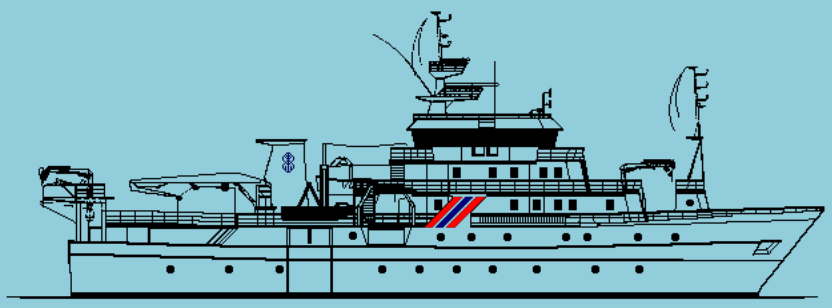
NORAD – FAO PROJECT 2008403

CRUISE REPORTS "DR. FRIDTJOF NANSEN"
BCLME – PROJECT BEHP/NANSEN/06/01



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Survey of the bottom fauna and selected physical and chemical compounds in April 2008

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Instituto Investigação Marinha (INIP)
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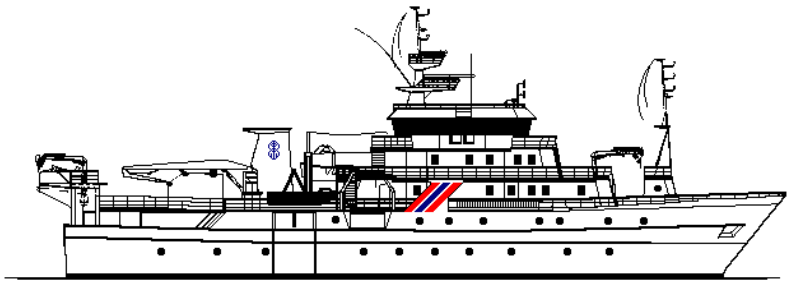
Angola
BCLME
Chevron

UNIFOB AS, SAM (UiB)
Norway
Ministry of Petroleum (MinPet)
Angola
Agostinho Neto University
Angola
GCLME

Bergen April 2008



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Participations at the cruise

From Instituto Nacional de Investigação Pesqueira (**INIP**) (Angola):

Silvana Manuell Faria
Paulo Coelho
Ines Valente Vicente Quitumba
Hélia Dinah Guise da Piedade
Milucha Tomàs
Francisco Mendes
Faustino Paulo

From Institute of Marine Research, Norway:
Bjørn Serigstad
Magne Olsen
Jan-Frode Wilhelmsen
Andreas Nieuwejaar
Tore Mørk
Ole Sverre Fossheim

From UNIFOB AS, Section of Applied Environmental Research, Norway
Gisle Vassenden

We would like to thank the officers and the crew onboard *Dr. Fridtjof Nansen*.

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1. INTRODUCTION

The co-existence of the fisheries, sea transport and oil sectors is a worldwide challenge related to sustainable utilisation of marine living resources in particular, and conservation and protection of the marine environment in general.

An important factor in safeguarding this co-existence between different commercial users of the marine environment has been the development of legislation and policy instruments and the establishment of governmental institutions, NGOs and private institutions.

The new monitoring plan for Angola, called “Environmental Monitoring of the Petroleum Activities on the Angolan Continental Shelf” has been the basis for this survey in Cabinda.

The coast of Cabinda from S 5º00 to S 6º00t consists mainly of sandy beaches, lined with sand dunes. The area is part of the marine ecosystem called GCLME (Guinea Current Large Marine Ecosystem). Cabinda is strongly influenced by the fresh water discharge from the Congo River which has the second largest water flow in the world behind the Amazon. Most of the water from Congo River flows northward affecting the horizontal and vertical gradient of temperature and salinity in the Cabinda area. In addition pollutants from big cities along the river, agriculture and runoff from land may give effects on marine life.

For more than 50 years, oil exploration and production have taken place in Cabinda. The petroleum industry is operating both on land and offshore. There is a concern that this petroleum activity may have negative impact on the marine resources resulting in reduced recruitment to fishstockes or loss of marine biodiversity. In addition there is a concern among other users of the sea, especially among the artisanal fishermen and other people living along the coast making their income from the sea. Besides the possible impact on the marine ecosystem these people also fear health problems for themselves and coming generation. Another concern in addition to possible pollution is the access to fishing grounds and beaches where they traditionally have made their work and living. A reduced water quality and increased industrial activity will probably also be negative for the tourism industry.

With all these possible impacts on the ecosystem with possible impact on different users of the sea it is important to make as good documentation as possible of the environmental conditions in an area. This makes it possible take action if the conditions show to be severely influenced by some specific activities. To be able to have a good environmental monitoring, an environmental monitoring plan covering the areas of concern must be in place. When timeseries is established it is possible to see if the situation is stable or if pollution is increasing. Hopefully the conclusion can be that the situation is becoming better. This should be possible with modern technology.

The present survey is the second focusing on environmental monitoring of the Cabinda continental shelf, and the intension is that these surveys should be the start of a systematic environmental monitoring in Angola.

History of petroleum industry in Angola

The Petroleum was first discovered in Angola in the 1800th century. The first attempts of industrial exploration started in the early 1900th century but it was no commercial success in the beginning.

The first commercial oil well was discovered in the Cabinda province in 1954. It was located in shallow waters in the Basin of Low Congo. The Cabinda Gulf Oil Company (CABGOC) was established and started exploration in 1966.

From 1974 to 1995 the Angolan oil industry was in a structuring phase. SONANGOL (National Society of Fuels of Angola) was founded in June of 1976. SONANGOL was responsible for the concessions of the exploration rights and hydrocarbon production.

The Angolan continental shelf was divided in Blocks by SONANGOL. In 1979 14 blocks (Block 0 – 13) in shallow waters from 0 to 200m depth were defined. In 1990 17 new blocks (Block 14 – 30) in deep water from 200m to 1500m where defined. The ultra-deep areas were divided in 4 Blocks.

Today the Angolan shelf is divided in 35 Blocks *of which 17 are awarded, 7 are abandoned and 11 are still free. (*December 2007)

COOPERATION IN ANGOLA

For Implementation of the National Environmental Monitoring Plan for Angola multisectorial cooperation has been established among the Ministry of Fisheries (National Institute of Fishery Research), Ministry of the Urbanism and Environment, Ministry of Petroleum, Ministry of Geology and Mines and the Agostinho Neto University.

The problems with pollution and transport of pollutants are complex and a transboundary. Petroleum activities are not limited to the Angolan territory; it also takes place north of Angola in Congo and Gabon. In this way it is a shared problem with counties in the large marine ecosystems; GCLME and BCLME. Angola is a link between the two current systems.

The monitoring survey was a joint effort between the BCLME and the GCLME and will hopefully enhanced the understanding of the nature and extend the knowledge of how the offshore oil activities can affect the marine ecosystem. This first survey will hopefully contribute with valuable information especially on the benthic communities and levels of contamination by hydrocarbons and heavy metals in the sediments.

The Angolan Multisectoral Group of Experts has divided activities in two phases:

1) **The first phase** is to Elaboration the Angolan Environmental legislation for Monitoring of offshore oil activities. The Ministry of the Urbanism and Environment coordinates this activity with assistance from the Ministry of Petroleum and Ministry of the Fisheries.
2) **The second phase** is the Monitoring Strategies which is coordinated by the Ministry of Fisheries (National Institute of Fisheries Research).

2 METHODS

2.1 Sampling cruise – planning and operations

October 2007. Meetings in Luanda for presentation of results from the Cabinda Environmental Monitoring cruise in October 2006.
The meeting was held at INIP with participation from MinPescas, MinPet, MinUeA, Augustino Neto University, Sonangol, Chevron, Esso, Statoil Hydro and the Norwegian Embassy. On this meeting new field activities were planned to start in May 2008.

February 2008, cruise plan for Nansen revised and the Oil-Fish cruise was shifted from May to April 2008.

March 2008 meeting with: MinPet, MinPescas, Min UeA, INIP, WB, StatoilHydro and Norwegian Embassy in Angola for planning of the field activities.

The plan was to involve Sonangol in the Environmental monitoring activities, in addition to other petroleum operators on the Angolan Continental shelf. The monitoring in 2006 was in cooperation with Chevron.

MinPet took the lead in the planning together with the Norwegian Advisor in Luanda.

Maps were provided by MinPet from Chevron and from StatoilHydro by the Advisor.

MinPet stressed that it was important to do the planning, provide licenses from the involved ministries and to present a sampling plan before they could have meetings with Chevron or other operators.

The Norwegian Advisor has drafted a MOU for the Cooperation between MinPescas/MinPet and FAO, but due to some confusion about responsibility, the signature on this MoU was delayed.

A preliminary cruise plan was presented, but the specific sampling area was not elaborated in detail. This was not possible since there was no information about activities in the different areas and no information about accessibility.

April 2008. Meeting with MinPet (INIP was not represented) for planning of the cruise and the sampling sites.

April 10: MinPet informed that the contact with Sonangol was difficult this time and that the sampling had to take place in Cabinda in a Chevron operated area.

April 11: A former Chevron employee, now working for MinPet gave some information about the activity in different areas of Cabinda and advised us to take samples at:

1) The Wamba Oilfield near the border to Congo. This is an old oil producing field in Block 0. Water depth approximately 70 meters

2) The Bomboco Oilfield which is quite new and has extensive drilling activity. This field is in Block 0. Water depth approximately 100 meters
3) The Kuito FPSO which is a large complicated field producing and processing oil and gas. The field is in Block 14 on approximately 400m water depth

In addition to a sampling plan at the 3 fields, a plan for regional sampling outside the security zones was prepared. This was supposed to be a plan B if access to the oil fields was denied.

1) One transect East–West along the border to Congo with 6 stations, starting at 25m ending at 400m depth.
2) One transect North-South from the border to Congo in North to DRC in South at approximately 100m depth.
3) One transect East-West north of Congo River starting at 25m ending at 400m depth

As a plan C we proposed to take samples as East West transects South of Congo River and at two transects where sampling of sediments took place in 1992. Results from these investigations are presented in a Master's thesis from University of Bergen.

April 14: Meeting between MinPet, INIP Norwegian adviser and Chevron-Luanda.
The head of Environmental section of MinPet also met informally with Chevron representatives on a trip to Cabinda. We got the impression that he should pas the necessary information to the security responsible at the Malongo Base in Cabinda.

April 14. The cruise started but the MoU was not received from FAO. The vessel *Dr Fridtjof Nansen* left Luanda April 14, at 14:00. The vessel sailed northward during the night. Onboard we were uncertain if we could start working. We asked INIP to confirm that sampling according to Plan B, outside the safety zones could start.

