Institut für Meereskunde an der Universität Kiel

Cruise Report

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F.S. "POSEIDON" Cruise 211

31.8. - 11.9. 1995 Reykjavik (IS) - Lisbon (P)

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CONTENTS

- 1. Purpose of the cruise
- 2. List of participants
- 3. Research program
- 4. Narrative of the cruise
- 5. Preliminary results
 - 5.1. Hydrography (M. Busse and L. Mintrop)
 - 5.2. The carbonate system
 - 5.2.1. Total carbonate and alkalinity in surface waters (L. Mintrop, A. Körtzinger and S. Schweinsberg)
 - 5.2.2. Determination of pH and alkalinity in surface waters (F. Fernandez Pérez and J. Pérez Juste)
 - 5.2.3. pCO₂ in surface waters (L. Mintrop)
 - 5.3. Methane and pCO₂ (R. Keir, G. Rehder)
 - 5.4. Methylamines and ammonia in atmosphere and surface waters (S. Gibb)
 - 5.5. Halocarbon analysis (J. Baker)
 - 5.6. Sulfur compounds
 - 5.6.1. Dimethylsulfide and related compounds (A. Hatton)
 - 5.6.2. Dimethylsulfide in surface waters (C. Szakolczai)
 - 5.7. Direct measurements of air-sea fluxes (M. Moerman and F. Hansen)
 - 5.8. ¹²C/¹³C isotope relation in dissolved inorganic carbon (G. Rehder, R. Keir, H. Erlenkeuser)
 - 5.9. Nutrients (H. Johannsen)
 - 5.10. Chlorophyll and carotenoid pigments (S. Gibb)
- 6. Figures
- 7. Data tables
- 8. Concluding remarks

1. Purpose of the cruise

On the cruise 211 of R. V. POSEIDON leading from Reykjavik, Iceland, to Lisbon, Portugal, several investigations concerning the air-sea exchange of trace gases should be carried out, most of the participating groups beeing tied to the OMEX-air-sea exchange group.

2. List of participants

Dr. Ludger Mintrop Dr. Robin Keir Gregor Rehder Dr. Stuart W. Gibb Angela Hatton Jonathan M. Baker Cyril Szakolczai Finn Hansen Marcel Moerman Jorge Pérez Juste Marcus Busse chief scientist scientist scientist scientist scientist scientist technician technician student UBG, Bremen and IfM, Kiel, D GEOMAR, Kiel, D GEOMAR, Kiel, D PML, Plymouth, GB UEA, Norwich, GB UEA, Norwich, GB CNRS, Gif-sur-Yvette, F RISO, Roskilde, DK TNO, Den Haag, NL IIM, Vigo, ES IfM, Kiel, D

abbreviations:

UBG IfM	Universität Bremen, Fachbereich Geowissenschaften Institut für Meereskunde an der Univ. Kiel
GEOMAR	Forschungszentrum für marine Geowissenschaften
PML	Plymouth Marine Laboratory
UEA	University of East Anglia, School of Environmental Sciences
CNRS	Centre National de Recherche Scientifique
RISO	Riso National Laboratory, Meteorol. Department
TNO	TNO Physics and Electronics Laboratory
IIM	Insituto de Investigaciones Marinas

3. Research program

The planned cruise track is shown in Figure 1a with the stations indicated where CTD-casts should be taken. After leaving Reykjavik a station situated in the Denmark Strait shall be approached, using the time to fully install all systems and start first underway measurements. A hydrocast is planned at the first station mainly to characterize the different water masses expected along the depth profile and their concentrations of the different compounds listed below, which will be analysed during this cruise. The second station will be the Goban Spur near the Irish shelf, a central region of OMEX. The last station off the Portuguese coast is planned as a pilote to future OMEX-activities in this area. However, main emphasis is laid on underway investigations to measure the variables listed in the following:

Carbon dioxide and oceanic carbon system variables:

Emission of anthropogenic carbon strongly disturbs the natural carbon cycle. The ocean with its largest accessible carbon reservoir on earth will ultimately control carbon concentrations in the atmosphere, but the short term reaction on the anthropogenic pertubation is most important for the development of climate in the near future. The flux at the air-sea interface is regulated by the difference of partial pressure of CO2 in the two phases. Partial pressure of CO2 in surface seawater and air shall be followed during the whole cruise by a continuously measuring IR-system (IfM Kiel) and a GC-system, which allows for the analysis of a sample approx. every 10 minutes (GEOMAR Kiel). The flux of CO2 between ocean and atmosphere should be measured directly by a dissipation method with two instruments installed in parallel in the ship's mast. From surface samples taken at certain time intervals (ranging from 30 minutes to 4 hours) pH will be measured on board ship and samples shall be taken to determine alkalinity (IIM Vigo, IfM Kiel) and total carbonate (IfM Kiel). This will allow for the analysis of the oceanic carbonate speciation. The internal consistency of the carbon parameter (pH, pCO2, alkalinity, total carbon) shall be checked as well as the comparability of results from different labs.

<u>Methane:</u>

Methane is a trace gas in the atmosphere which has a variety of natural and anthropogenic sources. In shallow seas, methane concentration will be controlled by the intensity of in-situ sources such as gas seeps, and the rates of oxidation and gas exchange with the atmosphere. To learn more about the natural pathways of methane also for the interpretation of continental margin and deep-sea data (OMEX), the opportunity of this cruise shall be used. Samples from hydrocasts as well as from surface sea water shall be analyzed for dissolved methane concentrations.

Sulfur compounds:

Volatile sulfur compounds like dimethylsulfide (DMS) are produced by biological processes in the sea surface and emitted into the atmosphere. DMS is generated from the breakdown of dimethylsulphoniopropionate (DMSP), an osmoregulatory compound of phytoplankton. Once in the atmosphere it formes the bases for cloud nuclei, contributing to the acidity of rainwater. DMS can also be oxidized to dimethylsulphoxide (DMSO) via photooxidation or bacterial oxidation. Atmospheric concentrations are approximately two orders of magnitude lower than those in seawater, so there is effectively a net one-way flux of DMS from the ocean to the atmosphere. Investigations about this flux should be determined from measurements of DMS concentrations in air and surface seawater during the cruise.

Nitrogen compounds:

Nitrogen compounds in oxic seawater range from the thermodynamically most stable species, nitrate, to reduced compounds such as ammonia and its methyl derivatives, the methylamines (monomethylamine, MMA; dimethylamine, DMA and

trimethylamine, TMA). These are biogenic compounds widely distributed in the marine environment and intimately involved in oceanic nitrogen fertility. By virtue of their volatility they are capable of evasion across the air-sea interface and may be an important source alkali to the troposphere and so subsequently play a significant role in the regulation of atmospheric and rainwater pH. Analysis of methylamines and ammonia were to be carried out during the cruise in order to help answer these questions.

Halocarbons:

The halocarbon methyl bromide (CH₃Br) is the major source of bromine ions to the stratosphere. Bromine has an ozone depletion potential of up to six times that of chlorine, so is a very effective ozone destroyer. The sources of CH₃Br are both anthropogenic (structural and agricultural fumigants, gasoline) and natural (the ocean and biomass burning). Very little is known about the fluxes to the atmosphere from any of the sources, especially from the ocean; some scientific groups believe the ocean to be a source and some a sink. On the cruise, the concentrations of CH₃Br, CH₃Cl and CH₃I were to be determined in surface water and air samples to answer this question.

Nutrients:

Since nutrients are essential for any build up of organic carbon by organisms their concentrations can serve as indicator for biological processes and to trace the biological history of a water parcel and its potential for further development. Since the trace gases under investigation on this cruise are more or less coupled to biological processes, nutrient analysis from surface samples should be carried out to support the other investigations.

Chlorophyll and carotenoid pigments:

In biological oceanography the photosynthetic pigments, in particular Chlorophyll a, have long been recognised as unique and convenient markers of phytoplankton biomass. Although spectrophotometric and fluorimetric techniques have been widely used to determine biomass, the utilisation of high performance liquid chromatography HPLC not only permits a more accurate measurement of Chlorophyll a, but also allows simultaneous separation and quantification of a range of other chloropigments and carotinoids in marine phytoplankton. Many of these compounds have strong chemotaxonomic associations, through which it is possible to obtain an understanding of the taxonomic composition of the overall phytoplankton biomass. It might be possible that pigments are potential proxy biomarkers for biogas fluxes. However, as far as methylated biogases are concerned, particularly the MA's and halocarbons, correlation data is extremly sparse. So analysis of chlorophyll and carotenoids on this cruise in parallel to the biogas measurements should serve to close this gap.

4. Narrative of the cruise

leaving Reykjavik ...

The cruise POSEIDON 210 ended in Reykjavik, Iceland, on August 28. The following day was filled with activities to unload the ship, while a lot of logistic problems had to be solved to get all the equipment of the various groups together for the next cruise. After the members of the last cruise had left the ship in the morning of August 30, hectic activities began to convert the ship into the place with the highest instrument density except Spacelab, not without provoking questions like "how many months are you going to stay here?". The last delivery of equipment arrived few minutes before the POSEIDON left the pier on August 31 at 10:00 for its 211th cruise to sail west towards the first planned station in the Denmark Strait.

The setup of instruments continued the first day and a seawater pump was mounted in the moon pool of the ship to supply seawater for sampling and continuous measurements. The CTD, that had been successfully used on the last cruise, had been mounted into a $24 \times 10L$ -bottle rosette.

starting the measurements ...

The continuous determination of methane started on September 1, using an equilibrator feed by the seawater supply. Unfortunately, the transport had killed the computer for continuous pCO_2 measurement, so the system had to be converted to a manual mode, thus allowing to start the measurements in the afternoon at the location where the first station was planned.

the stationwork ...

After a first test of the CTD-rosette with the instrument standing on deck was positive, a test station was inserted into the scedule. The rosette was lowered to about 200m and bottles were triggered to close. Data transmission worked well, but when the rosette was recovered, no bottle had closed. While approaching the first station, all connection and the release system were checked and the rosette tested while standing on deck, with mixed success. The ship's electrical engineer did a brave job to localize problems in the wire and fix them. However, problems in the release trigger system persisted. A further test after stopping the ship lowering the rosette to 100m failed again as did any attempts when the location of the first station was reached. When there was no hope left for the problem to be fixed, the first station had to be left without sampling. The next days, a lot of effort was undertaken to solve the rosette problem, consulting the experts in Kiel by fax and telephone endlessly. The weather forecast solved the problem, unfortunately not in a positive way: due to reported bad weather in the target region the course was altered, even partly going back, to avoid getting in close contact with the storm. This made the expected time of arrival in Lisbon questionable, so the course had to be changed again to head directly to Lisbon as soon as the weather would allow, thus omitting the Goban Spur station and leaving no ship time left for the third station.

underway sampling ...

