RV „GAUSS“

Cruise no. 446a

10 – 28 August 2005

Translation of the report
Pictures in the report in German language

Report of the chief scientist

Dr. Gerd Becker

Bad weather approaching

Stern A-frame of RV Gauss with single-conductor cable of „Delphin“ tow fish

Hamburg, September 2005

Cruise Objectives

Oceanographic, chemical, and radiological total survey of the German Bight, English Channel, and North Sea using the towed CTD system „Delphin“ at the time of maximum stratification; water sampling and calibration at additional stations.

Participants:

Dr. Gerd Becker	Physics; chief scientist
Ms. Petra Einfeldt	Physics
Andreas Pfeiffer	Physics
Rüdiger Rasmus	Physics
Jens Wemheuer	BIOSENS
Achim Schulz	Physics
Manfred Schimanski	Org. chemistry
Ms. Elke Hammermeister	Org. chemistry
Udo Ziebarth	Org. chemistry
Ms. Rita Kramer	Nutrient chemistry
Ms. Wiebke Brandt	Nutrient chemistry
Ms. Roswitha Velten	Nutrient chemistry
Ms. Ilse Büns	Nutrient chemistry
Ingo Goroncy	Radiochemistry
Ms. Monika Gorny	Radiochemistry

Materials and methods

- CTD/rosette sampler (Seabird SBE 19 with oxygen sensor and fluorometer, 12-conductor rosette sampler with 10-litre sampling bottles
- Delphin tow fish (standard version with CTD, fluorometer, AMT oxygen sensor)
- thermosalinograph Seabird with turbidity and gelbstoff sensor
- oxygen determination according to Winkler-Carpenter using dissolved oxygen analyser (DOA) made by SIS, with photometric endpoint determination
- Secchi disc transparency at each station
- filtration through glass fibre filter GF/C under 0.2 bar low-vacuum pressure (max. 500 mL)

Nutrient samples

PO_4-P: (Murphy and Riley, 1962)
Under acid conditions, ortho-phosphate reacts with ammonium molybdate to form phosphomolybdic acid, which is reduced to a blue-coloured phosphorous molybdate complex by ascorbic acid. Absorption is measured at 880 nm and is proportionate to the concentration.
(Reaction at 40 °C)
Range of application: c (PO_4-P) 0.01-4.00 µmol/L.

SiO_4-Si: (Koroleff, 1971)
Silicate reacts with an ammonium molybdate sulfate solution to form silicomolybdic acid, which is reduced to a blue-coloured silicon molybdate complex by ascorbic acid. Adsorption is measured at 810 nm and is proportionate to the silicate concentration. Phosphate interference is prevented by adding oxalic acid prior to the reduction.
(Reaction at approx. 40 °C)
Range of application: c (SiO_4-Si) 0.1-50.0 µmol/L.

NO_2-N: (Bendschneider and Robinson, 1952)
Nitrite is determined by diazotation of sulfanilamide under acid conditions and formation of an azo pigment through attachment to N-(1-naphthyl)-ethylenediamine-dihydrochloride (azo coupling). Absorption of the azo pigment is measured at 540 nm.
(Reaction at ambient temperature)
Range of application: c(NO_2-N)0.01-3.00 µmol/L.

NO_3+NO_2-N: (Bendschneider and Robinson, 1952)
Nitrate is reduced to nitrite by passage through a copper-cadmium column. This nitrite, together with existing nitrite, is determined by diazotation of sulfanilamide under acid conditions and formation of an azo pigment through attachment to N-(1-naphthyl)-ethylenediaminedihydrochloride (azo coupling). Absorption of the azo pigment is measured at 540 nm.
(Reaction at ambient temperature)
Range of application: c(NO_3- NO_2-N)0.1-30.0 µmol/L.

NH_4-N (Berthelot 1859)
Ammonium is measured by determining the sum of $NH_4^+$and NH_3. The automated determination of ammonium is based on a modified Berthelot reaction. Ammonium is converted with dichloroisocyanuric acid under alkaline conditions to form monochloroamine, which reacts with salicylate to form 5-aminosalicylate. After oxidation and a coupling reaction, a green coloured indophenol derivative is obtained. Absorption of this colour complex is determined photometrically at 660 nm. Sodium nitroprussiate is used as catalyst.
(Reaction at 37 °C)
Range of application: c(NH_4-N)0.1-12.0 µmol/L.

A BSH special laboratory container (BSHC 200 009-4) housed the nutrient analysing equipment. The container was connected to the water supply and electric system of RV GAUSS. Photometric measurements of the nutrient parameters o-phosphate, silicate, nitrate+nitrite, nitrite, and ammonium were made parallely using a segmented low analyser system (SFAS).