April 15. Based on the following letter we started sampling.

Attn. Master, Cruise leader R/V Dr. Fridtjof Nansen

Please be advised that the Instituto Nacional Investigacao Pesqueira (INIP) has authorized the collection of water and sediment samples off Cabinda and the Congo River Basin. The sampling is part of the fisheries investigations undertaken as part of the bilateral cooperation between Angola and Norway in the fisheries sector, and the multilateral cooperation with the UN Food and Agriculture Organization FAO, Rome, Italy.

For further information, please contact INIP, attn. Dir. Nkosi Luyeye.

The first sampling started at 15:15 on the 15th April at the inner shelf close to the Angola-Congo border. Sediment sampling continued along the border to 21:25. During the night only CTD stations was taken. The sediment sampling start again at 0630 on April 16th, at 365 m depth north of Kuito FPSO. Last sample was collected 18:30.

April 16. Eight sampling stations were completed at 1830 in the evening when Dr. Fridtjof Nansen was called on the radio by Malongo Security. There may have been problems with the radio communication for some time. We got an order to stop the sampling and leave the area immediately. Explanation about our general fishing license and that we were taking samples

according to agreement with MinPet and MinPescas was of no value. We also informed about the meetings with Chevron in Luanda. No information had reached the security responsible in Cabinda.

A patrol vessel was sent to escort us out of the Cabinda area. We were going full speed south to Congo River. Communication with the patrol vessel was difficult since they only spoke Portuguese. We got some assistance from the local cruise leader for translation and communication.
Malongo security confirmed by radio that we could proceed south without stopping.

April 17: We arrived at INIP, Luanda in the evening. INIP had received the MoU from FAO and they wanted to extend the fishing licence to cover sediment sampling by grab in addition to fishing. This extension of the licence turned out to be quite complicated.

April 18: A letter was sent from MinPet to the minister of Fisheries to confirm that they supported the monitoring plan. But the ministry of fisheries had to sign the MoU. In addition the extension of the fishing licence should be issued. An agreement was made that one of the National directors in MinPescas should issue the extended licence on Monday 21.

April 21: The technical director of INIP spent the whole day in meetings with MinPet, MinPescas and Chevron Luanda. When the agreement to extend the fishing licence should be signed the Minister decided that he had to sign and the signature could not be given until next morning.

April 22: The fishing licence was signed, but when it arrived around 1300 the technical director at INIP told that there was something wrong with the licence and it had to go back to MinPescas to be corrected. The licence was returned and corrected. The correction was to restrict the sampling with grab to cover only Cabinda and only 1 cruise. We asked the director if we could take samples outside Cabinda. But it was made clear that grab could not be used in any other area than Cabinda.

Actually this new licence restricted our possibility to take samples in the way we have done before. We have probably used the terms benthic community sampling instead of grabbing As a result of the restrictions in the licence our plan C could not be followed.

Departure from Luanda at 1600 on April 22.

April 23: The vessel arrived at the location in Cabinda where we had to leave on April 16. We called up Malongo Security and told that we had got licence to take the samples and wanted to start working at the transect outside the security zones. Malongo Security told that we were not cleared for operations in this area and no information about the operations had reached them. We referred to the Chevron representative that was in meetings with our Adviser, MinPet and INIP. We also told that we had got maps from Chevron and elaborated the plans together with Angolan authorities.

Since information had not reached the security responsible we was ordered to leave the area and they should check out if there had been some information from Angolan authorities about our plans.

We called MinPet and asked them to contact the Malongo Security to make sure that they were informed.

We reduced the speed of Nansen on the way south, waiting for answer from MinPet or Malongo Security. We were then ordered to speed up and leave the area. We were told that it was prohibited to stop the ship in the CABCO area which is the whole Cabinda area.
Just before reaching the Congo River we were called up on the radio with a message to go to the Cabinda anchorage where we should have an inspection of the vessel. A Chevron inspector to follow our sampling should also come onboard. This was the start of the real planning.

April 24. The inspection started at 0730 in the morning. The ISPS inspector left the ship 0930 to go back to the base to write a report. Nansen was security cleared at 1200.

The technical inspection was finished at 1200, a report was written and the ship was cleared for operation in the CABCO area late evening.

An operation instruction manual for the CABCO area was sent to Nansen and new maps was provided. We were told that maps older than 1 month could not be used for operations in this area. The maps we got in Luanda was two years and of little value for safe planning of operations. An example is that one of our sampling sits was registered with 6 pipelines on the seafloor on our map but on the new one there were 51 pipelines around the same platform. The Chevron representative told that there has been a lot of damage to installations from ships and that they have got a new quality insurance system in place to reduce this kind of events. A written plan should be submitted on the right format this should be evaluated by a security team and work permit could be issued if there is no threat to installations or operations. This process usually takes 10 days. But since we already were in the area and there was a request from the Angolan government Chevron would try to help us and speed up this process.

Our sampling plan had to be revised. All positions had to be presented as Easting and Nothings in the Malongo 1987 datum, as well as in WGS84 datum. After some studies of basic mathematics and a program on Magne Olsen’s computer we managed to come up with the desired format.

April 25: Still at anchor outside Cabinda waiting for inspector. Inspector arrived in the evening. A test of the navigation system onboard is required. This test has to wait until next day in daylight.

The maps of CABCO area are not complete. Some area has been surveyed by ROV and details marked in the map. Some areas are not surveyed and old wellheads, pipelines, cables and garbage may result in problems and risks during our sampling. To be allowed to sample this area an ROV or side-scan sonar is required. A video-grad could probably also be approved for use in this
.
We had to report that none of these tools was available onboard R/V Dr Fridtjof Nansen. This restricted our operations to cover only the pre-surveyed areas which are primarily inside the 500 meters security zone and along the pipelines.

April 26: Test of navigation system is performed. Report written and system approved.

The decision of CABCO was that only two of our proposed sampling sites could be approved for grabbing.

Samples were taken successfully at these locations.

A new plan for sampling downstream from the Bomboco oilfield was presented.

April 27: In the security meeting on Sunday morning the sampling was considered not to comply with the safety standards, partly because the vessel did not have dynamic positioning and partly because we could not see where be grab hit the bottom between the complex technical installations.

We were invited to submit further plans, but we got the message that they could not be evaluated until Monday 28. Another problem was that no inspectors were available since 3 tankers were coming to take cargo on Monday.

We had to head back to Luanda to be prepared for the visit of the Norwegian Embassy with guests onboard Dr Fridtjof Nansen on Tuesday April 29.

Reports were from the Environmental Monitoring in Cabinda in 2006 was sent to Chevron at the Malongo base. They invited us to come to the Malongo Base in Cabinda to present the results and to start planning of monitoring activities for next year. Such a meeting can take place in the fall 2008

Conclusion:
Two interesting transects across the Cabinda area has been sampled. This is a good basis for further training in processing and analysis of biological and chemical samples.

The scientists that have been on previous environmental cruises and on training in Norway are working as professionals on board performing the work in an excellent way.

Good cooperation and contacts with Angolan authorities are important, but it is also important to make sure that those responsible for the security in the operation area are informed and preferably involved in the planning.

The communication between the authorities and the operators in Cabinda was not good enough this time. Since Chevron people were involved we felt confident that the necessary licences were in place, this was not the case this time.

In 2006 we had almost the same process of planning. The only difference was that Chevron representatives from Cabinda attended meetings in Luanda for planning. This is the people that have the responsibility for safe operations. In 2006 everything went smoothly.

The weather conditions during the cruise were good and there were no incidents hurting or damaging crew members, sample equipment, samples or the vessel.

2.2 Survey area and planned sampling design

Figure 2.1 shows the sampling sites. Figure2.2 - 2.4 shows the 3 different sediment sampling sites near the three oilfields Wamba, Bomboco and Kuito which was planned to investigate.

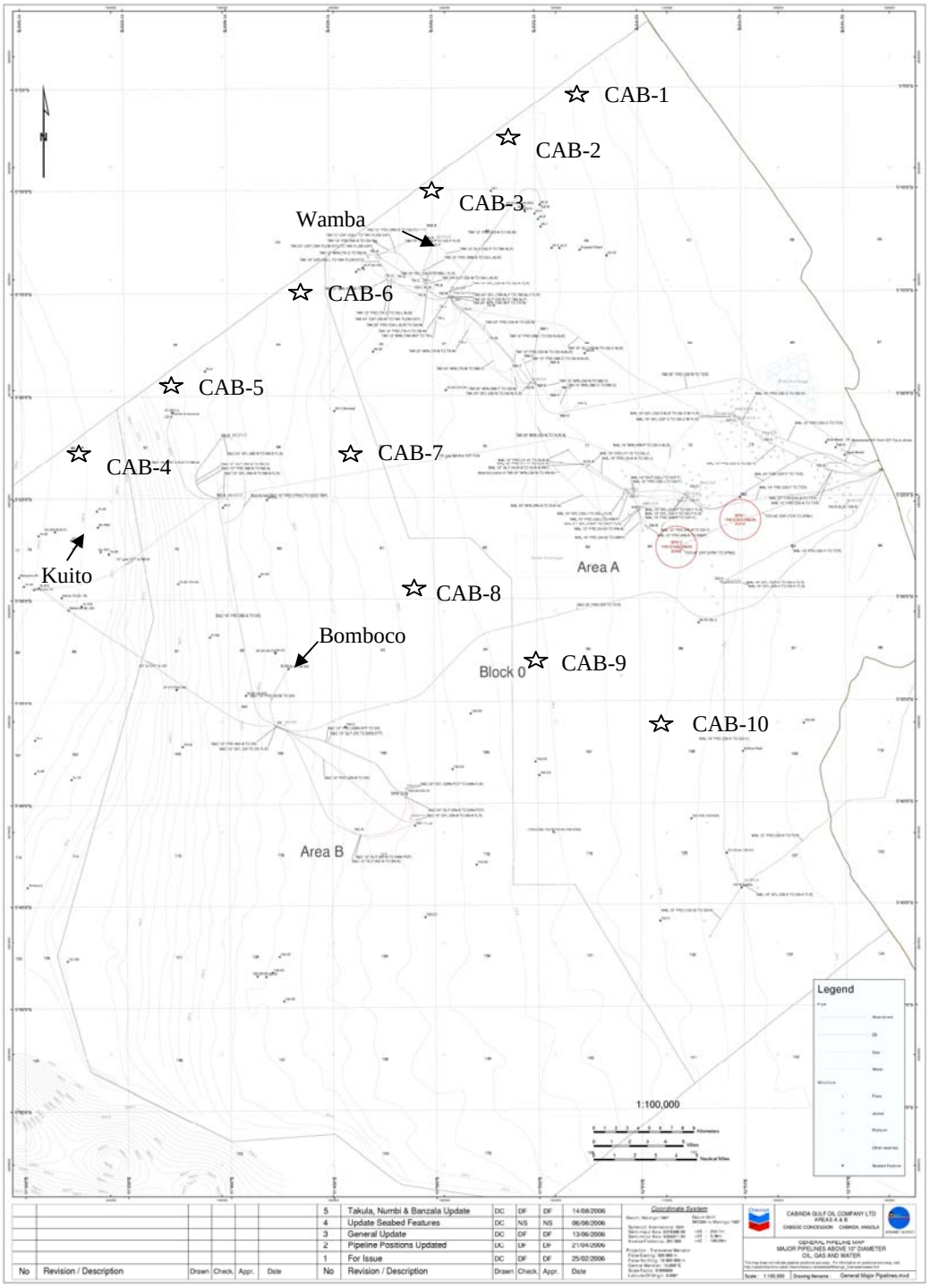

Figure 2.1 Map showing the proposed sampling area in Cabinda (Block 0 and 14). Stars indicating regional sites. Detailed maps for the oil field Wamba, Bomboco and Kuito are presented in Figure 2.2-2.4.