Since no deep samples could be expected any more, the surface measurement program was intensified to get an optimal data coverage and also to include some processes off the Spanish and Portuguese coast. No coastal upwelling was observed at the Portuguese coast, although this is reported to be a regularily observable feature at this time of the year. After passing the estuary of the Tejo river the seawater pump was switched off and the remaining instruments were packed.

arriving Lisbon ...

The pier was reached at 14:00 hrs on Sept. 11. All hands were needed to pack all the equipment as quickly as possible to get the container from board and give the crew the opportunity to wash the ship from top to bottom for the following day. On Sept. 12 a press conference and a reception was held at the beginning of the next cruise, when Prof. G. Siedler took over as chief scientist for the next cruise, # 212.

at last ...

The scientific question about upwelling was solved later by GEOMAR: Gregor Rehder, relaxing from the cruise, stepped into the water of the Algarve coast two weeks after the cruise where he could feel a very effective upwelling by getting ice-cold feet but learned at the same time from fellow-holidaymakers that this has not occured but very recently. This findings lead to the conclusion that obviously the seasonal upwelling occured late this year and started well after the cruise had been terminated.

5. Preliminary results

5.1. Hydrography (M. Busse, L. Mintrop)

Along the transect (see Fig. 1b), temperature and salinity were registered continuously by the thermosalinograph and stored as 1-minute mean values. The cruise track is divided into two parts, the first from Reykjavik (A) to the location where the first station was planned (B), and the second part from there to Lisbon (C). Figure 2a shows the measured water temperature and the salinity along track A-B and figure 2b shows the values along track B-C.

While there is little variation in salinity (34.9-34.95) and temperature (9.5-10.0°C) on part A-B after leaving the harbour of Reykjavik, temperature and salinity rise steadily to 20°C and 35.3, respectively, along part B-C until reaching the estuary of river Tejo.

5.2. The carbonate system

5.2.1. Total carbonate and alkalinity in surface waters (L. Mintrop, A. Körtzinger and S. Schweinsberg)

Around 80 surface samples were collected for the determination of total carbonate and alkalinity. During the time of the cruise, the instruments were about to return from an Indian Ocean expedition. They were installed on the R.V. POLARSTERN in November, therefore the samples were taken on that cruise and were measured on board POLARSTERN. Total carbonate (C_T) was measured by coulometric titration using the SOMMA-system, alkalinity by potentiometric titration with the VINDTA-system. Total carbonate values are also necessary for the interpretation of the results from the ¹³C-measurements and alkalinity values will be compared to those obtained by the Vigo-group. This intercomparison is in progress now but is not terminated yet to be included in this report. Preliminary values are listed in the data section.

5.2.2. Determination of pH and alkalinity in surface waters (F. Fernandez Pérez and J. Pérez Juste)

Samples of surface seawater were collected at approx. 30 min. intervals during daytime. The pH was measured using a Metrohm pH meter and combination glass electrode standardisized with NBS pH 7.413 and pH 4.008 buffers. The electrode was adapted to the ionic strength of seawater by means of a synthetic seawater buffer of pH 4.4. Temperature was measured and the pH values normalized to 15°C. In order to determine the systematic errors produced by variations of residual liquid-junction potential by estimating the apparent activity coefficient of hydrogen ions, titration curves for seawater were made at the end of the cruise. The curves were linearized and the mean value obtained from the inverse slope has been used to correct the pH₁₅ results. The pH_{is} is the pH recorded at zero potential. This pH_{is} can vary because of the real variations of the electrode, changes in the buffer or an error during the calibration. The anomalies from each calibration and the linear

regressions have been used to correct the pH₁₅ results obtained (Fig. 3a). The pH₁₅ measured during the cruise is plotted vs. the Julian day in Fig. 3b.

Selected seawater samples for alkalinity were collected and stored until analysis in the land laboratory. Alkalinity was measured using an automatic potentiometric titrator (Metrohm) with a separate glass electrode and a reference electrode. Potentiometric titrations were carried out with hydrochloric acid to a final pH of 4.44. Fig. 3c shows the relationship between alkalinity and salinity. From this relationship the alkalinity for the samples not measured has been calculated.

5.2.3. pCO₂ in surface waters (L. Mintrop)

Due to the damage of the computer during transport the automatic determination of surface pCO₂ had to be converted into a manual mode. Fortunately, the data from the IR-system could be read out by a labtop found on board. The switching of the valves to measure calibration gases and atmosphere had to be done manually. Besides some more work later to the data, data quality did not suffer. Nevertheless, some corrections (moisture and temperature) still have to be incorporated into the calculation to convert the molar fraction measured into the fugacity of CO2 in dry air at in situ temperature. However, this will not change the observed pattern, since this will likely result only in an offset correction for all data by some few micromoles. A comparison between the continuous method (IfM Kiel) and the discontinuously measuring GC-system (Geomar, Kiel) is done at the moment and not yet included in this report. Data were collected in one minute intervals, however, Fig. 4 shows the molar fraction of CO2 from 10 minute values along the track (B-C, see above). Along the track, values are increasing from a pronounced undersaturation of the seawater in respect to the atmosphere (up to 60 ppm) to slight oversaturation in the last part, approching the Portuguese coast, until values increase dramatically in the river Tejo estuary to more than 500 ppm.

5.3. Methane and pCO₂ (R. Keir, G. Rehder)

The concentrations of CO_2 and methane in the atmosphere have both risen due to human activities, from 280 to 360 ppmV for CO_2 and from 700 to 1750 ppbV in the case of methane. Since there is an influence of these trace gases on the earth's radiation budget, it is important to know the role of the ocean in the biochemical cycles and the ocean's response to the changing atmospheric mixing ratios.

The importance of the ocean system to the cycle of the two gases is quite different. The ocean is believed to act as the major sink for the burden of CO_2 produced from anthropogenic sources, but in the case of methane the ocean acts as a minor source to the atmosphere.

The marine environment is believed to contribute about 2-5% to the global source strength of methane, mainly from the shelf regions. The estimate of the open ocean source has recently been reduced by one order of magnitude, based on studies in the pacific between 1987 and 1994.

A fully automated device for the detection of methane and pCO₂ was run throughout the cruise, with only short periods in which the instrument was shut down for maintainance.

Seawater concentrations are measured by the detection of the mole fraction of the gases in a sample of air that has been equilibrated with a continuous flow of seawater. The air is dried with SicapentTM, separated by gas chromatography and measured with an FID. The CO₂ is reduced by H₂ on an activated Ni-catalyst before detection.

In addition to the air sampled from the equilibrator, two calibration gases and clean, uncontaminated air pumped from the ship's bow are measured. The whole sequence of 8 measurements (Calib.Gas1 - Equil.air - Air - Equil.air - Calib.Gas2 - Equil.air - Air - Equil.air) is run during an 80 minutes period, with a time interval of 20 minutes between 2 seawater measurements. A scheme of the device is shown in Fig. 5a.

Methane concentrations were in general in equilibrium with the atmosphere. Over Iceland shelf, the surface waters were oversaturated by ~4%. Strong oversaturations were detected in the River Tejo estuary, indicating very high methane content (Fig. 5b). The end of our investigations was unfortunately too early to give an estimate of the freshwater concentration.

The pCO₂ profiles show that the Atlantic Ocean is a strong sink for atmospheric CO₂ in the area of investigation during summer, with a partial pressure difference of nearly 100 ppmV west of Iceland. CO₂-undersaturation decreased from the North to the South (Fig. 5c), which is in agreement with previous measurements in this region. CO₂-oversaturation was only found at the end of the survey in waters influenced by the freshwater supply from the River Tejo.

5.4. Methylamines and ammonia in atmosphere and surface waters (S. Gibb)

Nitrogen, a biologically essential element in the marine environment, is found in a variety of inorganic and organic forms in oxic seawater ranging from the thermodynamically most stable species, nitrate, to reduced compounds such as ammonia and its methyl derivatives, the methylamines (monomethylamine, MMA; dimethylamine, DMA and trimethylamine, TMA). These are biogenic compounds widely distributed in the marine environment and intimately involved in oceanic nitrogen fertility. By virtue of their volatility they are capable of evasion across the air-sea interface and may be an important source alkali to the troposphere and so subsequently play a significant role in the regulation of atmospheric and rainwater pH.

An understanding of the marine distribution and biogeochemical cycling of these compounds has largely been restricted through the absence of a sensitive and selective analytical technique capable of their individual quantification at the nano-molar levels characteristically found in the marine environment. Only recently has it been possible to reliably analyse ammonia and the methylamines at these concentrations in natural waters.

The objective was to characterise the spatial distribution of the methylamines (MA's) and ammonia in the surface waters and overlying atmospheric phases of the N.E. Atlantic and to establish the magnitude and direction of their air-sea gas exchange fluxes and interpret the results of these studies within the context of the biogeochemical cycle of nitrogen. Further the distribution and fluxes of MA's were to correlate with those of their sulphur cycle analogue DMS and also the phytoplankton biomass and taxonomic composition.

Surface seawater samples were collected from an on line supply either in gas-tight polyethylene bottles (250 ml) or in glass syringes (100 ml). Methylamines and ammonia were determined by *Flow Injection Gas Diffusion coupled to Ion Chromatography* (FIGD-IC). This novel technique, recently automated for shipboard deployment, permits the simultaneous measurement of MA's and ammonia at the nano-molar concentrations typical of oceanic waters. (I.o.d. 1-3 nM; co. of variation 2-6% at 20nM for methylamines). It should be noted that FIGD-IC gives a measure of the total dissolved species present in an aqueous sample and it is these values which are reported i.e. dissolved gas+solvated cation e.g. in the case of ammonia [NH₃]_{total} = [NH_{3(g)} + NH₄⁺_(s)].

For atmospheric samples, tandem filter systems, equipped with cyclone separators in series with Teflon and acid impregnated paper filters, were employed in the collection of particulate and gaseous atmospheric methylamines and ammonia. Filters were frozen for subsequent laboratory extraction and FIGD-IC analysis.

Event only rainwater samples were collected using a series of polyethylene funnel-bottle combinations. Assay of MA's and ammonia were ferformed on unfiltered samples and thus reflect total (wet + dry) deposition during a rain event. methylamines and ammonia were measured in rainwater samples using FIGD-IC operated under the same conditions as for seawater analysis.

