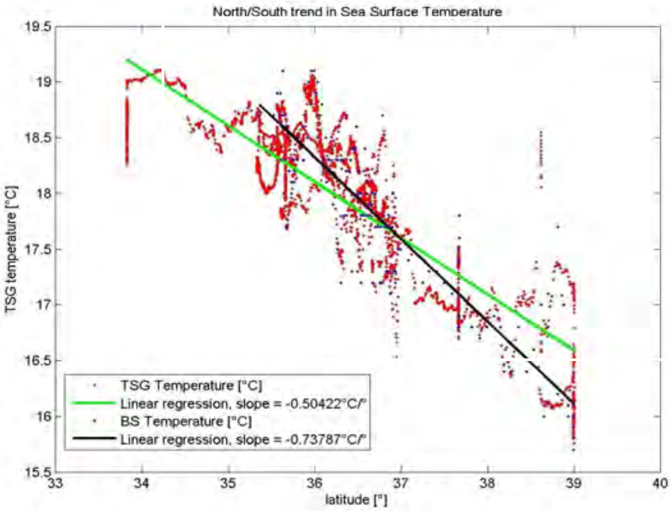


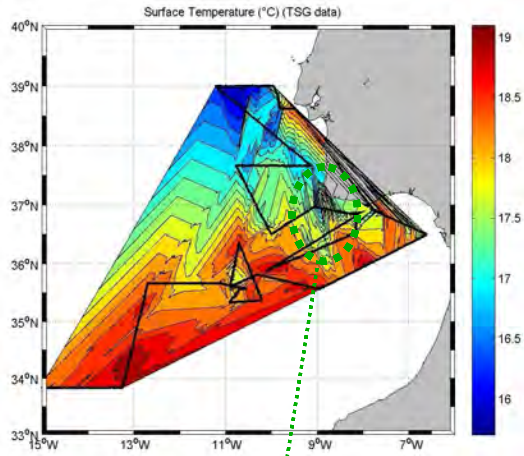
(Warning : Linear-interpolation between distant data points is far from being accurate!)

Large scale analysis

As it can be seen on the sea surface temperature data collected by the TSG, surface temperatures increased as the ship moved southward. This trend is also detectable with the BS data.

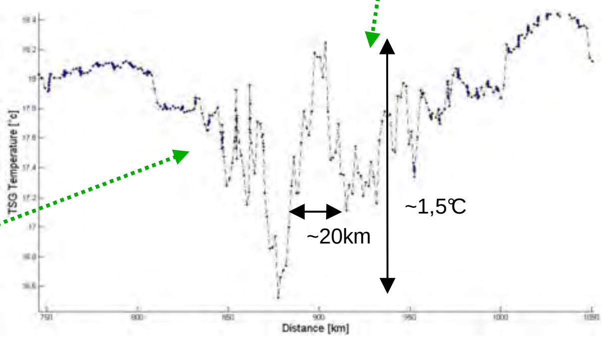
The observed decrease of sea surface temperature of the two data sets, zonally averaged, are in good agreement. [1°N/S = 111km]

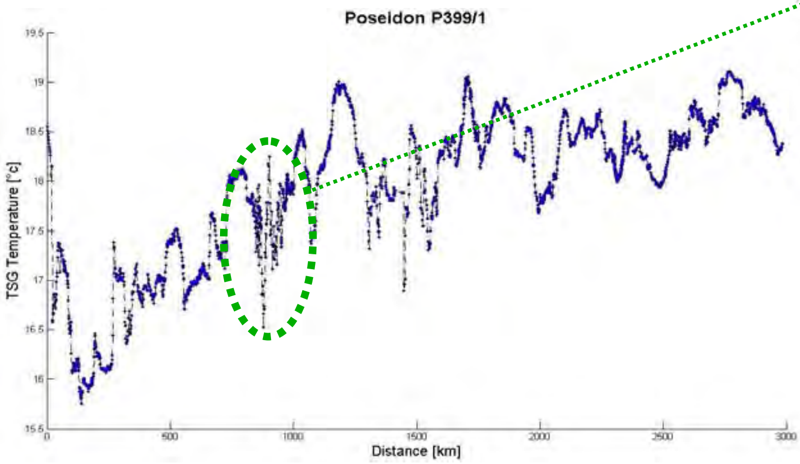




Small scale analysis

Analysis on the small scale shows large variability in temperature off Cape St. Vincent and in coastal areas. These small scale variations (of order 20km) can only be detected in the horizontal highly resolved TSG data.