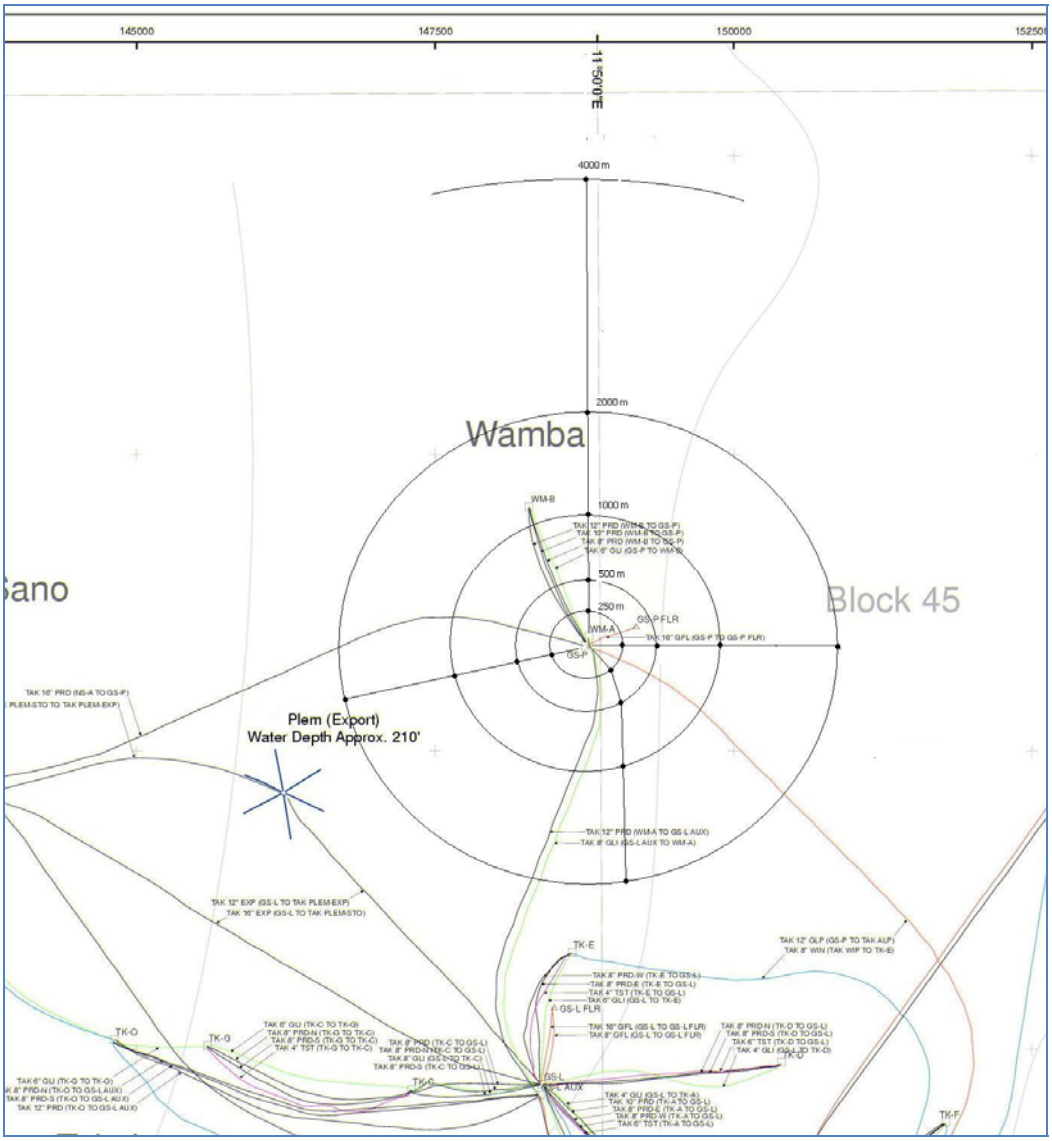

Figure 2.2 Detailed maps of the pipelines around Wamba (updated in 2006), and the proposed sampling design. The sites are located 250 m, 500 m, 1000 m and 2000 m from the platform along four different transects. In addition one site 4000 m and 10000 m distance north of the platform will be taken.

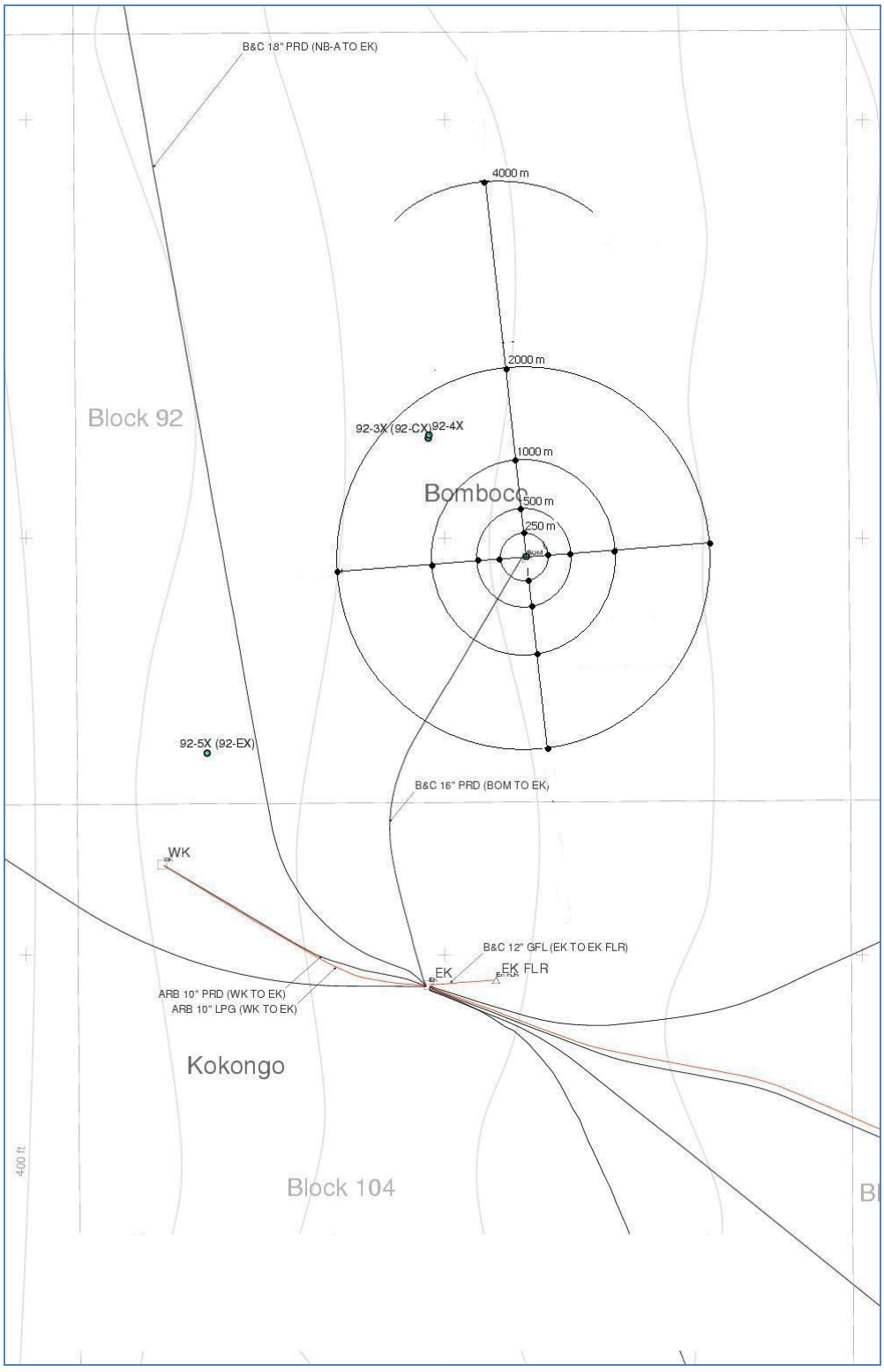

Figure 2.3 Detailed maps of the pipelines around Bomboco (updated in 2006), and the proposed sampling design. The sites are located 250 m, 500 m, 1000 m and 2000 m from the platform along four different transects. In addition one site 4000 m and 10000 m distance north of the platform will be taken.