Samples/standards/wash fluids and reagents are introduced into the system by a peristaltic pump and mixed within the system. The liquid stream is segmented by means of air bubbles ensuring homogeneous mixing and preventing sample carryover. Photometers, which consist of a detector head and an electronic measuring unit, register the analogue signals of absorption and transmit them to recorders and interfaces/computers.

- DN/TDP samples
- seston filter (incl. partic. CN)
- particular P filter
- particular CHO filter
- centrifuge
- DOC samples (IOW, Klaus Nagel) surface and bottom
- total sections in the Skagerrak area
- chlorophyll filter for HPLC analysis through GF/F fibre glass filter at the surface and in the chlorophyll maximum at each station
- determination of pH value using WTW pH 91, WTW electrode type E39
- turbidity measurement using Turner nephelometer TD 40 (relative nephelometer Turner units)
- chlorophyll measurement using 1-Hz fluorometer type BBE 42c30 Moldaenke
- radiochemistry (per sample):
  caesium: 100 l sea water passed through ion exchanger (potassium hexacyanoferrate II cobaltate II) to obtain 20 g laboratory sample; analysed at Hamburg
- transuranic elements (Pu, Am, Cu): 100 l sea water, via precipitation of iron hydroxide reduction to 1 l sample each; analysed at Hamburg
  iodine: 1 l sea water preserved using sodium hydroxide; analysed at Hannover
  tritium: analysis of 1 l untreated sea water
  technetium: 100 l sea water filled in 3 drums; analysed at Risö/Denmark
  strontium: 70 l sea water in 2 drums; analysed at Hamburg

Map of stations

Fig. 1 Station network and Delphin towing transects, cruise 446a

Cruise narrative
RV GAUSS sailed from Hamburg, Kirchenpauerkai, at 09:00 h on 10 August 2005. The first stations on the Elbe downstream section were at Twielenfleth and off Cuxhaven, where samples for organic chemistry were taken. The current was strong (4 kn), so that the CTD and rosette could only be deployed near the surface. Also the 100 l sampler could only be deployed open. The weather was unfriendly, misty, windy, and rainy; 6 – 7 Bft from 290°.
First sample treatments, and at the same time installation and testing of equipment. 18:00 h general information meeting of all participants. Emphasis on strict smoking ban in the laboratories and on the working deck because of special hazards posed by solvent vapours.
Wind increased slightly, with gusts reaching 7 – 8 Bft. Ship speed decreased to less than 9 kn. Station 10 was reached with delay.

11 August
Weather unchanged, 6 – 7 Bft, hazy, rough seas. Weather calmed during the morning, and the ship gained speed. Station 10 was reached toward 14:00 h and work was completed without any problem. The built-in thermosalinograph showed a major deviation (0.6 PSU), requiring an inspection. Sample filters contained a relatively large amount of plankton. After the TS graph had been opened, a large particle was found in the L-sensor. After its removal the difference between the two devices disappeared.

12 August
Work continued largely on schedule. Due to tidal stream influence, work at the stations regularly had to be started earlier or later than scheduled. At the Dover Strait station, off Dover, work was completed without any problems despite strong tidal currents and considerable ship traffic including one channel swimmer with accompanying boat. Steamed westward at Bft 4 and cloudy, quite friendly weather. Despite the relatively calm weather the average ship speed was only about 10 kn, which means we were still behind schedule.

13 August
Calm weather while we steamed to the western end of the English Channel, 8 hours behind schedule. After having talked to the captain, we hoped to catch up the delay during our northward leg.
In the approaches to the Channel, salinities of 35 or less. At station 904, 35.23 and no stratification. Salinity at the western end of the Channel about 35.32, temperature 18.7 °C. Transparent water with visibility depth of 8 m. Thermocline at 15 – 20 m. Small mackerels – no seagulls! At the westernmost station 906, stratification, transparent water, and a chlorophyll maximum in the thermocline were observed, probably due to decayed plankton. After this station, we proceeded with three engines, making good headway with westerly winds of 5 – 6 Bft. Changed to the south side of the Channel.

14 August
With NW winds around 5 Bft, the strong tidal stream again hindered the vessel's progress, so that no time was gained. Nevertheless, a sunny Sunday morning has its charm. We passed the Channel islands, temporarily reaching high speeds over

ground (max. 14.4 kn). No stratification off the islands, S at 35.15. We wondered why there were hardly any seagulls around.