Methylamines were observed to be relatively ubiquitous in surface waters but generally at concentrations of 1-2 orders of magnitude lower than that of ammonia (see the data tables and sample chromatogram Fig. 6). MMA was consistently the most abundant methylamine, followed by DMA and TMA. The trend of decreasing concentrations with increasing methylation of the parent ammonia compound is consistent with observations made of other surface waters in both coastal and open ocean regimes (e.g. English Channel, N.W. Indian Ocean) and may be a reflection on their biogenic production and microbial transformation.

Whilst concentrations of DMA and TMA determined in the N.E. Atlantic were comparable to those recorded offshore in the Mediterranean Sea (1-9 and 0-7 nM respectively) levels of MMA exceeded even those measured recorded in the coastal euthrophic waters of the Gulf of Lions (4-38 nM). Comparable seawater concentrations of MMA have only been found previously in the monsoon driven, coastal upwelling system of the N.W. Indian Ocean.

Although the presence of ethylamine (EA), a primary alkylamine and structural isomer of DMA, has been reported by other workers it has not previously been quantified in seawater using FIGD-IC. However, during the Poseidon N.E. Atlantic transect, the occurrence of EA was indeed confirmed.

Due to the currently absence of chlorophyll and carotenoid pigments it has not been possible to determine the relationship between MA distribution or air-sea interfacial fluxes with either phytoplankton biomass or specific taxonomic algae groups. Nor has it yet been possible to correlate the spatial distribution of MA's with DMS/DMSP.

Since atmospheric aerosols and gas samples have not yet been analysed (see also the data tables), it is not possible to describe the atmospheric distribution and speciation of MA's and ammonia nor the magnitude and direction of their air sea exchange fluxes. However, given that some of the highest open ocean concentrations of MA's were observed in the region between LAT 60°N LON 26°W and LAT 55°N LON 19°W it would be surprising if the ocean was not acting as a local source of atmospheric MA's and ammonia.

Rainwater concentrations of ammonia would appear to be consistent with those previously reported for the N. Atlantic $(0.1 - 23.3\mu M \text{ and } 0 - 8.9\mu M)$. The only reported concentrations of individually resolved MA's in rainwater of 11 - 29, 6.7 - 11 and 5.8 - 17 for MMA, DMA and TMA respectively would also appear to be in reasonable agreement.

In addition to ammonia and the MA's, EA and one other, as yet unidentified, alkylamine were found in the rainwater samples collected.

5.5. Halocarbon analysis (J. Baker)

Methyl bromide (CH₃Br) is the major source of bromine ions to the stratosphere. Bromine has an ozone depletion potential of up to six times that of chlorine, so is a very effective ozone destroyer. It is for this reason, that the production of CH₃Br may be banned. The sources of CH₃Br are both anthropogenic (structural and agricultural fumigants, gasoline) and natural (the ocean and biomass burning). Very little is known about the fluxes to the atmosphere from any of the sources, especially from the ocean; some scientific groups believe the ocean to be a source and some a sink. The processes leading to the formation of CH₃Br are as yet unknown.

To analyse the halocarbon concentrations in the atmosphere and ocean gas chromatography was used. The air sample or stripped gas is preconcentrated on a trap at -180°C and then injected onto a column to separate the components and detected by an electron capture detector.

The concentrations of CH_3Br , CH_3Cl and CH_3l varied very little along the cruise track, maybe a slight decrease in concentrations if any change. The results will be analysed in full in the near future.

I will be collecting a large data set of CH₃Br (and various other halocarbon) concentrations in the atmosphere and ocean to be able to produce a computer model otf the global concentrations. I will be also looking into greater detail at the oceanic source.

5.6. Sulfur compounds

Dimethylsulfide (DMS) is a biogenic sulfur compound generated from the breakdown of dimethylsulphoniopropionate (DMSP), an osmoregulatory compound of phytoplankton. DMS is a volatile compound which passes readily over the sea-air interface into the atmosphere. Once in the atmosphere it formes the bases for cloud nuclei, contributing to the acidity of rainwater. DMS can also be oxidized to dimethylsulphoxide (DMSO) via photooxidation or bacterial oxidation. Atmospheric concentrations are approximately two orders of magnitude lower than those in seawater, so there is effectively a net one-way flux of DMS from the ocean to the atmosphere.

Two independent groups were measuring DMS on the cruise. Results will be compared to serve as an intercalibration.

5.6.1. Dimethylsulfide and related compounds (A. Hattón)

The objective of the cruise was to measure concentrations of DMS, DMSO and DMSP dissolved and particulate and use these to investigate the relationship between the three compounds in surface waters.

DMS was measured using a gas chromatograph fitted with a flame photometric detector. Samples were preconcentrated in a Tenax TA loop prior to analysis. DMSP samples were broken down to DMS using NaOH and DMSO was broken down using the enzyme DMSO-reductase, these were then measured as DMS samples.

Preliminary results indicated that DMS concentrations were low throughout the cruise. Concentrations ranged from <0.5-2.1 nM for DMS, <0.5-3.1 nM for DMSO, 6.8-55 nM for DMSPd and 22-80 nM for DMSPp.

5.6.2. Dimethylsulfide in surface waters (C. Szakolczai)

During the cruise, the concentrations of dimethylsulfide in seawater were measure every two hours between 7:00 and 21:00 UTC using gas chromatography with flame detection.

In total 71 DMS analyses were performed, 45 samples collected for DMSP and 45 others for DMSO. DMSP and DMSO analysis will be performed in the laboratory by the same method. In addition, the DMS detector response will be calibrated with respect to a primary standard tube.

Decreasing DMS concentrations were recorded from the North to the South of the transect. In addition, a large DMS peak was observed between 55 and 56°N, 19-20°W (Sept. 4).

A full data set will be compiled and correlated with other oceanographic and meteorological measurements.

5.7. Direct measurements of air-sea fluxes (M. Moerman and F. Hansen)

The objective of the TNO Physics and Electronics Laboratory (TNO-FEL) to participate in the gas-exchange experiments of the Poseidon is to collect experimental data for the interpretation of the flux measurements of chemical reactive gases, and participate in the analysis and interpretation of the flux data to gain better understanding of processes in the marine atmospheric surface layer and air-sea exchange.

CO₂ fluxes are measured as an independant determination of the flux of a chemically inert species, to improve the data collection and processing methods including the development of an dissipation method with the TNO/Riso system consisting of two CO₂ samplers and a sonic, and because CO₂ fluxes are interesting in itself.

As an example, Fig. 7 shows the spectrum and the cospectrum of the CO₂ absorption line from the two instruments.

5.8. $^{12}C/^{13}C$ - isotope relation in dissolved inorganic carbon (G. Rehder, R. Keir, H. Erlenkeuser)

In parallel to the other surface samples also samples were taken for the analysis of carbon- and oxygen isotopes. The samples were brought to the Leibniz-Labor für Altersbestimmung und Isotopenforschung (Kiel University) and will be analyzed by masspectrometry.

Although North Atlantic Deep Water shows a linear correlation between $\delta^{13}C_{\Sigma CO_2}$ and phosphate because of the uptake of isotopic light carbon during photosysnthesis and its remineralization in the water column, the mixed layer water differs from this relationship due to air-sea exchange of CO₂. In the North Atlantic, surface water $\delta^{13}C$ is shifted to lower values. The isotopic fractionation during air-sea exchange is temperature dependent, and as a result, the slope of the $\delta^{13}C_{\Sigma CO_2}$ to phosphate becomes less steep.

The data collected during POS 211 can give new information in the $\delta^{13}C_{\Sigma CO_2}$ - Nutrient relation in the North Atlantic surface waters and hence, the relative importance of the biological pump and air-sea exchange on the carbon cycle.

5.9. Nutrients (H. Johannsen)

Samples for the determination of the nutrients phosphate, silicate, nitrite and nitrate were collected during the cruise and stored deep frozen. After the ship returned to Germany, the samples were brought to the POLARSTERN to be measured on a cruise in November by standard photometrical methods using a four channel autoanalyzer (IfM Kiel). Results are included in the data tables.

5.10. Chlorophyll and carotenoid pigments (S. Gibb)

In biological oceanography the photosynthetic pigments, in particular Chlorophyll a, have long been recognised as unique and convenient markers of phytoplankton biomass. Although spectrophotometric and fluorimetric techniques have been widely used to determine biomass, the utilisation of high performance liquid chromatography HPLC not only permits a more accurate measurement of Chlorophyll a, but also allows simultaneous separation and quantification of a range of other chloropigments and carotinoids in marine phytoplankton. Many of these compounds have strong chemotaxonomic associations, through which it is possible to obtain an understanding of the taxonomic composition of the overall phytoplankton biomass e.g. measurement of the carotenoid fucoxanthin is used to infer the presence of diatoms, whilst the presence of 19'-hexanoyloxyfucoxanthin is used as a biomarker of prymnesiophytes.

There is growing evidence that the various classes of phytoplankton exhibit a unique impact on ocean chemistry and this has important implications for biogeochemical cycling. Since various pigments are biomarkers for specific groups, there is often a correlation between pigments and biogeochemical features e.g. chlorophyll a with pCO_2 and of 19'-hexanoylfucoxanthin with DMS. It would thus appear that pigments are potential proxy biomarkers for biogas fluxes. However, as far as methylated biogases are concerned, particularly the MA's and halocarbons, correlation data is extremly sparse.

The objective of the cruise was to use the chlorophylls and carotenoids to map the spatial distribution of phytoplankton biomass and taxonomic composition along the cruise transect and to attempt to elucidate the spatial relationship between these biomarkers and the respective distribution of methylated biogases.

Algal cells were collected from 2L water samples on 47 mm (GF/F) fibre filters and snap frozen in liquid nitrogen (a total of 63 samples were obtained). Pigments will be extracted from filters by ultrasonication in cold buffered methanol. Chlorphyll and carotenoids will be separated by reversed phase binary HPLC equipped with absorbance and fluorescence detectors.

No analysis has yet been performed of filters collected during the cruise. However, storage of filters in liquid nitrogen has been shown to arrest pigment degradation for up to one year. It is envisaged that samples collected for the analysis of pigments will be analysed January-February 1996.