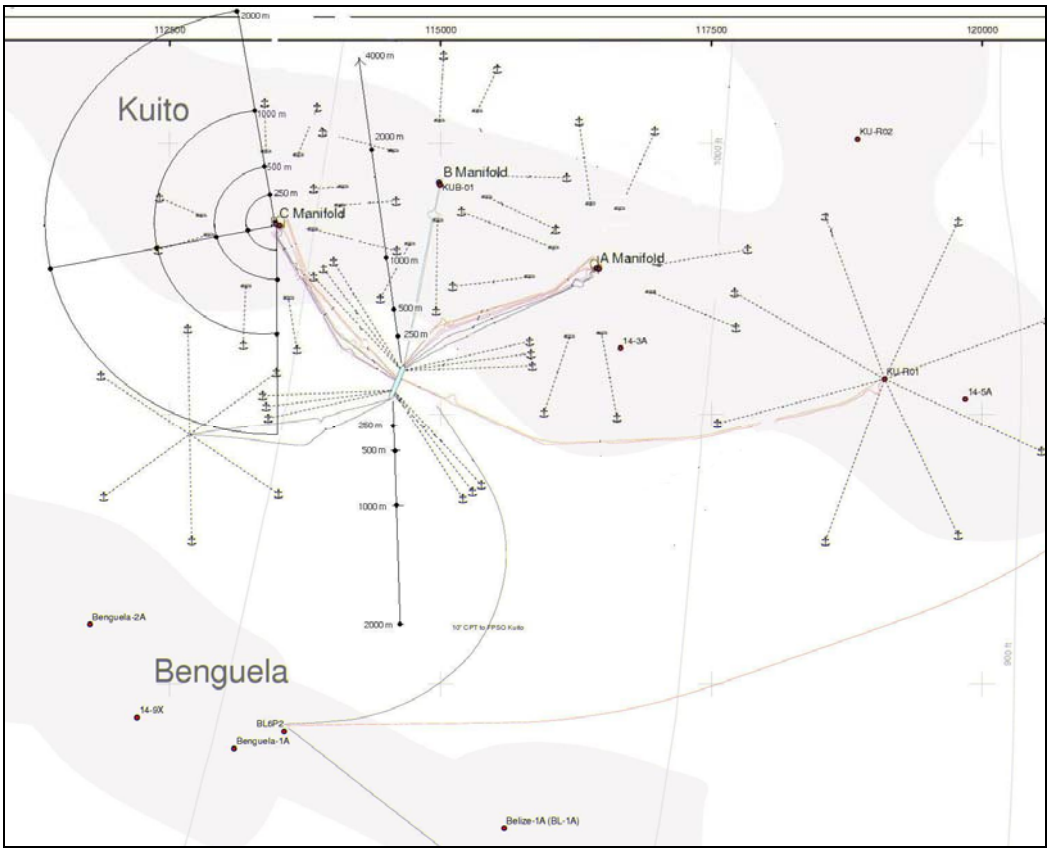

Figure 2.4 Detailed maps of the pipelines around Kuito (updated in 2006), and the proposed sampling design. The sites are located 250 m, 500 m, 1000 m and 2000 m north and south of FPSO. In addition one site 4000 m and 10000 m distance north of the FPSO will be taken. It is also planned to take samples along three transects from Manifold C (250 m, 500 m, 1000 m and 2000 m distance).

Table 2.1 show the position of sites investigated. The water depth in the sediment sampling area varies between 26and 365 m. Deepest CTD station was 702 m deep.

Table 2.1 Information of the CTD stations

Station nr:	Date	Time UTC	Longitude	Latitude	Depth (m)
HD520	15/04/2008	13:42:55	11.9587	5.0954	26
HD521	15/04/2008	17:01:47	11.8822	5.1419	51
HD522	15/04/2008	19:13:21	11.8340	5.1715	63
HD523	15/04/2008	21:19:02	11.7393	5.2404	89
HD524	15/04/2008	22:10:20	11.6390	5.3145	121
HD525	15/04/2008	22:46:02	11.5780	5.3560	229
HD526	15/04/2008	23:18:43	11.5239	5.3908	408
HD527	16/04/2008	00:10:16	11.4525	5.4357	557
HD528	16/04/2008	01:05:03	11.3876	5.4795	702

Table 2.2 Information of the bottom fauna sampling sites in Cabinda.

Station nr:	Date	Time UTC	Longitude (E)	Latitude (S)	Depth (m)	Sediment description	Volume (liter)	Chemistry layer (cm)	Comments
CAB 1	15/04/2008	13:55:11	11.9594	5.0979	26	Mud with sand and stones.	1,5 – 18	0-1 cm	Difficult to take good samples. Varying bottom condition
CAB 2	15/04/2008	17:12:06	11.8825	5.1416	51	Mud	21	0-1 cm	
CAB 3	15/04/2008	19:22:40	11.8322	5.1718	63	Mud	21	0-1 cm	
CAB 4	16/04/2008	05:21:11	11.5450	5.3901	365	Mud	21	0-1 cm	
CAB 5	16/04/2008	09:15:52	11.6383	5.3155	121	Mud with black sand	18 – 21	0-1 cm	
CAB 6	16/04/2008	11:26:51	11.7378	5.2407	89	Mud	8,5 – 21	0-1 cm	
CAB 7	16/04/2008	14:29:01	11.7827	5.3668	67	Mud	13 - 21	0-1 cm	
CAB 8	16/04/2008	16:31:42	11.8331	5.5001	63	Mud	16 - 21	0-1 cm	
CAB 9	26/04/2008	19:25:00	11.9508	5.6090	44	Stones, fine sand, mud		0-1 cm	Difficult to take samples
CAB 10	26/04/2008	20:28:00	12.0424	5.7092	25	Mud		0-1 cm	

2.3 Sampling and sample treatment

All the sampling was done by the crew from Instituto Nacional de Investigação Pesqueira (INIP) under supervision by Gisle Vassenden (UNIFOB AS/SAM-Marine/UiB), Bjørn Serigstad and Magne Olsen (Institute of Marine Research). Section of applied environmental research (SAM-Marine) is accredited by Norsk Akkreditering for sampling under accreditation number Test 057. The sampling was undertaken in accordance with the Norwegian guideline "Aktivitetsforskriften", the modification of Requirements for Environmental Monitoring of the Petroleum Activities on the Angolan Continental Shelf and international standards (ISO 5667-19 and ISO 16665).

Positioning of *Dr. Fridtjof Nansen* was done by Global Positioning System (GPS). The positions were approved by the oil company.

2.3.1 Temperature, salinity and oxygen

CTD sites were taken along 1 transect from the shore to the open water. And 1 transect along the coast at approximately 100 m depth. A Seabird 911 CTD plus was used to obtain vertical profiles of temperature, salinity and oxygen. Real time plotting and logging was done using the Seabird Seasave software installed on a PC. The profiles were taken down to a few metres above the bottom. The new oxygen sensor has shown to be very stable, and no calibration was conducted during the survey. The calibration constant calculated during the survey off the western Gulf of Guinea was applied for the whole survey.

2.3.2 Sediment sampling

Sampling took place at two different types of sampling sites, ordinary field sites and reference sites/regional sites. Ordinary field sites were the most numerous. At each site, 8 grab samples were taken. Five were used for biological analysis and 3 for chemical analysis (metals and oil hydrocarbons). Sediment that was used for chemical analysis was taken from the upper 0-1 cm of the sample. From field sites downstream and closest to the installation and at some reference sites, additional sectioned samples were taken for chemical analysis from 1-3 and 3-6 cm depth of the sediment.

The field sampling sites were spread out along two transects at a predefined distance from the installation. It was proposed to take the samples 250 m, 500 m, 1000 m, 2000 m distanse from the platform. One transects extended upstream and downstream from the centre of the installation, and the other extended to the right and left at a right angel to the first transect at the centre of the installation. Because of pipelines and electrical cables at the seafloor, and for security reason, some sites are not sampled or they were moved.

Sediment samples were taken by a van Veen grab with adjustable weight and an opening of 0.1 m^2. We had one heavy grab with long arms and one light grab with short arms. The total volume of the long armed grabs was 21 litres

On deck the volume of each sample was measured. Sediment was described, and colour was recorded, as well as anomalous odour and conspicuous taxonomic groups. The colour of the sediment was determined according to Munsell® Soil Colour Chart System year 2000 revised (GretagMacbeth, New Windsor, NY, USA) when the sample arrived on deck.

Samples for biological analysis were sieved through sieves with mesh size 5 mm and 1 mm round holes. Material retained in the sieves was placed in plastic containers where formalin and borax was added. Each sample was marked and stored on board in transport containers.

Samples for chemical analysis were taken through the hatches on top of the grab from the upper 0-1 cm of the sediment.

To avoid contamination an ordinary table spoon or special designed metal spoon was used when taking the sediment for hydrocarbon and grain size analyses, but a plastic spoon was used when taken the sediment for metal analyses. The spoons were washed with seawater between each sample. Each sample was put into Rilsan plastic bags which were marked and immediately frozen to prevent evaporation of labile compounds. The samples were kept frozen until further analysis in the onshore laboratory.

Samples for TOM and grain size analyses were taken from the upper 0-5 cm of the sediment and put in separate plastic bag, marked and frozen immediately.

2.4 Sample analyses

The samples will be transported to Bergen, Norway, for the analysis of grain size, total organic matter and chemical compounds in the sediment.

The sediment will be analysed for concentration of Cd, Cu, Ba, Zn, Cr, Pb and THC at each sampling site. Some sites will be in addition be analysed for Hg, NPD and PAH compounds.

The benthos in the sediment will be sorted out in the laboratory at INIP in Luanda, and the species will be identified.

The result of the different analyses are presented in Table 2.3, Table 2.4, Figure 2.5 and Figure 2.6.

Table 2.3 Concentration of metal (mg/kg dw)

Site Nr.	Sample nr.	Date	Ba	Pb	Cd	Cu	Cr	Hg	Zn	Dry weight %
Cab 1	1	15.04.08	12	20	0.40	1.5	36	0.016	63	64.4
	2		14	19	0.41	1.3	35	0.015	55	59.0
	3		12	21	0.53	<0.076	31	0.009	54	65.7
Cab 2	1	15.04.08	99	28	0.09	10	49	0.040	72	37.5
	2		130	39	0.13	16	69	0.061	100	26.4
	3		110	31	0.09	11	55	0.043	81	34.9
Cab 3	1	15.04.08	130	26	0.09	12	51	0.044	71	38.3
	2		100	26	0.08	12	52	0.044	72	36.5
	3		100	23	0.08	11	46	0.041	66	36.7
Cab 4	1	16.04.08	140	17	0.13	14	53	0.048	65	33.2
	2		140	22	0.15	17	67	0.061	82	31.2
	3		160	18	0.11	13	57	0.053	71	31.9
Cab 5	1	16.04.08	59	20	0.067	2.6	58	0.022	100	62.7
	2		65	17	0.050	1.9	45	0.019	79	52.0
	3		49	13	0.047	1.9	35	0.017	60	51.5
Cab 6	1	16.04.08	68	21	0.080	12	56	0.046	78	32.3
	2		51	18	0.072	8.7	51	0.033	73	33.3
	3		62	22	0.092	12	58	0.045	85	31.4
Cab 7	1	16.04.08	36	19	0.06	4.6	61	0.027	120	47.4
	2		32	20	0.06	3.8	66	0.025	130	47.3
	3		33	18	0.06	2.9	57	0.022	110	45.2
Cab 8	1	16.04.08	60	26	0.07	6.5	60	0.039	110	43.3
	2		61	20	0.06	6.5	46	0.032	81	44.4
	3		69	23	0.05	5.9	53	0.034	97	44.3
Cab 9	1	16.04.08	15	23	0.09	<0.076	35	0.017	88	66.0
	2		12	17	0.07	<0.067	21	0.008	57	75.0
	3		15	14	0.040	0.28	25	0.014	56	64.6
Cab 10	1	16.04.08	78	18	0.04	9.5	48	0.075	73	33.5
	2		57	16	0.04	8.9	41	0.061	60	36.0
	3		73	16	0.04	8.4	43	0.058	66	39.5