The variability in surface temperature at the Iberian coastal areas can be the consequence of coastal upwelling and small scale eddies. This phenomenon occurs in coastal areas where the wind blows along the coast line, resulting in an Ekman transport at right angle to the direction of the wind. Thereby cooler and fresher (and nutrient rich) water is brought to the surface.

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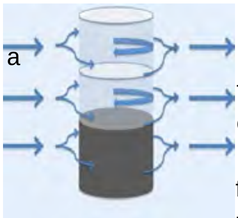
POSEIDON CRUISE 399/1

How to detect Taylor Columns

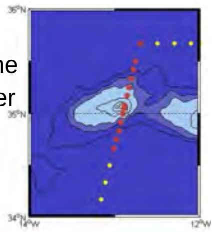
Hannah Teuteberg, Marius Kriegerowski
University of Hamburg

What is a Taylor Column?



The formation of Taylor columns is simple and striking consequence of the Taylor-Proudman theorem. They occure when there is a relative motion between an obstacle and fluid in a rotating system. When the fluid deflects past the obstacle, this deflection proceeds into the fluid above the obstacle and leads to a rotating flow on top of the obstacle.

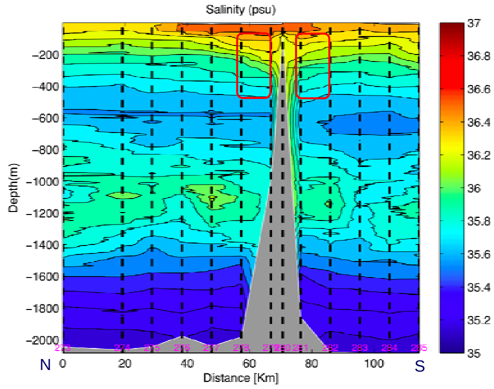
During POSEIDON cruise P399/1b, we crossed two seamounts, of which one is the Ampère Seamount, which we took a closer look at.



Red Dots: CTD Stations 273 – 285

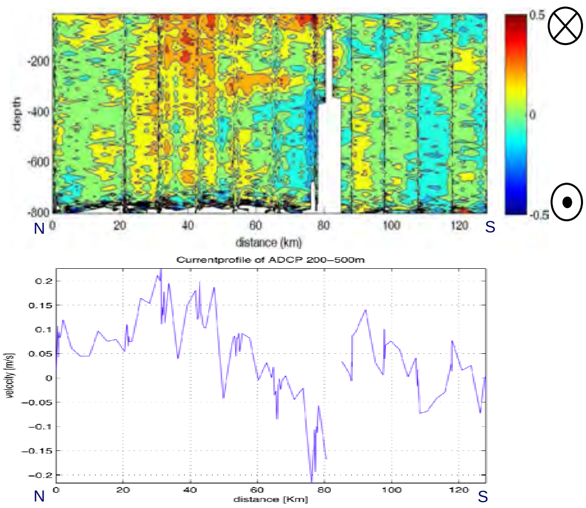
The Procedure

1) Having a look at salinity



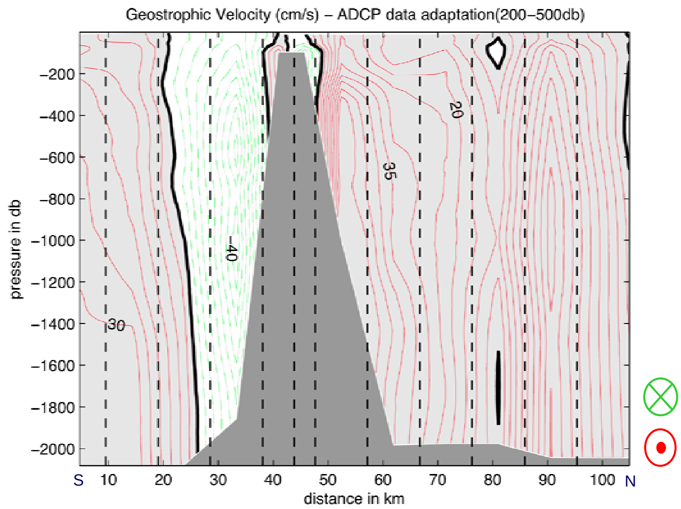
A high pressure field underneath the seasurface, originating from an anticyclonic eddy leads to a downward inclination of the haloclines in the upper layers. This phenomena was detectable in the CTD dataset, as can be seen in the red shaded area in the salinity plot.