6. Figures

(starting on following page)

- Fig. 1: cruise track as planned (a) and as followed (b)
- Fig. 2: salinity and temperature along the first (a) and second part (b) of the track
- Fig. 3a: variation of pH(isoelectric)
- Fig. 3b: pH(NBS) at 15°C vs. Julian day
- Fig. 3c: alkalinity-salinity correlation
- Fig. 4: molar fraction of carbon dioxide along the cruise track (prelim. values)
- Fig. 5a: schematic of the automated underway system for the determination of surface water pCO₂ and methane
- Fig. 5b: CH₄ mole fraction of gas in equilibrium with surface water
- Fig. 5c: CO₂ saturation during POS 211 (raw data)
- Fig. 6: chromatogram of a surface seawater sample with amine peaks
- Fig. 7: spectrum and cospectrum of the CO₂ absorption line

7. Data tables (appending after the figure section)

- 7.1. total carbon and nutrient data
- 7.2. pH data and calculated alkalinity, total carbon and pCO₂
- 7.3. status and summary of MA and ammonia data
- 7.4. list of samples collected for MA and ammonia analysis in atmospheric aerosols and gases

8. Concluding remarks

The scientists wish to thank the crew of F.S. POSEIDON for excellent cooperation. Many people in addition to those on board helped with analyses of samples in the land laboratory and working on the data. Their effort is greatly acknowledged. Hopefully their enthusiasm will persist to turn the preliminary data presented here into jointly elaborated scientific results.





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FIG 3a: variation of pH(isoelectric)





FIG. 3c: alkalinity-salinity correlation





Schematic of the automated underway system for the determination of surface water pCO_2 and methane

CH_4 mole fraction of gas in equilibrium with surface water



FIG. 5b

CO₂ saturation during Pos 211/ (raw data)



FIG. 5c



Fig. 6: Typical FIGD-IC Conductivity (8µS fsd) vs. time (mins) Chromatogram for surface seawater. Peaks of interest: 4. NH₄⁺, 5. MMA, 6. DMA, 8. TMA, 9. sec-butylamine (int. std.). Other peaks: 1. injection, 2. H⁺, 3. Na⁺, 7. unidentified.

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14:17:17



FIG. 7

bottle #	date	time	temp.	sal.	Ст	nCT	NO ₂	NO ₃	PO4	SiO4
	UTC	UTC	TSB 2	TSB	[µmol/kg]	[µmol/kg]	[µmol/L]	[µmol/L]	[µmol/L]	[µmol/L]
POS043	24.00.05	40.00	<u> </u>							<u> </u>
	31.08.95	19:02	9.92	34.958	2058.3	2060.8		sample		
POS034	31.08.95	23:00	9.85	34.947	2066.2	2069.3	0.05	2.28	[
POS059	01.09.95	07:00	10.05	34.904	2067.4	2073.1	0.13	3.42		1.27
POS042	01.09.95	13:06	10.13	34.909	2069.9	2075.3	0.13	5.18	1.25	0.92
POS047	01.09.95	19:30	9.92	34.899	2062.6	2068.5	0.14	5.09	1.43	0.93
POS055	01.09.95	21:00	9.87	34.905	2068.2	2073.9	0.18	5.24	1.27	0.97
POS031	01.09.95	23:03	9.60	34.919	2095.5	2100.4	0.16	3.53	1.42	0.90
POS016	02.09.95	01:00	9.97	34.912	2068.0	2073.2	0.07	3.57	1.28	0.41
POS039	02.09.95	03:00	9.76	34.900	2063.2	2069.1	0.20	4.76	1.37	1.16
POS015	02.09.95	05:00	10.08	34.888	2069.3	2075.9	0.22	6.20	1.34	1.54
POS051	02.09.95	07:00	10.40	34.872	2063.7	2071.3	0.14	5.54	1.45	1.61
POS001	02.09.95	09:05	10.42	34.879	2060.8	2067.9	0.10	2.60	1.26	0.77
POS018	02.09.95	11:06	10.31	34.879	2064.0	2071.1	0.08	5.21	1.23	1.08
POS044	02.09.95	13:00	10.47	34.863	2062.0	2070.1	0.34	3.97	1.43	1.63
POS052	02.09.95	15:00	10.36	34.867	2062.6	2070.5	0.21	4.13	1.42	0.94
POS026	02.09.95	17:10	10.70	34.886	2062.1	2068.9	0.31	3.25	1.09	1.38
POS035	02.09.95	19:00	10.59	34.895	2063.0	2069.2	0.12	4.94	1.27	2.28
POS036	02.09.95	21:00	10.71	34.974	2065.9	2067.4	0.22	3.42	1.03	0.97
POS019	02.09.95	23:02	10.96	34.978	2072.7	2074.0	0.13	1.62	0.96	0.47
POS027	03.09.95	01:00	11.08	34.963	2061.3	2063.5	0.07	3.66	1.19	0.83
POS060	03.09.95	03:00	11.11	34.967	2065.8	2067.7	0.14	3.32	1.07	0.79
POS061	03.09.95	05:00	11.14	34.956	2066.5	2069.1	0.07	1.63	1.16	0.44
POS021	03.09.95	07:00	10.94	34.962	2068.7	2070.9	0.15	3.30	1.04	0.92
POS062	03.09.95	09:00	11.35	34.942	2060.4	2063.8	0.22	2.27	1.21	0.49
POS038	03.09.95	11:05	12.39	34.973	2057.6	2059.2	0.07	1.82	0.85	0.21
POS030	03.09.95	13:04	11.88	34.941	2056.4	2059.9	0.06	1.09	0.95	0.12
POS029	03.09.95	15:05	12.67	34.956	2066.2	2068.8	0.06	0.84	0.69	0.00
POS046	03.09.95	17:01	13.15	34.985	2043.0	2043.8	0.19	0.58	0.64	0.03
POS025	03.09.95	19:08	13.34	35.015	2051.6	2050.7	0.11	0.55	0.98	0.17
POS022	03.09.95	23:01	12.32	34.900	2073.3	2079.2	0.12	2.22	0.80	0.72
POS041	04.09.95	03:00	13.09	34.997	2048.6	2048.8	0.14	1.46	0.66	0.00
POS049	04.09.95	07:00	14.31	35.037	2054.4	2052.3	0.09	0.15	0.65	0.09
POS017	04.09.95	11:05	14.08	35.009	2041.5	2040.9	0.36	0.30	0.54	0.30
POS048	04.09.95	15:00	14.45	35.021	2057.6	2056.3	0.15	0.61	0.52	0.22
POS033	04.09.95	19:00	14.91	35.062	2044.5	2040.9	0.05	0.00	0.54	0.29
POS053	04.09.95	23:04	15.29	35.113	2094.6	2087.8	0.22	0.48	0.50	0.05
POS020	05.09.95	02:56	16.45	35.134	2034.8	2027.1	0.00	0.00	0.36	0.27
POS058	05.09.95	07:00	16.65	35.112	2032.8	2026.3	0.11	0.10	0.38	0.14
POS028	05.09.95	11:05	16.62	35.111	2027.9	2021.5	0.06	0.07	0.60	0.10

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POS054	05.09.95	19:05	17.07	35.104	2026.1	2020.1	0.09	0.05	0.45	0.3	1 worst offer
POS037	05.09.95	23:05	16.95	35.135	2042.3	2034.4	[empty			
POS056	06.09.95	11:00	16.88	35.130	2032.6	2025.0		1	0.73	0.3	9
POS024	06.09.95	15:05	16.90	35.129	2029.5	2022.0	0.10	1	0.35	0.0	
POS040	06.09.95	19:00	16,91	35.128	2039.0	2031.5	0.00	0.00	0.30		
POS050	06.09.95	23:00	16.92	35.127	2034.0	2026.6	0.01	0.01	0.24	0.09	
POS045	07.09.95	03:00	16.49	35.114	2036.9	2030.3	0.03	0.07	0.36	0.10	-
POS032	07.09.95	07:05	17.43	35.162	2047.6	2038.2	0.61	0.51	0.50	0.43	-
POS023	07.09.95	11:05	17.44	35.177	2047.4	2037.1	0.01	0.02	0.26	0.19)
POS057	07.09.95	15:05	17.28	35.138	2047.2	2039.2	0.22	0.22	0.36	0.15	
POS006	07.09.95	19:05	17.15	35.156	2047.0	2037.9	0.11	0.14	0.42	0.21	
POS004	07.09.95	23:00	17.91	35.200	2034.0	2022.4	0.09	0.12	0.32	0.12	
POS011	08.09.95	03:01	17.74	35.213	2048.5	2036.1	0.12	0.16	0.37	0.16	
POS005	08.09.95	07:00	18.32	35.216	2056.8	2044.2	0.01	0.06	0.30	(2.93	
POS012	08.09.95	11:10	18.23	35.276	2045.5	2029.5	0.15	0.17	0.37	0.19	1
POS003	08.09.95	15:09	18.13	35.254	2039.3	2024.6	0.00	0.04	0.27	0.46	
POS002	08.09.95	19:10	17.94	35.280	2047.6	2031.3	0.06	0.11	0.32	0.32	
POS007	08.09.95	23:00	18.59	35.298	2041.3	2024.1	0.01	0.06	0.33	0.32	
POS008	09.09.95	03:00	18.89	35.259	2046.7	2031.6	0.01	0.12	0.21	0.00	
POS013	09.09.95	07:00	19.05	35.287	2042.3	2025.7	0.27	0.20	0.32	0.12	
POS010	09.09.95	11:12	19.18	35.296	2041.1	2024.0	0.05	0.04	0.30	0.03	
POS009	09.09.95	15:10	18.78	35.252	2067.9	2053.1	0.62	(0.50)	0.32	0.60	208772
POS014	09.09.95	19:06	17.83	35.210	2075.5	2063.1	0.06	0.08	0.28	0.30	VIIC
POS079	09.09.95	23:00	17.71	35.217	2063.5	2050.8	0.05	0.11	0.29	(1.66	208807
POS081	10.09.95	01:00	17.74	35.195	2063.7	2052.3	0.12	0.07	0.25	0.10	
POS080	10.09.95	04:00	18.25	35.231	2061.6	2048.1	0.04	0.05	0.45	0.24	
POS074	10.09.95	05:05	18.44	35.244	2061.3	2047.1	0.05	0.02	0,25	<u>0.07</u>	
POS070	10.09.95	07:00	18.76	35.266	2066.9	2051.3	0.03	0.04	0.57	(7.14	208774
POS075	10.09,95	09:00	19.11	35.290	2064.7	2047.7	<u>(0.55</u>)	0.42	0.41	1.67	208810
POS068	10.09.95	09:05	19.12	35.291	2061.8	2044.8	0.03	0.04	0.34	0.16	
POS076	10.09.95	11:00	19.45	35.314	2065.6	2047.2	0.00	0.00	0.29	(1.96	208775
POS071	10.09.95	13:01	19.79	35.338	2061.4	2041.6	0.03	0.06	0.31	(2.56	208812
POS069	10.09.95	15:05	20.10	35.359	2058.0	2037.1	0.00	0.00	0.21	0.31	
POS064	10.09.95	17:00	20.12	35.348	2058.4	2038.1	(0.87)	0.85	0.27	3.44	208814
POS065	10.09.95	19:08	20.33	35.352	2058.0	2037.5	0.01	0.05	0.23	2.43	208776
POS063	10.09.95	22:58	19.61	35.327	2067.2	2048.1	0.03	0.10	0.27	0.17	
POS066	11.09.95	01:00	20.20	35.346	2062.9	2042.7	0.32	(1.77)	(1.88)		203316
POS067	11.09.95	03:05	19.92	35.353	2066.4	2045.8	0.23	0.28	0.31	0.20	
POS072	11.09.95	05:05	20.70	35.384	2065.3	2042.9	0.01	0.05	0.31	0.00	
POS078	11.09.95	07:00	19.18	35.335	2064.2	2044.7	bottle e	empty			
POS073	11.09.95	07:25	19.27	35.374	2066.2	2044.3	0.48	0.44	0.70	2.70	208778
POS077	11.09.95	09:00	19.52	35.249	2083.9	2069.2	0.08	0.08	0.30	1.70	208766

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TABLE 7.2.