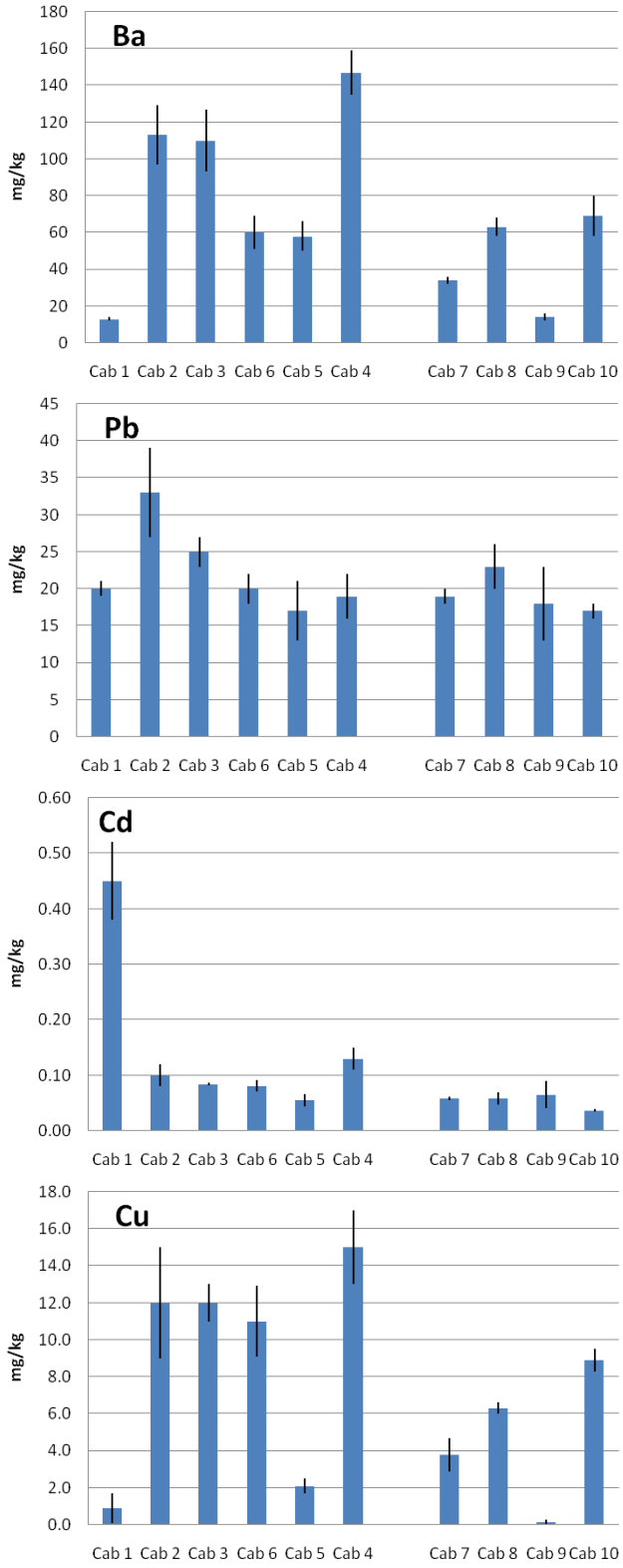

Figure 2.5. Result of the metal analysis from the regional sampling sites in Cabinda. The sites are organized with increasing distance from the shore (Cab 1-Cab 4) and along the the north – south transect (Cab 7-Cab 10).

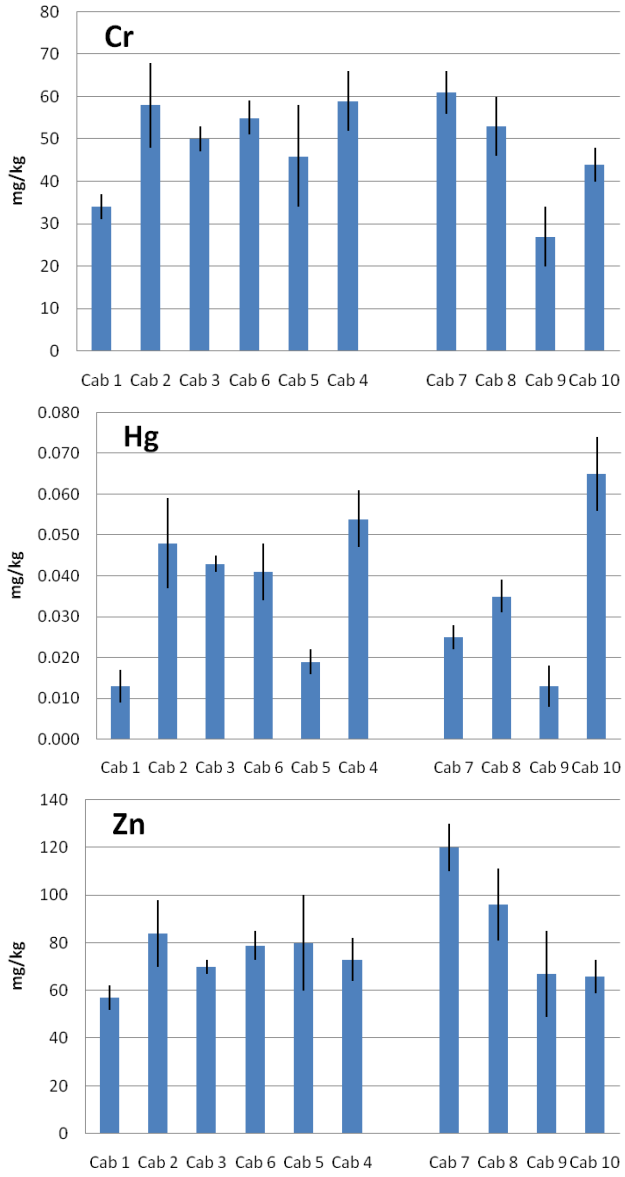

Figure 2.5 continue. Result of the metal analysis from the regional sampling sites in Cabinda. The sites are organized with increasing distance from the shore (Cab 1-Cab 4) and along the the north –south transect (Cab 7-Cab 10).

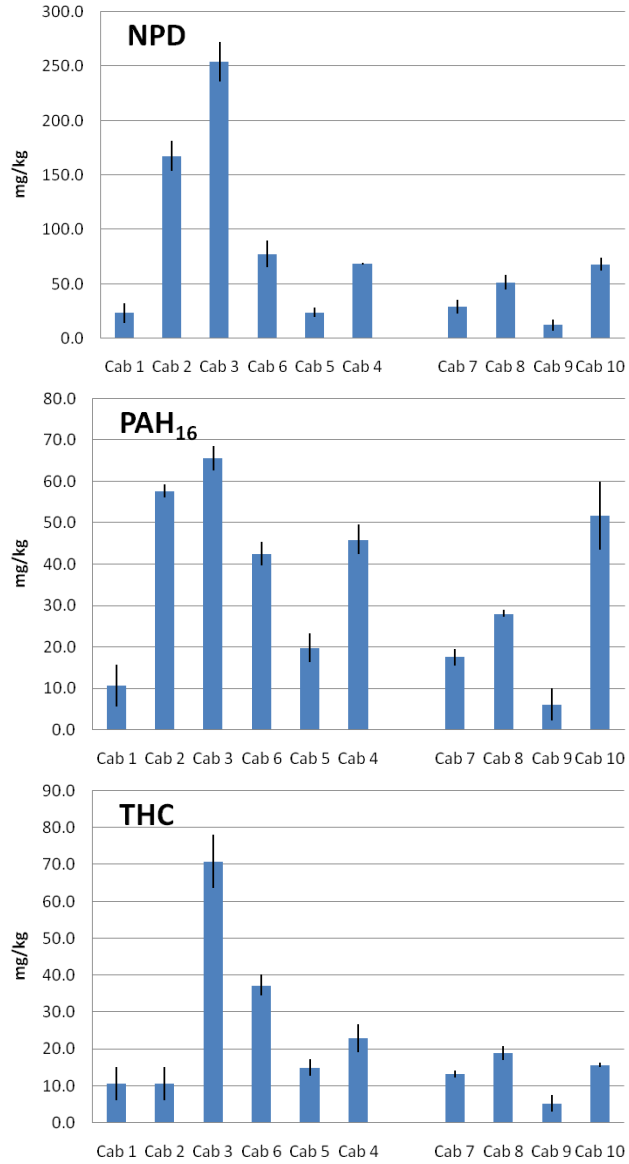

Figure 2.6. Result of the hydrocarbon analysis from the regional sampling sites in Cabinda. The sites are organized with increasing distance from the shore (Cab 1-Cab 4) and along the the north –south transect (Cab 7-Cab 10).