15 August
Proceeded with three engines, but progress nevertheless was slow because we had caught an unfavourable tidal phase. Preparation of „Delphin“ tow fish for its first deployment. The usual station work proceeded on schedule. As the team was not yet complete, the full task of monitoring „Delphin“ was assigned to Mr. Wernheuer and Mr. Pfeiffer, who used the transect between stations 11 and 16 to run in the tow fish.

16 August
The „Delphin“ transect was completed successfully; problems were encountered with a quick-look computer, which needs to be replaced. After station 16, a major distance had to be covered, which was used for multiple analyses and comparisons by the nutrients and organics group.

17 August
With weak southerly winds, we now made good progress. Laboratory preparations for work on the 60 °N transect. Replacement of computer in the „Delphin“ container.
In the morning, firefighting and general alert drills involving all participants. In the evening, completion of the „Delphin“ transect across the Fair Isle Strait. The missing participants, Mr. Rasmus and Mr. Schulz, were taken on board without any problem. The vessel then steamed toward the 60 °N transect and started the northernmost „Delphin“ transect. Made good progress during the night.

18 August
Toward morning, the wind breezed up, and a strong SW wind of 6 – 7 Bft was encountered off the Norwegian coast, causing a sea state that hindered our progress in southern direction. The water off the Norwegian coast was relatively cold (compared to 2004, about 4-6 °C colder), and fishing efforts were without success (no mackerels).

19 August
Steamed in W direction on the 59 °N transect. The weather calmed, and we reached 10 kn. „Delphin“ operated without any problems. There were bottlenecks in the nutrients group regarding watchkeeping duties, which will be discussed with those concerned in order to solve the problem. The fluorescence measuring device „Twin-Flu“ failed after having been lifted yesterday in the hydrographic well; it was to be lifted once more but broke down completely after conversion to the new software.

20 August
The weather deteriorated again during the night, with gale-force N winds reaching 6-7 Bft. Equipment for testing the wire of the single-conductor winch cable had been taken on board with a view to the 2006 Atlantic cruise. The outcome of prolonged testing was that the wire has to be replaced.
In the afternoon, a big bird of prey was found sitting on the forecastle, later on the mast. It had probably come from Norway, led astray by strong winds and poor visibility.

21 August
The weather had calmed during the night and there was hardly any wind in the morning. During the operations at station 41, a slick of crumbly, slightly oily substance was seen drifting past the vessel; its estimated length was a few hundred metres. Below the polluted surface, large numbers of jellyfish were observed.
The wire of W11 (Delphin) showed abrasion in some places, and the last 10 – 20 m next to the towfish was found to be twisted open, with broken strands. Change to W5, which has a slightly unfavourable position, allowing no direct contact to the container or view of the tow fish. With three containers, two additional winches, the amount of spare equipment and numerous water drums, GAUSS is now loaded to capacity!

22 August
Work was progressing quickly. While paying out and heaving W5, there were occasional hitches. The problem was later investigated, and it was found that the cause was probably voltage surges due to speed changes of the propulsion engine of GAUSS. Modifications to the control unit will be necessary. Meanwhile, a new connector was soldered to the wire of W11 and provided with water-proof insulation.

23 August
The 57°N transect was completed towards 05:00 h, and the course was set for Aberdeen. Long wait for the pilot. GAUSS was moored at Regency Pier, in the centre of Aberdeen, toward 10:00h MEST.
Processing of samples continued, and the data were secured. At 20:00 in the evening, GAUSS sailed from Aberdeen heading for station 33. The time off had been enjoyed by the whole team, and work was resumed with fresh energy. Delphin was changed over again to the W11 winch. The initially moderate wind from southerly directions increased quickly, reaching 7 Bft during the night.

24 August
The wind increased further, and the vessel made slow progress. Station 33 was reached as late as 05:30 h. With an E course and southerly winds gusting to 9 Bft, the vessel was rolling strongly, and the working deck was under water. Those working on board were instructed to wear lifejackets. Sampling was only possible with stopped engines. Also the deployment and recovery of the Delphin tow fish was difficult. The organics cabinet and the two 100 l bottles were shifted by a blow of the sea. Therefore, they were returned to the position in front of the bull's eye of the CTD room, where they could be fastened more securely. This made it impossible for the CTD operator to monitor deployment and recovery of the probe – a safety hazard! Either the cabinet has to be modified or positioned in such a way (including lashings) that the CTD operator can monitor the handling of the rosette on the deck.