								Calculated	Calculated	Calculated
dia	hora	juliano	lat	long	temp	sa	ph15	Alk	TIC	pCO2
8,31	14,04	243,59	64,211	-23,043	10,371	34,906	8,227	2296	2039	274
8,31	14,30	243,60	64,215	-23,178	9,955	34,916	8,280	2297	2010	232
8,31	15,00	243,63	64,220	-23,330	9,883	34,938	8,250	2298	2028	252
8,31	15,38	243,65	64,227	-23,521	10,039	34,964	8,228	2301	2042	270
8,31	16,04	243,67	64,232	-23,651	10,053	34,961	8,233	2300	2040	267
8,31	16,30	243,69	64,238	-23,781	9,973	34,964	8,219	2301	2047	276
8,31 8,31	17,00	243,71	64,242	-23,928	9,995	34,964	8,238	2301	2037	262
8,31	17,33 18,10	243,73 243,76	64,248	-24,095	10,048	34,959	8,240	2300	2036	262
8,31	18,30	243,76	64,255 64,259	-24,282 -24,388	9,990	34,960	8,236	2300	2038	264
8,31	19,07	243,80			9,975	34,961	8,241	2300	2035	260
8,31	19,07	243,80	64,265 64,270	-24,586 -24,709	9,931 9,930	34,957 34,956	8,237	2300	2037	262
8,31	20,00	243,83	64,274	-24,709	9,915	34,956	8,232 8,233	2300 2300	2040	266
8,31	20,30	243,85	64,280	-25,031	9,913	34,953	8,230	2300	2039	265
8,31	21,00	243,88	64,285	-25,194	9,885	34,948	8,230	2300	2040	267
8,31	21,30	243,90	64,291	-25,355	9,886	34,947	8,220	2299	2042	269 279
8,31	22,00	243,92	64,297	-25,516	9,890	34,949	8,213	2299	2049	279
8,31	22,30	243,94	64,302	-25,675	9,901	34,944	8,213	2299	2049	279
8,31	23,02	243,96	64,309	-25,846	9,849	34,949	8,209	2299	2049	213
8,31	23,28	243,98	64,314	-25,983	9,843	34,949	8,209	2299	2051	282
9,01	8,01	244,33	64,411	-28,823	10,030	34,912	8,185	2296	2061	304
9,01	8,31	244,35	64,414	-28,999	9,979	34,902	8 183	2295	2061	304
9,01	9,00	244,38	64,417	-29,008	9,966	34,904	8 184	2296	2061	303
9,01	9,32	244,40	64,418	-29,007	9,980	34,903	8 198	2296	2054	292
9,01	10,30	244,44	64 423	-29,188	9,976	34,918	8,205	2297	2051	286
9,01	11,02	244,46	64,431	-29,379	9,876	34,930	8,185	2298	2062	301
9,01	11,30	244,48	64,435	-29,540	9,820	34,936	8,182	2298	2064	303
9,01	12,08	244,51	64,442	-29,762	9,926	34,917	8,188	2297	2060	300
9,01	12,30	244,52	64,448	-29,891	9,962	34,896	8,189	2295	2058	299
9,01	13,02	244,54	64,456	-30,083	10,148	34,908	8,192	2296	2057	299
9,01	13,37	244,57	64,463	-30,291	10,014	34,910	8,192	2296	2057	297
9,01	14,00	244,58	64,468	-30,428	9,918	34,902	8,188	2295	2059	299
9,01	14,30	244,60	64,475	-30,603	9,915	34,884	8,190	2294	2057	298
9,01	15,01	244,63	64,479	-30,786	9,769	34,907	8,185	2296	2060	300
9,01	15,30	244,65	64,484	-30,952	9,627	34,907	8,179	2296	2063	303
9,01	16,00	244,67	64,490	-31,123	9,616	34,912	8,181	2296	2063	301
<u>9,01</u> 9,01	16,30	244,69	64,496	-31,298	9,676	34,903	8,179	2296	2063	303
9,01	17,02 17,30	244,71 244,73	64,503	-31,489	9,699	34,904	8,183	2296	2061	300
9,01	18,03		64,507	-31,655	9,713	34,911	8,188	2296	2059	297
9,01	18,30	244,75	64,516	-31,848	9,947	34,901	8,187	2295	2059	300
9,01	19,30	244,81	64,517 64,497	-31,881	9,915 9,918	34,905	8,189	2296	2059	299
9,01	20,00	244,81	64,433	-31,653	9,574	34,899	8,191 8,183	2295 2297	2057	297
9,01	20,31	244,85	64,366	-31,646	9,434	34,914	8,172		2062	299
9,01	21,01	244,88	64,301	-31,544	9,883	34,904	8,185	2296	2067	306
9,01	21,30	244,90	64,239	-31,441	9,961	34,899	8,186	2290	2050	<u>301</u> 301
9,01	22,01	244,92	64,169	-31,338	9,540	34,903	8,177	2295	2059	301
9,01	22,30	244,94	64,104	-31,237	9,218	34,907	8,166	2295	2004	304
9,01	23,00	244,96	64,038	-31,134	9,498	34,915	8,176	2297	2070	308
9,01	23,30	244,98	63,975	-31,030	9,389	34,921	8,167	2297	2000	310
9,02	7,35	245,32	62,916	-29,511	10,364	34,871	8,172	2293	2064	318
9,02	8,00	245,33	62,866	-29,429	10,405	34,875	8,175	2293	2063	316
9,02	8,30	245,35	62,805	-29,338	10,395	34,872	8,173	2293	2064	318
9,02	9,00	245,38	62,744	-29,247	10,418	34,879	8,177	2293	2062	315
9,02	9,31	245,40	62,679	-29,153	10,367	34,879	8,178	2293	2062	313
9,02	10,00	245,42	62,618	-29,063	10,356	34,890	8,182	2294	2061	310
9,02	10,31	245,44	62,551	-28,972	10,307	34,919	8,176	2297	2066	314
9,02	11,00	245,46	62,492	-28,884	10,294	34,916	8,175	2297	2066	315
9,02	11,30	245,48	62,435	-28,782	10,365	34,884	8,180	2294	2061	311
9,02	12,01	245,50	62,372	-28,691	10,380	34,858	8,164	2292	2068	326
9,02	12,30	245,52	62,312	-28,601	10,473	34,864	8,173	2292	2063	319
9,02	13,00	245,54	62,249	-28,508	10,471	34,863	8,172	2292	2064	320
9,02	13,30	245,56	62,187	-28,414	10,469	34,861	8,170	2292	2065	322
9,02 9,02	14,01	245,58	62,121	-28,318	10,463	34,865	8,176	2292	2062	316
9,02	14,58 15,39	245,62	62,003	-28,142	10,374	34,869	8,180	2293	2060	312
9,02	16,00	245,65	61,917	-28,021	10,574	34,867	8,182	2292	2059	312
[10,00		61,873	27,957	10,591	34,875	8,182	2293 [2059	313