Table 2.4 Concentration of hydrocarbons (mg/kg dw)

Hydrocarbon	Cab 1			Cab 2		
	s1	s2	s3	s1	s2	s3
Naphtalene	<0,5	<0,5	<0,5	2,1	2,8	2,1
C1-naphtalener	<0,5	<0,5	1,1	3,5	4,5	2,1
C2-naphtalener	2,8	2,7	2,1	8	5,6	5,4
C3-naphtalener	1,3	1,1	<0,5	8,5	8,2	7,6
Phenantrene	1,6	1,5	0,7	4,8	4,5	4,6
C1-phenantrener	4,3	3,5	1,9	19,4	18,5	15,3
C2-phenantrener	9,9	8,5	5,7	42,4	43,5	39,4
C3-phenantrener	7,2	3,6	1,8	45,4	45,8	39,2
Dibenzothiophene	<0,5	<0,5	<0,5	0,6	0,7	0,5
C1-dibenzothiofener	<0,5	<0,5	0,1	4,5	3,9	3,1
C2-dibenzothiofener	1,3	<0,5	<0,5	10,3	12,2	10,1
C3-dibenzothiofener	4,2	2,3	1,1	22,0	28,8	22,5
Acenaphtylene	<0,5	<0,5	<0,5	1,7	1,8	1,6
Acenaphtene	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5
Fluoren	0,6	1,1	<0,5	1,7	2	1,9
Anthracene	<0,5	<0,5	<0,5	1,5	1,4	1,1
Fluoranthene	2,1	1,4	0,8	7,4	7,5	7,3
Pyrene	2,5	2,1	1,2	11,6	11,1	10,8
Benz(a)anthracene	0,8	0,6	<0,5	2,5	3	3
Chrysene	1,2	0,7	0,5	4,5	2,4	4,3
Benzo(b,j,k)fluorantene	2,7	2	1,1	9,9	9,7	7,8
Benz(e)pyrene	2	1,6	0,7	9,9	8,9	9,7
Benz(a)pyrene	0,7	0,6	<0,5	3,2	2,8	3,4
Perylene	17,4	15,5	7,9	60	58,2	54,3
Indeno(1,2,3-cd)pyrene	1,3	0,9	<0,5	2,7	2,8	2,8
Dibenz(a,h)anthracene	<0,5	<0,5	<0,5	1,7	1,5	1,7
Benzo(g,h,i)perylene	1,5	1,1	0,7	4,1	4,1	3,8
THC ug/g	14,9	11,0	6,0	14,9	11,0	6,0

Table 2.4 continue. Concentration of hydrocarbons (mg/kg dw)

Hydrocarbon	Cab 3			Cab 4		
	s1	s2	s3	s1	s2	s3
Naphtalene	1,1	1,2	1,3	1,9	1,9	2,1
C1-naphtalener	0,8	1,9	0,6	1,6	<0,5	<0,5
C2-naphtalener	4,3	5,1	4,6	4,4	4,4	4,1
C3-naphtalener	6,9	7,3	7,4	5,2	4,5	3,9
Phenantrene	6,5	6,4	5,9	4,3	4,8	4,1
C1-phenantrener	40,2	40,8	40,8	4,8	5,7	5,9
C2-phenantrener	42,0	54,5	62,3	29,4	28,0	29,5
C3-phenantrener	40,1	44,7	38,1	7,1	11,1	8,7
Dibenzothiophene	0,7	0,8	0,8	<0,5	0,5	<0,5
C1-dibenzothiofener	8,7	13,1	12,6	0,7	0,6	0,8
C2-dibenzothiofener	30,4	35,1	37,2	3,1	2,4	3,5
C3-dibenzothiofener	51,9	49,5	57,1	5,2	5,2	5,7
Acenaphtylene	3,7	3,9	3,7	1,4	1,2	1,4
Acenaphtene	<0,5	<0,5	<0,5	0,7	<0,5	<0,5
Fluoren	3,0	3,3	3,3	1,6	1,7	1,7
Anthracene	0,7	1,1	0,6	1,2	1,1	0,9
Fluoranthene	6,9	6,5	7,5	5,2	6,8	5,5
Pyrene	13,5	14,2	13,3	11,1	11,9	10
Benz(a)anthracene	3,2	3,4	4,7	1,4	2	1,4
Chrysene	2,5	4,3	5,2	2,3	1,8	1,2
Benzo(b,j,k)fluorantene	9,9	11,1	9	6,9	7,4	5,9
Benz(e)pyrene	10,5	9,8	13	3	3,4	2,8
Benz(a)pyrene	2,3	2,3	3,3	1,3	1,6	1,4
Perylene	49,7	50,4	53,1	41,7	40,9	39,6
Indeno(1,2,3-cd)pyrene	3,3	3,6	3,2	2,9	3,4	3,3
Dibenz(a,h)anthracene	1,5	1,8	2	0,5	0,5	<0,5
Benzo(g,h,i)perylene	4,2	4	4,4	3,2	3,5	3,5
THC ug/g	77,9	63,6	70,9	19,7	22,1	27,2

Table 2.4 continue. Concentration of hydrocarbons (mg/kg dw)

Hydrocarbon	Cab 5			Cab 6		
	s1	s2	s3	s1	s2	s3
Naphtalene	<0,5	0,9	<0,5	1,3	1,2	1
C1-naphtalener	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5
C2-naphtalener	2,7	2,5	2,6	3,8	3,2	2,9
C3-naphtalener	1,8	1,2	1,6	3,0	2,6	2,0
Phenantrene	1,6	1,9	1,4	3,4	3,1	2,8
C1-phenantrener	2,4	3	2,2	8,4	9,7	7,2
C2-phenantrener	6,9	8,6	6,7	21,1	19,0	13,6
C3-phenantrener	4,0	5,9	2,1	24,7	23,3	14,0
Dibenzothiophene	<0,5	<0,5	<0,5	<0,5	0,5	<0,5
C1-dibenzothiofener	<0,5	<0,5	<0,5	1,6	1,6	1
C2-dibenzothiofener	1,2	1	1,1	6,1	5,4	6,5
C3-dibenzothiofener	2,4	3,7	2,3	11,9	13,5	12,1
Acenaphtylene	0,5	0,5	0,6	1,2	1,1	1,1
Acenaphtene	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5
Fluoren	0,6	0,9	0,7	1,4	1,4	1,1
Anthracene	<0,5	0,4	0,4	0,9	0,9	1,1
Fluoranthene	1,8	2,3	1,9	5,3	4,5	3,8
Pyrene	4,4	6,6	5,5	10,3	10,5	10,5
Benz(a)anthracene	0,5	1	0,8	2,2	2	1,8
Chrysene	0,9	1,2	0,8	2,1	2,3	1,8
Benzo(b,j,k)fluorantene	2,5	3,5	2,9	6,7	7	6
Benz(e)pyrene	1,6	2,3	1,8	5,4	4,8	4,4
Benz(a)pyrene	0,6	0,6	0,7	2,1	1,8	1,8
Perylene	17,2	21,9	21,6	51,9	50,5	48,1
Indeno(1,2,3-cd)pyrene	1,4	1,6	1,5	2,9	2,7	2,7
Dibenz(a,h)anthracene	<0,5	<0,5	<0,5	1,1	1,1	<0,5
Benzo(g,h,i)perylene	1,8	2,2	2,1	4	3,9	3,8
THC ug/g	14,3	17,5	13,2	39,6	38,2	34,1

Table 2.4 continue. Concentration of hydrocarbons (mg/kg dw)

Hydrocarbon	Cab 7			Cab 8		
	s1	s2	s3	s1	s2	s3
Naphtalene	0,5	2,4	0,7	0,6	0,7	0,5
C1-naphtalener	<0,5	3,6	<0,5	<0,5	<0,5	<0,5
C2-naphtalener	2,3	4,4	2	2,7	3,2	3
C3-naphtalener	1,0	2,6	0,5	1,6	3,0	2,7
Phenantrene	1,2	1,5	1,4	1,8	2,2	2,2
C1-phenantrener	2,9	4,5	3,3	6,8	7,1	7
C2-phenantrener	7,2	6,9	10,1	13,6	17,4	17,7
C3-phenantrener	3,8	4,8	6,3	8,9	11,2	12,9
Dibenzothiophene	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5
C1-dibenzothiofener	<0,5	0,5	<0,5	0,8	1	0,9
C2-dibenzothiofener	1	1	1,3	1,6	4,5	2,1
C3-dibenzothiofener	2,7	2,9	4,0	5,1	5,7	6,3
Acenaphtylene	<0,5	<0,5	0,5	0,7	0,8	0,8
Acenaphtene	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5
Fluoren	0,5	0,6	0,5	0,8	1	0,9
Anthracene	<0,5	<0,5	<0,5	0,5	0,5	<0,5
Fluoranthene	1,4	1,7	1,7	2,5	2,5	2,6
Pyrene	3,6	4,1	3,5	5,7	5,9	5,8
Benz(a)anthracene	0,6	0,7	0,8	1,3	1,1	1
Chrysene	0,8	0,7	0,8	1,4	1,4	1,3
Benzo(b,j,k)fluorantene	2,7	3,3	3,3	4,8	4,7	4,6
Benz(e)pyrene	2	1,9	2,1	3,2	3,3	3,6
Benz(a)pyrene	0,7	0,8	0,8	1,2	1,2	1,4
Perylene	17,4	20,2	18,4	29,6	29,4	29,9
Indeno(1,2,3-cd)pyrene	1,5	1,6	1,6	2,6	2,8	2,6
Dibenz(a,h)anthracene	<0,5	<0,5	<0,5	0,7	0,7	0,6
Benzo(g,h,i)perylene	2	2,1	2,2	3,3	3,4	3,1
THC ug/g	13,4	12,2	14,1	17,3	20,9	18,6

Table 2.4 continue. Concentration of hydrocarbons (mg/kg dw)

Hydrocarbon	Cab 9			Cab 10		
	s1	s2	s3	s1	s2	s3
Naphtalene	<0,5	<0,5	<0,5	0,6	1	0,9
C1-naphtalener	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5
C2-naphtalener	2,2	<0,5	0,7	3,8	4,9	4,1
C3-naphtalener	0,7	<0,5	2,2	3,9	7,6	4,6
Phenantrene	1	0,6	1,1	4,4	3,6	3,4
C1-phenantrener	2,2	0,8	1,9	7,2	7,8	8
C2-phenantrener	5,6	3,4	4,8	15,8	18,4	20,7
C3-phenantrener	3,4	2,2	1,2	11,0	11,6	11,3
Dibenzothiophene	<0,5	<0,5	<0,5	<0,5	<0,5	0,3
C1-dibenzothiofener	<0,5	<0,5	<0,5	0,7	1,1	1,1
C2-dibenzothiofener	0,5	<0,5	<0,5	3	3,2	3,2
C3-dibenzothiofener	1,5	<0,5	1,2	11,1	14,5	11,3
Acenaphtylene	<0,5	<0,5	<0,5	0,8	1,0	1,0
Acenaphtene	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5
Fluoren	<0,5	<0,5	0,5	1,3	1,6	1,5
Anthracene	<0,5	<0,5	<0,5	1,5	1	1
Fluoranthene	1,1	<0,5	1,1	11	5,9	6
Pyrene	1,7	0,5	1,7	12,4	9,4	8,7
Benz(a)anthracene	<0,5	<0,5	<0,5	4,2	2,7	2
Chrysene	0,5	<0,5	0,5	2,5	2,3	1,6
Benzo(b,j,k)fluorantene	1,7	0,5	1,7	9,2	9,2	8,1
Benz(e)pyrene	1,3	<0,5	1	4	3,9	4
Benz(a)pyrene	<0,5	<0,5	<0,5	3,2	2,1	2,1
Perylene	14	4,5	12	75,1	78,8	78,3
Indeno(1,2,3-cd)pyrene	1	<0,5	0,8	4,1	4,3	3,6
Dibenz(a,h)anthracene	<0,5	<0,5	<0,5	0,6	0,5	<0,5
Benzo(g,h,i)perylene	1,2	<0,5	1	4,8	6	4,4
THC ug/g	6,1	2,8	7,0	15,1	16,1	15,9

3. OCEANOGRAPHIC CONDITIONS

3.1 Vertical sections

We did not obtain the planned hydrographical samples on the survey in April 2008; some data from this survey is shown in figure 3.2.
The locations of the hydrographic lines sections occupied during the survey in October 2006 are shown in Figure 3.1. This gives some explanation of the typical hydrographical conditions in this area.
Line A was the most closely located to the Congo River Fan region. The 10-15 m thick layer of very low salinity water (S < 29) persisted across the entire section, indicating a direct influence of the river discharge plume. On Line B, the low salinity signature was confined the two offshore stations only, Site HD1474 and 1475. Finally, on the northernmost Line C the low-salinity signature vanished from the distribution.