25 August
The weather was calmer, and we proceeded to the additional stations „Ente 3“ and „Ente 2“ which had to be worked earlier because shiptime for the next cruise has been reduced. Due to the small distance between stations and the long processing time of samples, a waiting period of about one hour was required at „Ente 3“ before the large bottles could be deployed again.
At dawn, we passed a big platform in the German EEZ which released smoke or steam above the water surface. Due to poor visibility, no details could be seen. There was a thunderstorm in the afternoon, but the weather improved as we approached the Danish coast. Because of the shallow depth and homogeneous water column,

Delphin was hauled on board, and station 26 was approached without the tow fish. Maintenance of Delphin and inspection of W5.

26 August
While crossing Horns Rev, we steamed against the tidal stream losing 1.5 hours, and the shallow station off Sylt was worked as late as 05:30 h. Delphin was deployed after station 23; no stratification, however (until station 22).
Discussion with chief on possible maximum cable length on the upper single-conductor reel. Reportedly, only 6200 m has been reeled in 2002, but this is not quite certain. For the Atlantic cruise scheduled for next year, 6500 m should be ordered again.
Stratification started in the area of station 22. Before that, the surface salinity gradient was almost linear, and no mesoscale structures were observed.

27 August
While steaming across the Dogger Bank at night, progress was once more hindered by the sea state and we lost 2 h; there was not much buffer time left. The vessel was rolling and pitching heavily in the short, steep waves of the Dogger Bank at 6 – 7 Bft. Unquiet night. Station 19 was reached as late as 08:15 h. By that time, the data connection with Delphin had been interrupted twice. It was restored by re-starting the programme.
The water column in the Dogger Bank area was found to be vertically homogeneous, with low chlorophyll concentrations. With continuing strong wind, the vessel temporarily reached only 7-8 kn speed. The westernmost position (station 18) was reached in the late afternoon, after which we headed toward Cuxhaven. W5 was cleaned and prepared for transport.

28 August
The weather having calmed during the night, we made better progress and largely caught up lost time. The equipment continued to operate satisfactorily. The shipboard thermosalinograph showed too low salinity values from 27.08. and had to be cleaned once more. As the weather was still calm, quick progress was now made. On the 54°N transect, weak stratification was encountered in some places, though plankton concentrations were low. Toward 20:00 h, we passed the FINO platform.

29 August
The last station before the Elbe river was worked toward 03:45 h. The Delphin tow fish had been hauled on board earlier in order to disassemble the equipment, winches, and laboratory container because there would not be enough time in Cuxhaven on 29. At Cuxhaven, preparations were made for the exchange of participants; the crane arrived on schedule and offloaded Delphin and other equipment. Toward 10:00 h the new participants of the second part of the cruise arrived. By 11:00 h, all exchange procedures had been completed.

Final remarks
Apart from some small problems with the equipment and winches, which were solved without major difficulties, the cruise was successful, affected only by the weather. The largely new deck’s crew of GAUSS co-operated excellently with the various working groups, and co-operation among the individual working groups was also very good.

Statistics of cruise no. 446a

62 CTD stations with a total of 310 x 10 l samples
349 salinity samples
about 2050 nm towed distance Delphin

Organics

64 x 10 l vessels for the determination of polar pesticides by means of solid phase extraction
44 x 100 l vessels for the determination of organic pollutants by means of liquid-liquid extraction
2 Gemini corer samples, 4 cores of about 40 cm length each, cut into 8 sections.
12 centrifuge samples

Radiochemistry

84 samples iodine 129	(1 l bottles)	
61 samples caesium 137	(100 l each)	
61 samples strontium 90	(70 l each)	
61 samples technetium 99	(100 l each)	
61 samples plutonium 239/40	(100 l each)	precipitation
61 samples plutonium 238	(100 l each)	precipitation
61 samples americium 241	(100 l each)	
61 samples curium 244	(100 l each)	
61 samples tritium	(1 l each)	

Nutrients

325 samples; used for repeat determinations of 5 parameters. 3250 analyses.
During cruise leg GA446A, 325 samples were analysed parallelly in 21 analysis runs, in repeat determinations, for PO_4-P, SiO_4-Si, SO_3+NO_2-N, NO_2-N, and NH_4-N. Each analysis run included a calibration, a „nut cocktail“ (in-house standard), and other standard checks to ensure quality. Additional analyses were run for the determination of reproducibility (10-fold repeat determinations) and matrix control.