9.02 17.00 245.71 61.750 -27.772 10.745 34,884 8,187 2234 2059 313 9.02 17.30 245.73 61,750 -27,772 10,726 34,884 8,187 2294 2058 311 9.02 17.30 245.73 61,686 -27,682 10,642 34,872 8,178 2293 2062 317 9.02 18,02 245.75 61,615 -27,581 10,540 34,866 8,180 2292 2060 314 9.02 18,30 245,77 61,554 -27,493 10,551 34,886 8,184 2294 2059 311 9.02 19,02 245,79 61,486 -27,393 10,595 34,897 8,186 2295 2059 311 9,02 19,02 245,81 61,427 -27,305 10,636 34,926 8,187 2297 2061 310 9,02 19,00 245,81 61,427 -27,305				_							
9.02 17.00 245.71 61.750 227.72 10.726 24.847 61.167 2294 2296 2062 10.757 90.22 10.502 10.560 34.867 61.177 220.22 200.00 371 9.02 16.02 245.75 61.664 27.333 10.595 34.687 8.166 2226 2060 310 9.02 15.02 245.93 61.464 27.333 10.595 34.697 8.166 2206 2061 310 9.02 21.90 245.93 61.463 27.333 10.595 34.926 6.164 2001 2066 311 9.02 21.30 245.93 61.663 22.010 10.696 34.967 6.164 2002 2064 311 9.02 22.30 245.94 61.080 26.567 10.715 34.977 6.196 2002 2064 310 9.02 23.00 245.84 60.897 26.567 10.778 34.977 6.199	9,02	16,30	245,69	61.812	-27 864	10 749	34 880	8 184	2204	2050	240
902 17.30 2487.73 61.68 27.682 34.76 27.83 27.862 34.77 902 115.02 245.77 61.055 27.681 105.60 34.665 0.184 22.84 27.66 317 902 115.02 245.75 61.466 27.133 10.595 34.695 0.184 22.267 20.66 317 902 115.02 245.75 61.466 27.121 10.663 34.962 8.186 20.07 20.65 317 902 21.00 245.85 61.262 27.028 10.714 34.974 8.186 20.07 20.66 313 902 21.00 245.85 61.056 26.937 10.642 34.976 8.184 20.07 20.661 311 902 22.00 245.25 61.056 26.937 10.642 34.976 8.184 20.07 20.661 311 902 23.0 245.96 90.963 36.9477 8.1182 20.07											
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202 1020 242, 7 10, 15 27, 243 10, 254 34, 865 6, 164 2224 2059 311 902 19, 30 245, 70 61, 654 27, 243 10, 354 34, 865 61, 164 2245 2059 311 902 20, 01 245, 55 61, 356 27, 205 10, 363 34, 352 61, 164 2301 2066 313 902 21, 30 245, 85 61, 252 77, 105 10, 364 34, 362 61, 164 2302 2066 313 902 21, 30 245, 84 61, 200 28, 77 10, 162 34, 367 61, 164 2302 2066 317 902 22, 30 245, 84 61, 200 26, 74 11, 107 34, 977 61, 169 2302 2066 311 902 22, 30 245, 84 60, 84 3797 61, 169 2302 2065 311 902 23, 30 245, 51 52, 024 11, 179 34, 977 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>8,178</td> <td>2293</td> <td>2062</td> <td>317</td>								8,178	2293	2062	317
30.2 19.3.2 243.7 61.654 -27.493 10.556 34.687 61.66 2254 2058 3111 9.02 19.30 246.61 61.427 -27.365 10.636 34.665 61.66 2207 2068 3101 9.02 21.00 245.68 61.282 -27.128 10.666 34.667 61.66 2207 2066 311 9.02 21.00 245.68 61.282 27.128 10.666 34.692 61.67 2202 2066 311 9.02 22.00 245.64 61.096 -28.642 11.086 34.697 61.69 2002 2006 311 9.02 22.00 245.64 60.968 26.647 10.786 34.977 61.69 2207 2008 311 9.02 22.30 245.846 60.9987 25.647 10.788 34.976 61.69 2207 2008 310 9.02 23.01 24.64 59.578 17.788							34,866	8,180	2292	2060	
3.02 19.02 245.79 61.486 -27.305 10.585 34.926 10.67 22.95 20.56 31.07 9.02 20.00 245.53 61.362 -27.218 10.680 34.926 31.64 22.005 31.7 9.02 20.31 245.58 61.262 -77.120 10.688 34.982 51.64 22.002 2066 31.3 9.02 21.30 245.98 61.222 27.026 10.713 34.974 51.164 23.02 2066 31.7 9.02 22.03 245.98 61.022 27.024 11.083 34.976 51.164 23.02 2066 31.17 9.02 22.03 245.84 61.096 34.977 51.194 23.02 2062 31.0 9.03 9.04 23.02 246.84 59.65 27.021 11.130 34.961 61.191 23.00 2064 31.190 9.03 9.04 244.94 59.22 24.021 11.462 3				61,554	-27,493	10,551	34.886	8,184			
9.02 19.30 245.81 61.427 27365 10.636 14.628 81.67 22.67 20.67	9,02	19,02	245,79	61.486							
9.02 20.00 246.53 6f.362 272.18 10.687 14.680 6.186 220.7 2008 317 9.02 21.00 245.68 6f.1222 271.02 10.688 44920 6.187 22002 20068 317 9.02 21.30 245.50 6f.165 22007 2068 317 9.02 22.30 245.50 6f.1066 26.947 11.083 34.976 61.184 22007 2066 317 9.02 22.30 245.54 6f.0066 26.744 11.037 34.977 61.193 22007 2066 317 9.02 23.00 245.54 60.0897 26.567 10.738 34.977 61.193 22007 2066 317 9.03 8.00 24.63 59.770 25.024 11.130 34.957 6.204 2200 2064 307 9.03 9.04 45.04 59.578 17.33 34.956 6.204 2200 2064 <t< td=""><td>9.02</td><td>19.30</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	9.02	19.30									
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9.02 21,30 245,30 61,166 26,937 10,642 34,697 61,160 2303 2766 3717 9.02 22,30 245,54 61,030 267,44 11,037 34,977 6,195 2302 2660 3101 9.02 23,30 245,59 60,063 26,564 10,996 4,976 6,195 2302 266,31 3104 9.03 8,00 244,33 59,760 25,024 11,130 44,951 8,191 2300 266,63 3144 9.03 9,05 244,33 59,692 24,460 11,333 49,656 8,204 2300 2054 306 9.03 10,02 244,42 59,522 24,461 11,338 34,955 8,270 2300 2054 306 9.03 10,34 244,64 59,458 24,461 14,34 34,555 8,270 2200 2057 306 9.03 11,30 244,54 59,157 24,468 <			245,88	61,232	-27,028	10.713	34,974				
9.02 22.00 245.92 61.066 26.444 11.083 44.975 81.164 23.02 26.037 31.11 9.02 23.00 245.96 60.0963 265.64 10.9964 44.975 81.166 23.02 22.063 310 9.02 23.00 245.96 60.097 25.957 10.766 44.077 81.169 23.02 22.063 310 9.03 8.00 246.33 59.970 22.024 11.477 34.0651 8.116 23.00 22.066 314 9.03 9.00 24.642 99.828 24.7661 11.477 34.0651 8.206 23.00 23.064 30.09 24.642 99.83 10.200 24.642 99.828 24.6621 11.643 34.967 8.210 23.000 23.064 30.09 23.000 23.064 30.09 24.071 11.963 34.967 8.210 23.000 23.061 30.07 23.01 23.01 23.01 23.01 23.01 23.01	9,02	21,30	245.90								
9.02 22.30 24.594 61.030 23.747 11.037 24.037 61.133 23.50 24.599 60.897 26.564 10.0964 44.377 6.183 23.02 23.30 24.599 60.897 26.567 10.766 34.477 6.189 23.02 23.62 310 9.03 6.00 244.33 59.707 24.831 11.239 34.946 6.198 23.02 23.64 311 9.03 9.05 244.53 59.562 24.762 11.329 34.946 6.196 23.00 23.00 23.04 30.64 30.0 24.64 30.855 24.762 11.383 34.956 6.204 23.00 23.06 30.64 30.64 30.64 30.0 24.64 39.264 23.06 30.0 23.02 23.00 20.65 311 30.3 13.30 24.64 39.344 12.407 34.935 6.201 23.00 20.03 30.65 30.03 30.03 13.00 24.64.55 59.01.07 24.4	9.02										
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9.02 23.30 246,98 60,897 26,657 10,786 34,977 6,169 2200 2064 310 9.03 8.00 246,33 59,717 24,331 11,289 34,948 8,196 22300 20051 314 9.03 9.05 246,34 59,542 24,402 11,477 34,956 8,204 2200 2054 306 9.03 10,00 246,42 59,522 24,408 11,434 34,956 8,204 2200 2054 306 9.03 10,00 246,42 59,522 24,662 11,443 34,957 8,210 2200 2056 306 307 303 11,30 246,64 59,399 24,468 11,466 34,937 8,211 2206 2060 3067 3067 307 903 14,01 246,54 59,050 24,067 12,299 34,665 8,216 2206 2407 307 903 14,01 246,56 59,060 246,71 <							34,978	8,193	2302	2062	310
9.03 8.00 246.33 89780 -25.024 11.130 34.951 8.191 2209 7268 7314 9.03 9.05 246.35 597.17 -24.931 11.292 34.948 8.196 2299 7258 316 9.03 9.02 246.40 59.528 -24.748 11.328 34.956 8.206 2230 2054 306 9.03 10.02 246.42 59.528 -24.748 11.538 34.956 8.205 2230 2054 307 9.03 10.03 246.44 59.458 -24.661 12.318 34.951 8.205 2230 2054 307 9.03 11.02 246.44 59.458 -24.661 12.318 34.955 8.210 2300 2054 307 9.03 11.02 246.44 59.458 -24.661 12.338 34.975 8.210 2300 2054 307 9.03 11.30 246.54 59.258 -24.661 12.338 34.975 8.210 2300 2056 336 9.03 11.30 246.54 59.259 -24.244 11.945 34.936 8.205 2298 2060 305 9.03 11.30 246.56 59.095 -24.074 11.820 34.925 8.211 2299 2060 305 9.03 11.30 246.56 59.095 -24.074 11.820 34.956 8.218 2300 2248 307 9.03 11.30 246.56 59.095 -24.074 11.820 34.956 8.218 2300 2247 307 9.03 11.401 245.56 59.095 -24.077 11.250 34.956 8.218 2300 2047 307 9.03 11.431 246.56 59.032 -23.944 12.319 34.950 8.218 2300 2047 307 9.03 14.60 246.56 59.032 -23.944 12.319 34.950 8.240 2300 2043 303 9.03 15.44 246.66 58.971 -23.715 12.722 34.958 8.240 2300 2035 223 9.03 16.00 246.57 58.783 -23.671 12.680 34.963 8.224 2301 2036 2233 9.03 16.00 246.73 58.592 -23.4261 13.413 35.008 8.234 2301 2036 2233 9.03 16.00 246.73 58.592 -23.4261 31.412 35.008 8.234 2301 2036 2233 9.03 16.00 246.73 58.592 -23.4251 31.426 34.968 8.234 2301 2039 237 9.03 11.707 246.71 58.641 -23.488 13.141 35.008 8.234 2301 2036 233 9.03 11.707 246.73 58.5922 -23.335 13.150 34.956 8.224 2310 2045 301 9.03 11.707 246.73 58.5922 -23.356 13.150 34.956 8.232 2303 2041 305 9.03 11.901 246.78 58.592 -23.261 13.045 34.956 8.232 2310 2045 301 9.03 19.01 246.78 58.592 -23.261 13.045 34.957 8.232 2303 2041 305 9.03 19.01 246.84 58.939 -23.716 13.038 35.009 8.237 2304 2364 311 9.03 21.00 246.84 58.939 -23.716 13.038 35.009 8.237 2304 2364 311 9.03 21.00 246.84 58.943 22.762 12.426 31.929 34.957 8.226 2303 2044 310 9.03 21.00 246.84 58.943 22.769 12.441 34.949 8.202 2303 2043 305 9.04 13.00 247.75 56.567 72.02 12.441 74.441 35.048 5.206 2303 2043 307 9.04 19.00 247.		23,30		60,897	-26,557	10,736	34,977	8,189	2302		
9.03 8.30 246.35 99777 24.331 11289 34.948 8.196 8.2269 226.9 276.9 3777 9.03 9.30 246.40 59.592 24.748 11.538 34.956 8.204 2200 2264 306 9.03 10.00 246.42 59.522 24.662 11.643 34.956 8.204 2200 2264 306 9.03 10.00 246.42 59.522 24.662 11.643 34.956 8.210 2202 2063 307 9.03 10.20 246.46 59.394 24.66 12.171 34.953 8.210 2202 2063 317 9.03 11.30 246.46 59.394 24.467 11.220 34.229 8.211 2228 2049 307 9.03 11.30 246.46 59.394 24.467 11.220 34.229 8.211 2228 2049 307 9.03 11.30 246.54 59.157 24.154 11.463 34.363 8.201 2288 2049 307 9.03 13.30 246.54 59.157 24.154 11.463 34.363 8.201 2288 2049 307 9.03 13.30 246.56 59.005 24.077 12.228 34.863 8.211 2239 2060 306 9.03 14.01 245.86 59.002 24.077 12.228 34.856 8.218 2300 2047 307 9.03 15.00 246.54 59.157 24.151 12.513 34.856 8.218 2300 2047 307 9.03 15.01 246.56 59.005 2.3277 12.239 34.556 8.226 2300 2043 303 9.03 15.01 246.56 59.005 2.3277 12.239 34.556 8.226 2300 2043 303 9.03 15.02 246.56 59.057 2.2377 12.228 34.568 8.240 2300 2043 303 9.03 15.02 246.56 59.072 2.2367 12.218 34.956 8.226 2300 2043 303 9.03 16.00 246.56 59.072 2.2367 12.1718 34.956 8.226 2300 2043 303 9.03 16.00 246.56 59.072 2.2367 13.12718 34.956 8.226 2300 2043 303 9.03 16.00 246.56 59.072 2.2377 13.12718 34.956 8.224 2301 2039 287 9.03 16.00 246.56 59.072 2.2367 13.12718 34.956 8.224 2301 2039 287 9.03 16.00 246.56 59.072 2.2375 13.12718 34.956 8.224 2301 2039 287 9.03 17.70 246.73 58.522 2.3357 13.155 34.996 8.223 2301 2039 287 9.03 17.70 246.73 58.522 2.23.357 13.12719 34.956 8.223 2303 2047 313 9.03 17.70 246.73 58.522 2.23.357 13.12719 34.956 8.223 2303 2047 313 9.03 17.70 246.73 58.926 2.23.357 13.1263 39.966 8.232 2303 2046 311 9.03 20.01 246.86 58.127 2.23.357 13.142 34.988 8.203 2033 2047 313 9.03 12.00 246.86 58.127 2.23.357 13.142 34.989 8.223 2303 2046 311 9.03 21.00 246.86 58.147 2.24.51 13.159 34.996 8.232 2303 2046 311 9.04 13.00 247.73 58.6627 2.23.071 13.164 34.998 8.223 2303 2046 311 9.04 13.00 247.74 58.6527 2.20.12 13.142 34.988 8.203 2.203 2046 311 9.04 13.00 247.75 58.612 2.20.	9,03	8,00	246,33	59,780							
9.03 9.05 246.38 696.45 244.20 11.477 24.951 2.020 2.030 2.004 301 9.03 10.00 244.64 595.82 24.469 11.538 34.956 8.204 2300 2054 306 9.03 10.02 246.64 59.589 -24.661 12.171 34.856 8.210 2300 2054 306 9.03 11.30 245.64 59.341 -24.467 11.820 34.927 8.211 2302 2056 306 9.03 12.30 245.62 59.167 -24.168 11.843 34.38 8.201 2300 2047 307 9.03 13.30 246.56 59.052 -24.971 1.2490 34.956 6.218 2300 2047 307 9.03 14.01 246.65 59.072 -23.981 2.2671 1.2493 34.965 6.218 2300 2047 307 9.03 16.00 246.65 59.071 <	9.03	8.30									
9.03 9.03 246.40 59.52 -24.746 11.533 24.966 22.00 22.054 23.00 22.054 30.80 9.03 10.04 246.42 59.58 -24.661 11.643 34.656 62.05 23.00 22.054 30.80 9.03 11.02 246.46 59.398 -24.661 12.390 8.210 23.00 22.053 315 9.03 11.30 246.64 59.391 -24.461 11.802 34.3928 6.211 22.98 20.49 30.7 9.03 13.30 246.55 59.095 -24.077 11.820 44.943 6.211 22.98 20.05 30.6 9.03 14.31 246.65 59.095 -24.077 12.239 34.956 6.218 23.00 20.47 30.7 9.03 16.30 246.65 59.093 -23.715 12.722 34.956 6.214 23.00 20.47 30.7 9.03 16.30 246.67 58.781											
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9.03 10.04 246.42 69.528 -24.662 11.643 34.951 6.205 2300 2054 3500 9.03 11.02 246.44 59.399 -24.486 12.396 34.975 6.210 2300 2051 3115 9.03 11.30 246.48 59.399 -24.444 11.945 34.936 6.209 2298 2049 3317 9.03 13.30 246.55 59.096 -24.071 11.250 34.943 6.211 2299 2050 309 9.03 13.30 246.56 59.032 -23.994 12.319 34.956 6.2218 2300 2047 307 9.03 14.31 246.65 58.903 23.827 12.712 34.956 6.224 2300 2043 303 9.03 15.04 246.67 58.713 -23.671 12.662 34.963 8.244 2301 2036 2337 9.03 17.02 246.77 58.792 23.671					<u>-24,748</u>	11,538	34,956	8,204	2300	2054	
9.03 10.34 246,44 59,258 22,4661 12,396 32,00 2001 2005 311 9.03 11.02 246,46 59,391 -24,467 11,290 34,975 9,211 22362 2053 3167 9.03 11.30 246,64 59,391 -24,461 11,965 34,929 6,211 2298 2050 306 9.03 13.30 246,56 59,056 -24,153 14,851 34,956 6,216 2300 2047 307 9.03 14,01 246,56 59,032 -23,914 12,859 4,264 2300 2047 307 9.03 15,63 246,67 58,761 -23,914 12,620 34,963 6,224 2300 2043 303 9.03 15,63 246,67 58,781 23,671 12,262 43,963 6,224 2301 2038 2311 2036 2311 2036 2311 2036 2311 2333 2313 2	<u> </u>	10,00	246,42	59,528	-24.662	11.643					
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9,04 10,31 247,44 56,433 -20,645 14,354 35,035 8,253 2314 2041 306 9,04 11,03 247,46 56,369 -20,563 14,088 35,008 8,254 2311 2037 301 9,04 11,33 247,48 56,305 -20,486 14,308 35,028 8,255 2313 2039 304 9,04 12,30 247,52 56,186 -20,334 14,646 35,062 8,250 2317 2045 313 9,04 13,00 247,54 56,123 -20,257 14,580 35,053 8,252 2316 2043 310 9,04 13,30 247,56 56,057 -20,183 14,626 35,055 8,258 2317 2040 306 9,04 14,00 247,58 55,993 -20,102 14,668 35,061 8,255 2317 2040 306 9,04 14,30 247,60 55,929 -20,024									2314	2044	
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9.04 15.30 247.65 55.802 -19.867 14.645 35.066 8.258 2312 2035 300 9.04 16.08 247.67 55.802 -19.867 14.645 35.066 8.258 2318 2041 306 9.04 16.08 247.67 55.720 -19.769 14.674 35.048 8.257 2316 2040 307 9.04 16.30 247.69 55.672 -19.714 14.674 35.046 8.257 2315 2040 307 9.04 17.00 247.71 55.608 -19.634 14.628 35.040 8.255 2315 2040 308 9.04 17.31 247.73 55.543 -19.553 14.602 35.043 8.264 2315 2035 300 9.04 18.00 247.75 55.481 -19.477 14.598 35.043 8.260 2315 2038 303 9.04 18.00 247.75 55.481 -19.477											
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9,04 16,30 247,69 55,672 -19,714 14,674 35,046 8,257 2315 2040 307 9,04 17,00 247,71 55,608 -19,634 14,628 35,040 8,255 2315 2040 307 9,04 17,31 247,73 55,543 -19,553 14,602 35,043 8,264 2315 2035 300 9,04 18,00 247,75 55,481 -19,477 14,598 35,043 8,260 2315 2038 303 9,04 18,00 247,75 55,481 -19,477 14,598 35,043 8,260 2315 2038 303				55,720	-19,769	14,674	35,048				
9,04 17,00 247,71 55,608 -19,634 14,628 35,040 8,255 2315 2040 308 9,04 17,31 247,73 55,543 -19,553 14,602 35,043 8,264 2315 2040 308 9,04 18,00 247,75 55,481 -19,477 14,598 35,043 8,260 2315 2035 300 9,04 18,00 247,75 55,481 -19,477 14,598 35,043 8,260 2315 2038 303			247,69	55,672							
9.04 17.31 247.73 55.543 -19.553 14.602 35.043 8.264 2315 2035 300 9.04 18.00 247.75 55.481 -19.477 14.598 35.043 8.264 2315 2035 300 9.04 18.00 247.75 55.481 -19.477 14.598 35.043 8.260 2315 2038 303	9.04		247.71			·					
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										2038	303
230	<u> </u>	18,30	247,77	55,416	-19,398	14,609	35,037	8,266			
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9,07	10,30	250,44	51,067	-15,349	17,404	35,164	8,278	2330	2040	328
9,07 9,07	<u>11,09</u> 11,31	250,46 250,48	50,975	-15,304	17,475	35,180	8,279	2332	2041	328
9,07	12,00	250,46	50,924 50,857	-15,278 -15,240	17,462 17,596	35,174	8,277	2331	2042	329
9,07	12,30	250,50	50,857	-15,240	17,607	35,184 35,171	8,281 8,280	2333	2041	328
9,07	13,00	250,52	50,716	-15,165	17,654	35,174	8,283	2331	2040	329
9,07	13,30	250,56	50,645	-15,128	17,751	35,174	8,285	2333	2038	<u>327</u> 326
9,07	14,30	250,60	50,505	-15,045	17,121	35,130	8,297	2328	2038	307
9,07	15,00	250,63	50,434	-15,007	17,224	35,137	8,297	2327	2027	307
9,07	15,31	250,65	50,360	-14,970	17,360	35,136	8,291	2327	2027	315
9,07	16,00	250,67	50,292	-14,936	17,637	35,162	8,291	2330	2033	320
9,07	16,30	250,69	50,224	-14,897	17,675	35,166	8,294	2330	2032	318
9,07	17,00	250,71	50,154	-14,857	17,643	35,155	8,299	2329	2027	313
9,07	17,30	250,73	50,083	-14,816	17,512	35,152	8,291	2329	2032	318
9,07	18,00	250,75	50,009	-14,785	17,344	35,158	8,303	2329	2025	305
9,07	18,31	250,77	49,935	-14,749	17,228	35,161	8,293	2330	2032	313
9,07	19,00	250,79	49,867	-14,710	17,235	35,163	8,290	2330	2033	315
9,07	19,30	250,81	49,796	-14,674	17,278	35,162	8,282	2330	2038	323
9,07	20,00	250,83	49,725	-14,635	18,000	35,186	8,300	2333	2030	317
9,07	20,30	250,85	49,654	-14,600	18,143	35,195	8,308	2334	2026	312
9,07	21,00	250,88	49,582	-14,562	17,708	35,174	8,299	2331	2029	314
9,07	21,30	250,90	49,512	-14,525	17,790	35,176	8,301	2332	2028	313
9,07	22,00	250,92	49,440	-14,487	17,583	35,156	8,285	2329	2035	324
9,08	7,05	251,30	48,145	-13,836	18,325	35,216	8,305	2338	2032	318
9,08	7,30	251,31	48,083	-13,813	18,308	35,215	8,305	2338	2032	317
9,08	8,00	251,33	48,011	-13,774	18,420	35,238	8,308	2340	2032	317
9,08	8,30	251,35	47,937	-13,734	18,209	35,248	8,300	2341	2037	321
9,08	9,34	251,40	47,778	-13,661	18,570	35,246	8,308 8,299	2341 2343	2032	319
9,08 9,08	10,03	251,42 251,44	47,709	-13,623	18,365	35,261	8,299	2343	2038	324
9,08	10,31	251,44	47,642	-13,596 -13,553	18,163	35,267 35,278	8,295	2343	2041	325
9,08	11,30	251,48	47,503	-13,555	18,344	35,278	8,285	2344	2045	336
9,08	12,00	251,40	47,434	-13,488	18,509	35,301	8,289	2346	2048	336
9,08	12,30	251,52	47,364	-13,453	18,566	35,302	8,290	2346	2047	336
9,08	13,05	251,55	47,278	-13,409	18,470	35,290	8,292	2345	2045	332
9,08	13,30	251,56	47,214	-13,379	18,355	35,283	8,288	2345	2047	334
9,08	14,31	251,60	47,056	-13,304	18,142	35,261	8,287	2343	2046	332
9,08	15,01	251,63	46,977	-13,265	18,150	35,252	8,291	2342	2042	328
9,08	15,31	251,65	46,898	-13,229	18,219	35,251	8,290	2342	2043	330
9,08	16,05	251,67	46,809	-13 189	18,264	35,250	8,291	2342	2042	330
9,08	16,31	251,69	46,742	-13,156	18,165	35,243	8,290	2341	2042	329
9,08	17,00	251,71	46,667	-13,118	18,305	35,259	8,291	2342	2043	331
9,08	17,31	251,73	46,588	-13,080	18,340	35,258	8,294	2342	2042	329
9,08	18,00	251,75	46,516	-13,042	18,014	35,258	8,288	2342	2045	329
9,08	18,30	251,77	46,439	-13,007	18,144	35,278	8,291	2344	2045	328
9.08	19,03	251,79	46,359	-12,967	17,906	35,278	8,281	2344	2051	334
9,08	19,30	251,81	46,295	-12,936	18,046	35,292	8,283	2346	2051	335
9,08	20,00	251,83	46,228	-12,898	18,089	35,299	8,283	2346	2051	335
9.08	20,31	251,85	46,152	-12,866	18,073	35,296	8,282	2346	2051	336
9,08	21,00	251,88	46,084 46,015	<u>12,831</u> 12,800	18,014 18,056	35,278 35,279	8,287 8,286	2344	2047	330 332
9,08	21,30	251,90	45,949	-12,800	18,000	35,279	8,288	2344	2046	331
9,08	7,00	251,92	45,949	-12,766	19,055	35,273	8,294	2344	2048	339
9,09	7,30	252,29	44,870	-12,244	19,055	35,200	8,294	2345	2044	339
9,09	8,00	252,31	44,820	-12,192	19,104	35,266	8,292	2343	2042	341
9,09	8,30	252,35	44,701	-12,163	19,104	35,256	8,291	2342	2043	342
9,09	9,40	252,40	44,562	-12,082	19,035	35,245	8,276	2341	2051	356
9,09	10,00	252,42	44,527	-12,044	19,114	35,246	8,278	2341	2049	354
9,09	10,30	252,44	44,474	-11,991	19,201	35,288	8,302	2345	2039	333
9,09	11,00	252,46	44,421	-11,936	19,188	35,286	8,298	2345	2041	337
9,09	11,30	252,48	44,367	-11,882	19,246	35,299	8,292	2346	2046	343
9,09	12,00	252,50	44,312	-11,827	19,305	35,294	8,295	2346	2043	341
9.09	12,36	252,53	44,249	-11,763	19,288	35,295	8,295	2346	2044	342
9,09	13,00	252,54	44,208	-11,720	19,281	35,300	8,295	2346	2044	341
9,09	13,40	252,57	44,136	-11,647	19,198	35,310	8,288	2347	2049	347
9,09	14,00	252,58	44,102	-11,613	19,220	35,309	8,289	2347	2049	347
9,09	15,00	252,63	44,000	-11,515	18,958	35,275	8,280	2344	2051	351
T	15,33	252,65	43,948	-11,462	18,497	35,227	8,269	2339	2053	354
9,09	16,00	252,67	43,905	-11,420	17,995	35,210	8,261	2338	2057	354