Below the top layer affected by the river plume and above the thermocline depth at 40-50 meters there were no significant differences between the sections. The water column was characterized by high temperature, (T > 24ºC), fixed salinity range (S = [30, 35]) and relatively high dissolved oxygen levels (DO > 4 ml l-1). This range of parameters indicates for the presence of the waters advected from the equator with a current associated to coastally-trapped seasonal Kelvin waves. The thermocline was clearly slanted toward the coast indicating for such a southward-flowing geostrophic current.

Below the thermocline, the water column on all sections exhibited a linear decrease with depth of temperature and salinity, as well as low dissolved oxygen levels (DO < 4 ml l-1). These properties indicated South Atlantic Central Water (SACW), a sub-thermocline water mass that is the source of nutrients and high productivity in the coastal zone during upwelling.

The hydrographic observations suggest the following scenario of the circulation in the Congo River Fan area during October. The river plume advects low-salinity water northwestwards. This is consistent with historical data from the Congo River Fan region. However, the flow within the plume may be detached from the mean current of the underlying water column. As suggested by the slant of the thermocline, the direction of the mean current below the plume may be southward thus opposite to the surface current. Altimetry data from satellites (not shown) confirm that southwards intrusions of equatorial water remotely forced by Kelvin waves occur off Angola twice a year, in February-March and in October. The presence of such a southward flow immediately prior or during the survey is corroborated by the presence of the Equatorial Water signatures on all hydrographic sections.

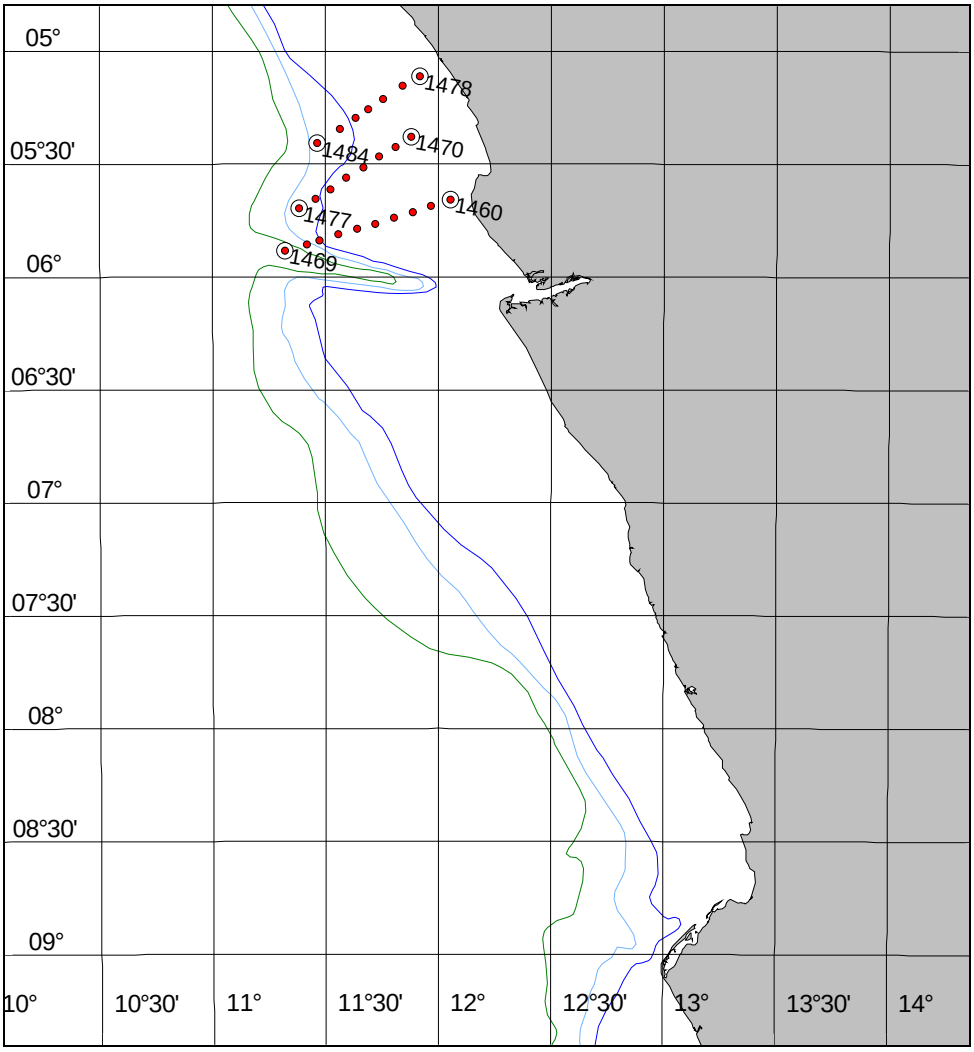

Figure 3.1 Map showing the hydrographical transects from the environmental survey in October 2006 in the Cabinda area.

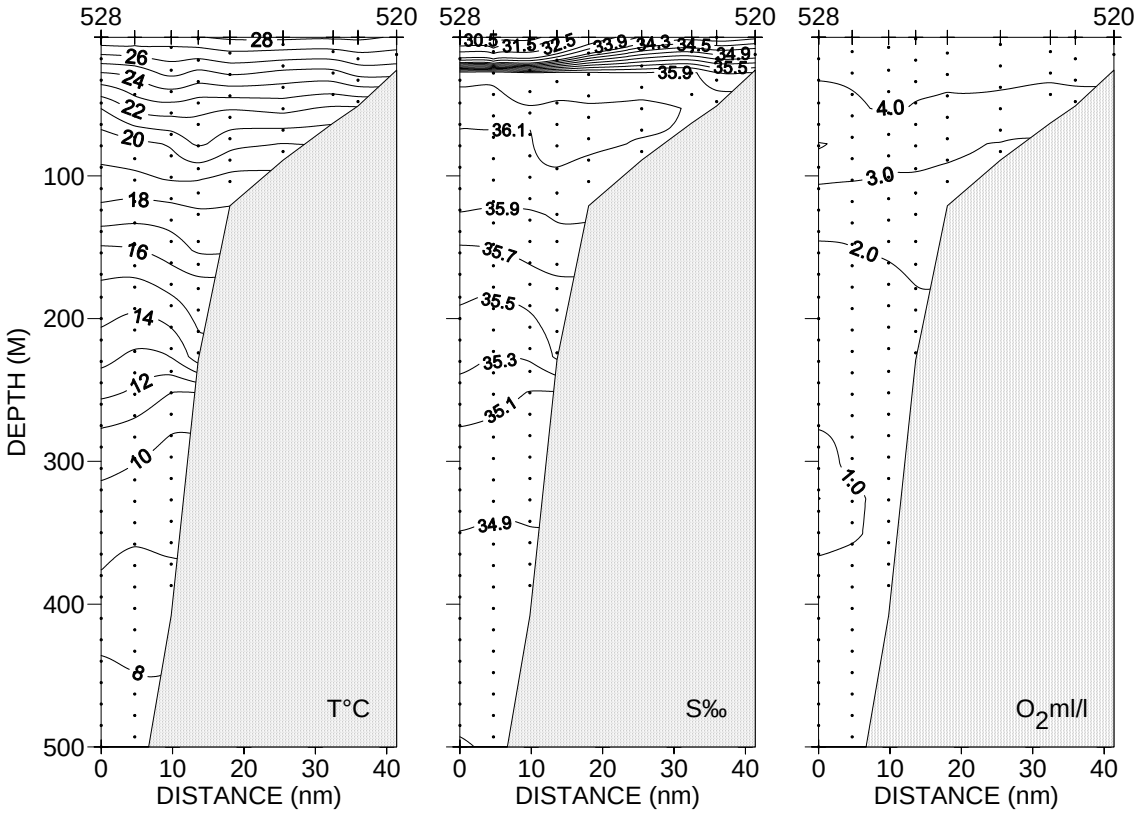

Figure 3.2 Vertical sections of temperature, salinity and oxygen in the Angola-Congo border transect April 2008.

4 APPENDIX

SAMPLING JOURNAL **Page nr: 1 of 8**

Vessel: R/V Dr. Fridtjof Nansen	Area: Cabinda Angola	Project code:	Survey nr: 2008403

Grab station nr.	Date	Position		Depth (m)
		Latitude	Longitude	
CAB 1	15.04.08	5.0979	11.9594	26

Weather:	Wind:	Wave hight (m):
Time Start: 15:15	Time Finish: 17:20	Duration: 02:05
Sample equipment used (name, bite area, weight): 0,1 m^2 van Veen grab with short arms and extra weight. Change to 0,1 m^2 with long arms and extra weight.		

Type of bottom sediment: mud with sand and stones	
Color: 2.5 Y 3/3 dark olive brown	Odor: no
Observation of animals: Ophiuroidea, Polychaeta	
Observation of oil, waste etc: No	No rejected samples: 12

Sample nr	Volume (cm from lid to sediment)	Hydrocarbons 300 g		Heavy metal 100 g		Grain size TOM 300 g	Remarks:
		Norway	Angola	Norway	Angola		
1	9 cm = 10 l	1	0	1	0	1	
2	6 cm = 13 l	1	0	1	0		
3	15 cm = 3,5 l	1	0	1	0		

Sample nr	Volume (cm)	No containers bottom fauna	Remarks:
4	18 = 1,5 l	2	
5	10 = 7,5 l	5	Many shells in the sediment
6	18 = 1,5 l	1	
7	18 = 1,5 l	2	
8	2 = 18 l	11	Many shells in the sediment

Vessel: R/V Dr. Fridtjof Nansen	Area: Cabinda Angola	Project code:	Survey nr: 2008403

Grab station nr.	Date	Position		Depth (m)
		Latitude	Longitude	
CAB 2	15.04.08	5.1416	11.8825	51

Weather:	Wind:	Wave hight (m):
Time Start: 18:15	Time Finish: 19:40	Duration: 01:25
Sample equipment used (name, bite area, weight): 0,1 m^2 van Veen grab with long arms was too heavy. Change to 0,1 m^2 with short arms.		