The results are given in µmol/L. Accuracy requirements for the parameters PO_4-P and NO_2-N are two digits after the point, for the parameters SiO_4-Si, NO_3+NO_2-N, NO_2-N, and NH_4-N one digit after the point, e.g.:

-	PO_4-P (µmol/L)	1.37
-	SiO_4-Si (µmol/L)	12.4
-	NO_2-N(µmol/L)	1.08
-	NO_3+NO_2-N (µmol/L)	22.6
-	NH_4-N (µmol/L)	9.4

Oxygen

332 analyses

Hamburg University

62 Secchi depth at each station
282 filtration using glass fibre filter GF/C under 0.2 bar low-vacuum pressure (max. 500 mL)
282 nutrient samples
282 TDN/TDP samples
282 seston filters (subsequently partCN)
DOC samples at water surface and bottom
approx. 180 chlorophyll filtering for HPLC analysis using GF/F glass fibre at the surface and in the chlorophyll maximum at each station (92 samples).
282 pH value determination using WTW pH91, WTW electrode type E39 (310 samples)
282 turbidity determination using Turner nephelometer TD40 (310 samples) (relative nephelometer Turner units)
282 chlorophyll determination using 1-Hz fluorometer type BBE 42c30 Moldaenke

First results

The North Sea has been in a warm phase since 1987, which was interrupted only by the relatively cold years of 1993 and 1996. From June 2001 through April 2005, the areally averaged surface temperature of the North Sea never fell below the long-term mean in any month. In view of the long duration of the warm anomaly it was assumed that the warm phase of the North Sea was nearing its end. This assumption is supported impressively by the data of the GAUSS cruise. Surface temperatures in the study area were, without exception, below normal (Fig. 2a). Whether that applies to the entire volume of North Sea water is not certain, judging by a preliminary data evaluation. On the one hand, the whole surface layer was generally too cold and, on the other hand, the surface layer was thicker than in the preceding years since 1998 and, moreover, the temperature of the bottom layer (Fig. 2b) clearly exceeded the long-term mean. Water temperatures below 7 °C were only observed in the deep layers of the Norwegian Deep. Conditions in the bottom water layer reflect winter temperatures during the temperature minimum, which largely determines the bottom water temperatures in summer and which occurred while the warm phase still continued.
In the northern half of the North Sea (transects 57, 58, 59, 60 °N), there was no pronounced gradient in the seasonal thermocline (Fig. 3); by contrast, in the southern half (sections 55 and 56 °N) the „normal“ thermocline with very strong gradients (up to 7 °C at 1 m depth difference) was more common, and a genuine two-layer stratification was present. A striking feature was the markedly structured thermocline in the eastern part of the 57 °N transect. Corresponding vertical salinity profiles (Fig. 4) showed that the essential vertical signal was the extent of westward progress of low-salinity water, which is determined by the Baltic outflow; at 57 and 58 °N, it had progressed westward beyond the 2 °E meridian and determined conditions in the surface layer.

The vertical distribution of chlorophyll-a (Fig. 5), measured by the built-in fluorometer of the Delphin tow fish (relative units: volt), showed markedly lower concentrations in 2005 than in the preceding years (from 1998). Simultaneously recorded oxygen levels have led to the assumption that the measured chlorophyll fluorescence resulted partly from decayed phytoplankton (oxygen depletion – reduced levels) and partly from producing plankton (elevated oxygen levels). Although, as in the preceding years, the strongest fluorescence signals originated in the area of the thermocline, higher fluorescence values were distributed preferably in the surface layer. Strong near-surface concentrations of algae (algal blooms) were not observed. These findings were confirmed by visibility depth readings (Fig. 6c, Secchi depths): visibility depths were generally good but there were no extremes as in the past two years, when plankton had accumulated primarily in the thermocline, causing high transparency in the surface layer. Whether the cause of the weak primary production in 2005 was lower inputs or changed climatic conditions in 2005 has not yet been ascertained. Only highly complex numerical ecosystem models are likely to provide an explanation. The high-resolution datasets now available should be suitable as basic data for validation of such models.
Oxygen saturation values in the entire study area (Fig. 6a,b,d) deserve the classification „good". In known problem areas in the outer German Bight and off the coast of Jutland, values were slightly below 80 %, corresponding to values <5.5 mg/l. Between the Dogger Bank and Little Fisher Bank, values were even lower (about 66 %, or 4.5 mg/l); this area is characterised by low tidal friction due to its proximity to the amphidromic point. Tidal near-bottom mixing in this area, both vertical and horizontal, probably is so low that the effect of local depletion is stronger. On the whole, oxygen conditions were found to be very satisfactory for the late summer season.
Analysing the horizontal salinity distribution in the surface and near-bottom layers (Figs. 2 c and d), a split between high Atlantic salinities in the western half and freshwater dominated distribution in the eastern half was observed in the surface layer. Close to the bottom, Atlantic water dominated the northern half of the North Sea, with salinities exceeding 35.25 in some areas. Salinities in the coastal waters of Belgium and the Netherlands as well as Germany and Denmark are determined by continental riverine discharges.