2) Interpreting ADCP data



For further examination of the flow‘s orientation, we made use of the ADCP dataset (Acoustic Doppler Current Profiler). ADCP values vertically averaged give a better idea of differences in the absolute velocity in the area surrounding the Seamount.

3) Combining ADCP and Geostrophy



We corrected the geostrophic velocity by using mean values of the ADCP velocity.
The final geostrophic profile shows an anticyclonic vortex, a so called Taylor column, on top of Ampère Seamount.

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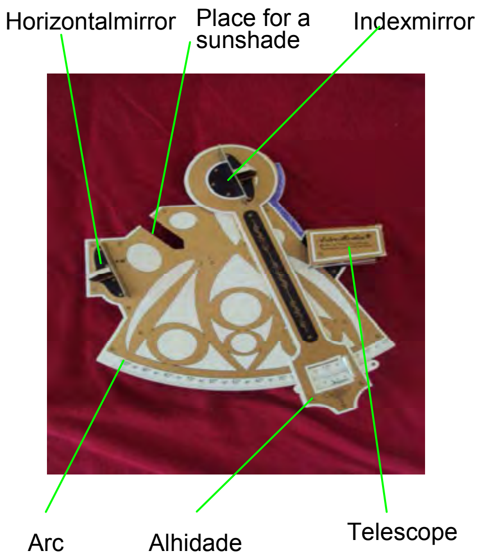
POSEIDON CRUISE 399/1

Navigation via sextant

Leonie Esters and Florian Sprung
University of Hamburg

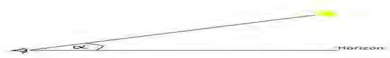
How to navigate without GPS?



Nowadays navigation via GPS (Global Positioning System) is the common way of navigation. On our cruise we wondered how it worked in former times. Therfore, we built an own sextant to find out how difficult it was to determine a geographical position.

How does a sextant work?

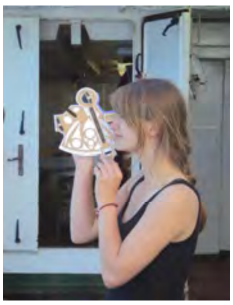
A sextant is an instrument for navigation. You measure the angular distance of celestial objects (like stars) from the horizon in order to determine your geographical position.
In an almanac you can check the sub-point of the celestial object at any time. The sub-point is the geographical position on the Earth where the celestial object is at the zenith. Therefore, it is very important to record the exact time of the measurement, because you need to look up the time related sub-point.
Because the measured height angle of the celestial object isn't 90° but 90°-φ (with φ = 90°- α), the own position must be somewhere on a circle with a radius of $r=\cos(\varphi)*R_E$. The center of this circle is the sub-point.
After a while you have to measure again. Now the celestial object has another sub-point (SP2). Consequently there is a new circle with SP2 as centre. This two circles have two intersections. Your position must be one of this intersections! Hence, you know approximately your own position you are able to determine the right intersection.



This picture shows the measured angle between a star and the horizon

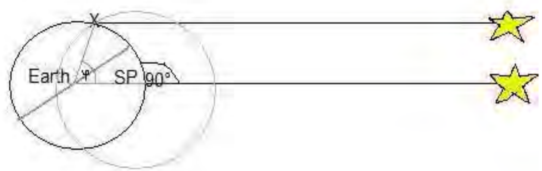
Sunshade

A sunshade is very important for navigation by using the sun. It is possible to become blind if you look directly into the sun without a shade. In former times no sunshades were used and a lot of seamen got problems with their eyes. The item „Peilauge“ for a blind eye might be based on this.



Last step: adjustment of the sextant

If you build a sextant, you should follow the instructions carefully



This picture shows the sub-point of a star. Futhermore it shows the positon X of an observer. You can see how to construct a circle around this sub-point (SP) to determine X.

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