Type of bottom sediment: mud	
Color: 10 YR 3/2 very dark grayish brown	Odor: no
Observation of animals: Polychaeta	
Observation of oil, waste etc: No	No rejected samples: 1

Sample nr	Volume (cm from lid to sediment)	Hydrocarbons 300 g		Heavy metal 100 g		Grain size TOM 300 g	Remarks:
		Norway	Angola	Norway	Angola		
1	Full = 21 l	1	0	1	0	1	
2	Full = 21 l	1	0	1	0		
3	Full = 21 l	1	0	1	0		

Sample nr	Volume (cm)	No containers bottom fauna	Remarks:
4	Full = 21 l	1	
5	Full = 21 l	1	
6	Full = 21 l	1	
7	Full = 21 l	1	
8	Full = 21 l	1	

SAMPLING JOURNAL **Page nr: 3 of 8**

Vessel: R/V Dr. Fridtjof Nansen	Area: Cabinda Angola	Project code:	Survey nr: 2008403

Grab station nr.	Date	Position		Depth (m)
		Latitude	Longitude	
CAB 3	15.04.08	5.1718	11.8322	63

Weather: Good	Wind: weak	Wave hight (m):0-0.5
Time Start: 20:28	Time Finish: 21:25	Duration: 00:57
Sample equipment used (name, bite area, weight): 0,1 m^2 with short arms without extra weight.		

Type of bottom sediment: mud	
Color: 5 Y 4/2 Olive gray	Odor: no
Observation of animals: Polychaeta	
Observation of oil, waste etc: No	No rejected samples:

Sample nr	Volume (cm from lid to sediment)	Hydrocarbons 300 g		Heavy metal 100 g		Grain size TOM 300 g	Remarks:
		Norway	Angola	Norway	Angola		
1	Full = 21 l	1	0	1	0	1	
2	Full = 21 l	1	0	1	0		
3	Full = 21 l	1	0	1	0		

Sample nr	Volume (cm)	No containers bottom fauna	Remarks:
4	Full = 21 l	1	
5	Full = 21 l	1	
6	Full = 21 l	1	
7	Full = 21 l	1	
8	Full = 21 l	1	

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Grab station nr.	Date	Position		Depth (m)
		Latitude	Longitude	
CAB 4	16.04.08	5.3901	11.5450	365

Weather:	Wind:	Wave hight (m):
Time Start: 06:30	Time Finish: 09:20	Duration: 02:50
Sample equipment used (name, bite area, weight): 0,1 m^2 with short arms without with extra weight.		

Type of bottom sediment: mud	
Color: 2.5 Y 3/1 very dark gray	Odor: no
Observation of animals: Polychaeta	
Observation of oil, waste etc: No	No rejected samples: 3

Sample nr	Volume (cm from lid to sediment)	Hydrocarbons 300 g		Heavy metal 100 g		Grain size TOM 300 g	Remarks:
		Norway	Angola	Norway	Angola		
1	Full = 21 l	1	0	1	0	1	
2	Full = 21 l	1	0	1	0		
3	Full = 21 l	1	0	1	0		

Sample nr	Volume (cm)	No containers bottom fauna	Remarks:
4	Full = 21 l	1	
5	Full = 21 l	1	
6	Full = 21 l	1	
7	Full = 21 l	1	
8	Full = 21 l	1	

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Grab station nr.	Date	Position		Depth (m)
		Latitude	Longitude	
CAB 5	16.04.08	5.3155	11.6383	121

Weather:	Wind:	Wave hight (m):
Time Start: 10:15	Time Finish: 11:43	Duration: 01:23
Sample equipment used (name, bite area, weight): 0,1 m^2 with short arms		

Type of bottom sediment: mud and black sand	
Color: 2.5 Y 3/2 very dark grayish brown	Odor: no
Observation of animals: Polychaeta, Gastropoda	
Observation of oil, waste etc: No	No rejected samples:

Sample nr	Volume (cm from lid to sediment)	Hydrocarbons 300 g		Heavy metal 100 g		Grain size TOM 300 g	Remarks:
		Norway	Angola	Norway	Angola		
1	Full = 21 l	1	0	1	0	1	
2	Full = 21 l	1	0	1	0		
3	2 = 18 l	1	0	1	0		

Sample nr	Volume (cm)	No containers bottom fauna	Remarks:
4	Full = 21 l	1	
5	Full = 21 l	1	
6	Full = 21 l	2	
7	Full = 21 l	1	
8	Full = 21 l	1	

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Grab station nr.	Date	Position		Depth (m)
		Latitude	Longitude	
CAB 6	16.04.08	5.2407	11.7378	89

Weather:	Wind:	Wave hight (m):
Time Start: 10:15	Time Finish: 11:43	Duration: 01:23
Sample equipment used (name, bite area, weight): 0,1 m^2 with short arms, without extra weight		

Type of bottom sediment: mud	
Color: 10 YR 3/2 very dark grayish brown	Odor: no
Observation of animals: Crustacea, Polychaeta, Mollusca	
Observation of oil, waste etc: No	No rejected samples:

Sample nr	Volume (cm from lid to sediment)	Hydrocarbons 300 g		Heavy metal 100 g		Grain size TOM 300 g	Remarks:
		Norway	Angola	Norway	Angola		
1	Full = 21 l	1	0	1	0	1	
2	Full = 21 l	1	0	1	0		
3	Full = 21 l	1	0	1	0		

Sample nr	Volume (cm)	No containers bottom fauna	Remarks:
4	Full = 21 l	4	
5	Full = 21 l	3	
6	Full = 21 l	5	
7	11 = 8,5 l	1	
8	Full = 21 l	2	

Vessel: R/V Dr. Fridtjof Nansen	Area: Cabinda Angola	Project code:	Survey nr: 2008403

Grab station nr.	Date	Position		Depth (m)
		Latitude	Longitude	
CAB 7	16.04.08	5.3668	11.7827	67

Weather: good	Wind: light breeze	Wave hight (m): 0-0.5
Time Start: 15:25	Time Finish: 16:35	Duration: 01:10
Sample equipment used (name, bite area, weight): 0,1 m^2 with short arms, without extra weight		

Type of bottom sediment: mud	
Color: 2.5 Y 3/3 dark olive brown	Odor: no
Observation of animals: Polychaeta, Echinoderma	
Observation of oil, waste etc: No	No rejected samples:

Sample nr	Volume (cm from lid to sediment)	Hydrocarbons 300 g		Heavy metal 100 g		Grain size TOM 300 g	Remarks:
		Norway	Angola	Norway	Angola		
1	Full = 21 l	1	0	1	0	1	
2	6 cm = 13 l	1	0	1	0		
3	Full = 21 l	1	0	1	0		

Sample nr	Volume (cm)	No containers bottom fauna	Remarks:
4	Full = 21 l	1	
5	Full = 21 l	1	
6	Full = 21 l	1	
7	Full = 21 l	1	
8	Full = 21 l	1	

Vessel: R/V Dr. Fridtjof Nansen	Area: Cabinda Angola	Project code:	Survey nr: 2008403

Grab station nr.	Date	Position		Depth (m)
		Latitude	Longitude	
CAB 8	16.04.08	5.5001	11.8331	63

Weather: Rain	Wind:	Wave hight (m):
Time Start: 17:25	Time Finish: 18:40	Duration: 01:15
Sample equipment used (name, bite area, weight): 0,1 m^2 with short arms, without extra weight		

Type of bottom sediment: mud	
Color: 2.5 Y 3/2 very dark grayish brown	Odor: no
Observation of animals: Polychaeta, Echinodermata	
Observation of oil, waste etc: No	No rejected samples:

Sample nr	Volume (cm from lid to sediment)	Hydrocarbons 300 g		Heavy metal 100 g		Grain size TOM 300 g	Remarks:
		Norway	Angola	Norway	Angola		
1	7 cm = 12 l	1	0	1	0	1	
2	Full = 21 l	1	0	1	0		
3	4 cm = 16 l	1	0	1	0		

Sample nr	Volume (cm)	No containers bottom fauna	Remarks:
4	Full = 21 l	1	
5	Full = 21 l	1	
6	Full = 21 l	1	
7			Leave the area
8			

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Grab station nr.	Date	Position		Depth (m)
		Latitude	Longitude	
CAB 9	26.04.08	5.3636	11.5735	44

Weather:	Wind:	Wave hight (m):
Time Start: 17:00	Time Finish: 19:25	Duration: 2:25
Sample equipment used (name, bite area, weight): Small grab, 0,1 m^2 with weight 4 empty grabs		

Type of bottom sediment: Stones, fine sand, mud	
Color: 10 YR 3/2 very dark grayish brown	Odor: No
Observation of animals: Anthozoa, crabs, Polychaeta	
Observation of oil, waste etc: No	No rejected samples: 11

Sample nr	Volume (cm from lid to sediment)	Hydrocarbons 300 g		Heavy metal 100 g		Grain size TOM 300 g	Remarks:
		Norway	Angola	Norway	Angola		
1	3 cm = 17l	1	1	1	1	1	
2	16 cm = 3l	1	1	1	1		
3	7 cm = 12 l	1	1	1	1		

Sample nr	Volume (cm)	No containers bottom fauna	Remarks:
4	1 cm = 20 l	4	
5	1 cm = 20 l	2	
6	1 cm = 20 l	2	
7	Full = 21 l	4	
8	Full = 21 l	2	

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Grab station nr.	Date	Position		Depth (m)
		Latitude	Longitude	
CAB 10	26.04.08	5.4230	12.2335	25

Weather:	Wind:	Wave hight (m):
Time Start: 20:28	Time Finish: 21:30	Duration: 1:02
Sample equipment used (name, bite area, weight): 0 ,1 m^2 with short arms without extra weight		

Type of bottom sediment: Mud	
Color: Gley 1 2.5/10Y Greenish black	Odor: No
Observation of animals: Gastropode	
Observation of oil, waste etc: No	No rejected samples:

Sample nr	Volume (cm from lid to sediment)	Hydrocarbons 300 g		Heavy metal 100 g		Grain size TOM 300 g	Remarks:
		Norway	Angola	Norway	Angola		
1	Full = 21 l	1	1	1	1	1	
2	Full = 21 l	1	1	1	1		
3	Full = 21 l	1	1	1	1		

Sample nr	Volume (cm)	No containers bottom fauna	Remarks:
4	Full = 21 l	1	
5	Full = 21 l	1	
6	Full = 21 l	1	
7	Full = 21 l	1	
8	Full = 21 l	1	