Nutrient chemistry (contributed by Dr. Weigelt-Krenz): nutrients in the surface waters of large parts of the North Sea had been depleted by plankton, which is typical of the season. **Nitrite+nitrate** concentrations up to 1.6 µmol/l were only measured in the river plumes, whereas levels in all other areas were close to the detection limit (0.1 µmol/l) or below (Fig. 9). **Phosphate** levels in large areas of the North Sea ranged between 0.02 and 0.1 µmol/l. Values at the Dogger Bank reached 0.37 µmol/l. Readings in this area are similar throughout the water column. Because of the shallow water depth and intensive mixing, remineralised substances reach the surface more quickly. That is also true in the coastal areas (Fig. 7).
Near the bottom, nutrient levels reflected the strong Atlantic inflow. Up to about 56 °N, phosphate concentrations of ≤ 0.7 µmol/l were measured; in the northern North Sea and in the area of the Norwegian Deep, values near the bottom rose as high as 0.9 µmol/l. Values in the southern North Sea dropped to 0.1 µmol/l. In the Elbe plume, phosphate levels ranged between 0.5 and 0.8 µmol/l. Here, progressing remineralisation and nutrient inputs from the river Elbe as well as stronger mixing in the shallow coastal waters are factors contributing to the higher nutrient concentrations (Fig. 8).

Similar observations were made with **nitrite+nitrate**. In the near-bottom layer in the Elbe outflow, concentrations up to 2 µmol/l were measured, while levels in the northern North Sea and Norwegian Deep reached 7.5 – 14 µmol/l (Fig. 10).
Also in the western part of the English Channel, the inflow of Atlantic water was reflected by higher nutrient concentrations. Phosphate values up to 0.3 µmol/l wer found, and nitrate values up to 3 µmol/l.
Silicate levels generally were below those of the preceding years. This indicates that the remineralisation of diatoms (spring bloom) this year had not progressed as much as last year. Concentrations up to 8 µmol/l near the bottom were measured off the coast of North Friesland. In the coastal waters of southern Norway, the highest measured value was about 6.5 µmol/l. Values in large areas of the North Sea ranged from 2.5 to 4 µmol/l, whereas in the Dogger Bank area some values dropped below 1 µmol/l (Fig. 12).
The radiochemical and organochemical analyses of samples are being carried out at different land-based laboratories, and results are not yet available.

List of Figures

CRUISE SUMMARY REPORT

FOR COLLATIMG CENTRE USE

Centre: DOD **Ref. No.:** 2005164

Is data exchange restricted ☐ Yes ☐ In part ☐ No

SHIP enter the full name and international radio call sign of the ship from which the data were collected, and indicate the type of ship, for example, research ship; ship of opportunity, naval survey vessel; etc.

Name: Gauss **Call Sign:** DBBX

Type of ship: Research Vessel

CRUISE NO. / NAME 446a

enter the unique number, name or acronym assigned to the cruise (or cruise leg, if appropriate).

CRUISE PERIOD start (set sail) 10/08/2005 (day/ month/ year) to 29/08/2005 (day/ month/ year) end (return to port)

PORT OF DEPARTURE (enter name and country) Hamburg, Germany

PORT OF RETURN (enter name and country) Cuxhaven, Germany

RESPONSIBLE LABORATORY enter name and address of the laboratory responsible for coodinating the scientific planning of the cruise

Name: Federal Maritime and Hydrographic Agency (BSH)

Address: Bernhard-Nocht-Str. 78, 20359 Hamburg

Country: Germany

CHIEF SCIENTIST(S) enter name and laboratory of the person(s) in charge of the scientific work (chief of mission) during the cruise.

Dr. G. Becker

OBJECTIVES AND BRIEF NARRATIVE OF CRUISE enter sufficient information about the purpose and nature of the cruise so as to provide the context in which the report data were collected.

Investigation of the summerly hydrographic situation of the North Sea, the German Bight and the Channel with continuous "Delphin"-tracks (towed undulating CTD-system) and CTD-measurements;

chlorophyll-fluorescens, oxygen, nutrients, organic pollutants and radioactivity;

PROJECT (IF APPLICABLE) if the cruise is designated as part of a larger scale cooperative project (or expedition), then enter the name of the project, and of organisation responsible for co-ordinating the project.

Project name:

Coordinating body:

PRINCIPAL INVESTIGATORS: Enter the name and address of the Principal Investigators responsible for the data collected on the cruise and who may be contacted for further information about the data. (The letter assigned below against each Principal Investigator is used on pages 2 and 3, under the column heading 'PI', to identify the data sets for which he/she is responsible)

A. Dr. G. Becker, BSH

B. Dr. Weigelt-Krenz, BSH

C. Dr. Nies, BSH

D. Dr. Theobald, BSH

E. Dr. Brockmann, Inst. f. Biogeochemie und Meereschemie, 20146 Hamburg

F.