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0.00	40.00	050.00	(0.00)							
9,09	16,30	252,69	43,861	-11,375	17,637	35,203	8,251	2337	2061	358
9.09	17,00	252,71	43,813	-11,326	17,641	35,197	8,256	2334	2056	353
9,09	17,35	252,73	43,755		17,713	35,195	8,258	2334	2055	352
9,09	18,08	252,76	43,699	-11,208	17,452	35,189	8,254	2333	2056	352
9,09	18,30	252,77	43,661	-11,173	17,497	35,210	8,258	2338	2058	349
9,09	19,07	252,80	43,598	-11,110	17,807	35,209	8,260	2338	2057	352
9,09	19,33	252,81	43,555	-11,063	18,235	_ 35,238	8,264	2340	2057	355
9,09	20,05	252,84	43,500	-11,011	18,265	35,221	8,265	2339	2055	354
9,09	20,33	252,86	43,452	-10,959	17,586	35,195	8,254	2334	2057	354
9,09	21,00	252,88	43,404	-10,911	17,444	35,178	8,254	2332	2055	351
9,09	21,35	252,90	43,344	-10,851	17,452	35,191	8,253	2334	2057	353
9,09	22,35	252,94	43,237	10,744	17,482	35,212	8,248	2338	2064	359
9,1	7,00	253,29	42,265	-9,999	18,765	35,266	8,247	2343	2069	381
9,1	7,31	253,31	42,187	-10,000	18,853	35,273	8,258	2344	2063	371
9,1	8,00	253,33	42,113	-10,000	18,935	35,278	8,263	2344	2061	367
9,1	9,06	253,38	41,950	-10,000	19,122	35,291	8,259	2345	2064	375
9,1	9,30	253,40	41,891	-10,001	19,191	35,296	8,259	2346	2064	375
9,1	10,15	253,43	41,778	-9,999	19,318	35,305	8,259	2347	2065	377
9,1	10,30	253,44	41,740	-9,999	19,361	35,308	8,260	2347	2065	377
9,1	12,04	253,50	41,495	-10,003	19,628	35,327	8,260	2349	2067	383
9,1	12,30	253,52	41,428	-10,001	19,701	35,332	8,274	2349	2059	369
9,1	13,00	253,54	41,349	-9,999	19,787	35,338	8,274	2350	2059	370
9,1	13,30	253,56	41,272	-9,998	19,872	35,344	8,272	2350	2061	374
9,1	14,00	253,58	41,195	-9,999	19,957	35,350	8,280	2351	2057	367
9,1	14,30	253,60	41,118	-10,003	20.075	35,351	8,273	2351	2061	376
9,1	15,03	253,63	41,034	-10,004	20,103	35,350	8,283	2351	2055	366
9,1	15,30	253,65	40,965	-10,003	20.025	35,346	8,279	2351	2057	369
9,1	16,05	253,67	40,874	-10,001	19,934	35,343	8,278	2350	2057	369
9,1	16,30	253,69	40,807	-9,999	19.914	35,340	8,279	2350	2057	367
9,1	17,30	253,73	40,648	-10,001	20.042	35,346	8,280	2351	2056	368
9,1	18,09	253,76	40,546	-9,999	20 278	35.354	8,280	2351	2057	372
9,1	18,30	253,77	40,491	-10,002	20,299	35,348	8,282	2351	2057	
9,1	19,00	253,79	40,416	-10.002	20,329	35,351	8,281	2351	2056	371
9,1	19,30	253,81	40,338	-9,999	20,297	35,355	8,280	2352		372
9,1	20,05	253,84	40,243	-10,000	20,225	35,344	8,279	2352	2057	373
9,1	20,33	253,86	40,167	-10.003	20,208	35,343	8,279	2350	2057	372
9,1	21,00	253,88	40.095	-10,002	20,474	35,386	8,279	2355	2057	372
9,1	22,00	253,92	39,934	-9,991	20,640	35,407	8,282		2060	377
							0,202	2357	2060	377