MOORINGS, BOTTOM MOUNTED GEAR AND DRIFTING SYSTEMS

This section should be used for reporting moorings, bottom mounted gear and drifting systems (both surface and deep) deployed and/or recovered during the cruise. Separate entries should be made for each location (only deployment positions need be given for drifting systems). This section may also be used to report data collected at fixed locations which are returned to routinely in order to construct 'long time series'.

PI	APPROXIMATE POSITION						DATA TYPE	DESCRIPTION
	LATITUDE			LONGITUDE				
See top of page.	deg	min	N/S	deg	min	E/W	enter code(s) from list on cover page.	Identify, as appropriate, the nature of the instrumentation the parameters (to be) measured, the number of instruments and their depths, whether deployed and/or recovered, dates of deployments and/or recovery, and any identifiers given to the site.

								Please continue on separate sheet if necessary

SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN

Except for the data already described on page 2 under 'Moorings, Bottom Mounted Gear and Drifting Systems', this section should include a summary of all data collected on the cruise, whether they be measurements (e.g. temperature, salinity values) or samples (e.g. cores, net hauls).

Separate entries should be made for each distinct and coherent set of measurements or samples. Different modes of data collection (e.g. vertical profiles as opposed to underway measurements) should be clearly distinguished, as should measurements/sampling techniques that imply distinctly different accuracy's or spatial/temporal resolutions. Thus, for example, separate entries would be created for i) BT drops, ii) water bottle stations, iii) CTD casts, iv) towed CTD, v) towed undulating CTD profiler, vi) surface water intake measurements, etc.

Each data set entry should start on a new line – it's description may extend over several lines if necessary.

NO, UNITS : for each data set, enter the estimated amount of data collected expressed in terms of the number of 'stations'; miles' of track; 'days' of recording; 'cores' taken; net 'hauls'; balloon 'ascents'; or whatever unit is most appropriate to the data. The amount should be entered under 'NO' and the counting unit should be identified in plain text under 'UNITS'.

PI see page 2	NO see above	UNITS see above	DATA TYPE Enter code(s) from list on cover page	DESCRIPTION Identify, as appropriate, the nature of the data and of the instrumentation/sampling gear and list the parameters measured. Include any supplementary information that may be appropriate, e. g. vertical or horizontal profiles, depth horizons, continuous recording or discrete samples, etc. For samples taken for later analysis on shore, an indication should be given of the type of analysis planned, i.e. the purpose for which the samples were taken.
A	**2050**	**nm**	**H11**	**towed CTD (undulating between 5m and 80m)**
				with sensors for oxygen, chlorophyll and turbidity
A	**62**	**station**	**H10**	**Seabird-CTD with GO-waterbottles (employed on upcasts at each station);**
A	**349**	**samples**	**H09**	**calibration samples for salinity,**
A	**2900**	**nm**	**H71**	**Thermosalinograph and BackScat-2-Fluorometer (chlorophyll, turbdity and yellow substance)**
C	**61**	**station**	**H31**	**Radioactivity**
D	**12**	**station**	**P01**	**Centrifuge**
B	**62**	**station**	**P01**	**Filtration**
B	**62**	**station**	**H21**	**Oxygen**
E	**62**	**station**	**B02**	**Chlorophyll**
E	**62**	**station**	**B06**	**DOC, DON, DOP**
E	**62**	**station**	**H90**	**Turbidity**
B	**62**	**station**	**H22**	**Phosphates**
B	**62**	**station**	**H23**	**Total P**
B	**62**	**station**	**H24**	**Nitrates**
B	**62**	**station**	**H25**	**Nitrites**
B	**62**	**station**	**H26**	**Silicates**
E	**62**	**station**	**H28**	**pH**
E	**60**	**station**	**D90**	**Secci depth**
D	**2**	**station**	**G04**	**Gemini Corer**
C	**61**	**station**	**H32**	**Isotopes**
C	**84**	**station**	**H32**	**Jod 129**
D	**23**	**station**	**P90**	**polar Pesticides**
D	**31**	**station**	**P13**	**organic Pollutants**
				Please continue on separate sheet if necessary

TRACK CHART: You are strongly encouraged to submit, with the completed report, an annotated track chart illustrating the route followed and the points where measurements were taken.	**Insert a tick(✓) in this box if a track chart is supplied**	X

GENERAL OCEAN AREA(S): Enter the names of the oceans and/or seas in which data were collected during the cruise – please use commonly recognised names (see, for example, International Hydrographic Bureau Special Publication No. 23, 'Limits of Oceans and Seas').