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Table 7.3.:	status and summary of MA and ammonia data
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Table 7.3.	species concentration							
medium	ammonia [µM]	MMA [nM]	EA⁺ [nM]	DMA⁺ [nM]	EA+DMA ⁺ [nM]	TMA [nM]		
surface seawater	#	6.8-117	0-5.8	0.4-8.0	0-30	0-6.0		
rain water	2.1-9.5	29-102	0-3.8	10-101	12.4-101	1.1-25		
atmospheric aerosol	NA	NA	NA	NA	NA	NA		
atmospheric gas	NA	NA	NA	NA	NA	NA		

*: where EA and DMA were quantifiably resolved, individual concentrations are given, in cases in which this was not possible, their summed concentrations are presented; #: data requires intercalibration; NA: not yet analysed

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Table 7.4.: list of samples collected for MA and ammonia analysis in atmospheric aerosols and gases

Table 7.4. filter set	sequence	date	time [GMT]	filters collected -aerosols	filters collected -gases
1	start	31/8/95	13:57	1 blank + 3	1 pair blanks + 3
	stop	1/9/95	18:00	replicates	pair replicates
2	start	1/9/95	20:00	1 blank + 3	1 pair blanks + 3
	stop	3/9/95	18:00	replicates	pair replicates
3	start	3/9/95	18:57	1 blank + 3	1 pair blanks + 3
	stop	5/9/95	18:23	replicates	pair replicates
4	start	6/9/95	08:15	1 blank + 3	1 pair blanks + 3
	stop	8/9/95	07:27	replicates	pair replicates
5	start	8/9/95	08:48	1 blank + 3	1 pair blanks + 3
	stop	10/9/95	13:00	replicates	pair replicates