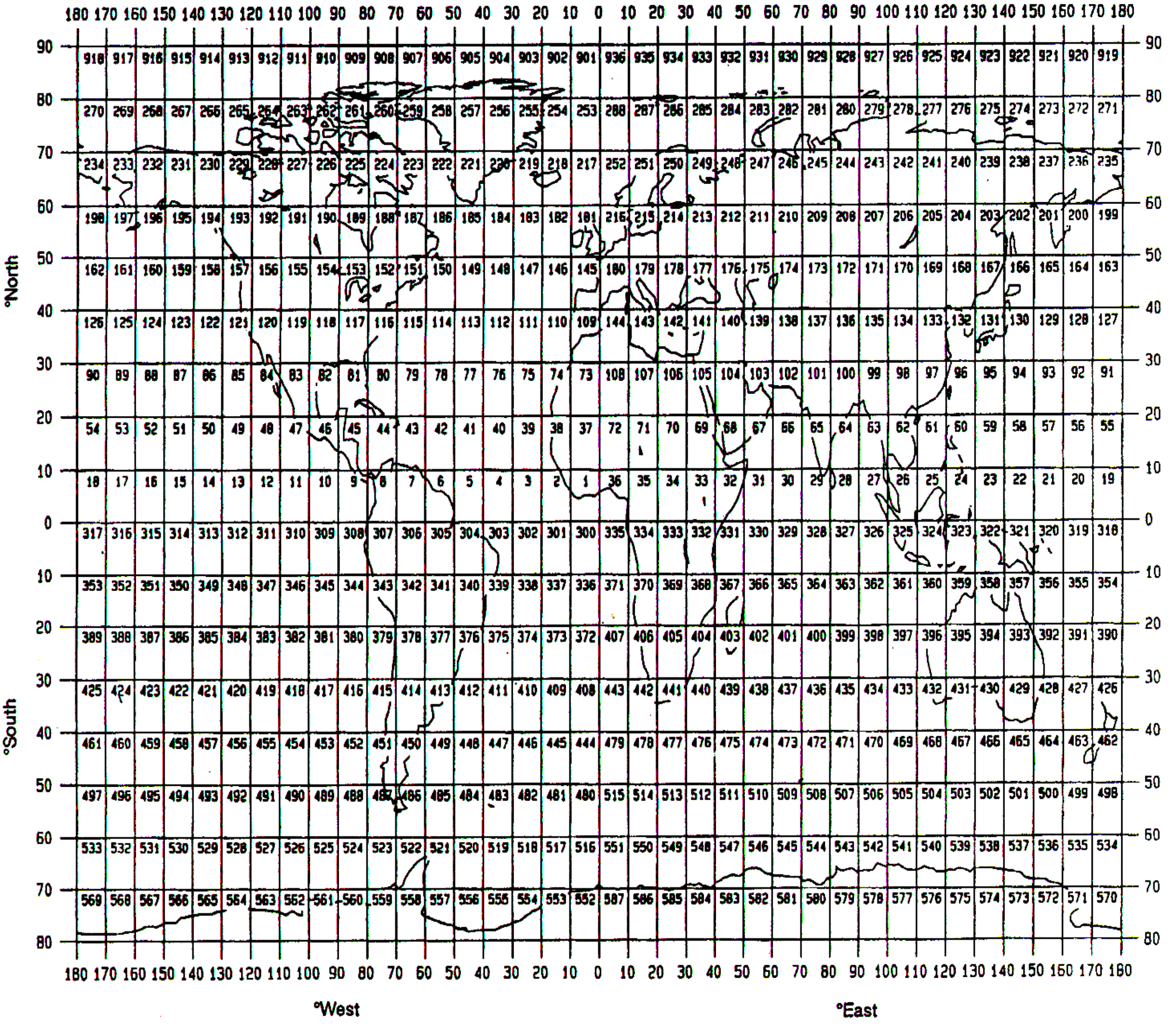
North Sea, German Bight

SPECIFIC AREAS: If the cruise activities were concentrated in a specific area(s) of an ocean or sea, then enter a description of the area(s). Such descriptions may include references to local geographic areas, to sea floor features, or to geographic coordinates.
Please insert here the number of each square in which data were collected from the below given chart

181, 216

GEOGRAPHIC COVERAGE - INSERT 'X' IN EACH SQUARE IN WHICH DATA WERE COLLECTED

see above



THANK YOU FOR YOUR COOPERATION
Please send your completed report without delay to the collating centre indicated on the cover page