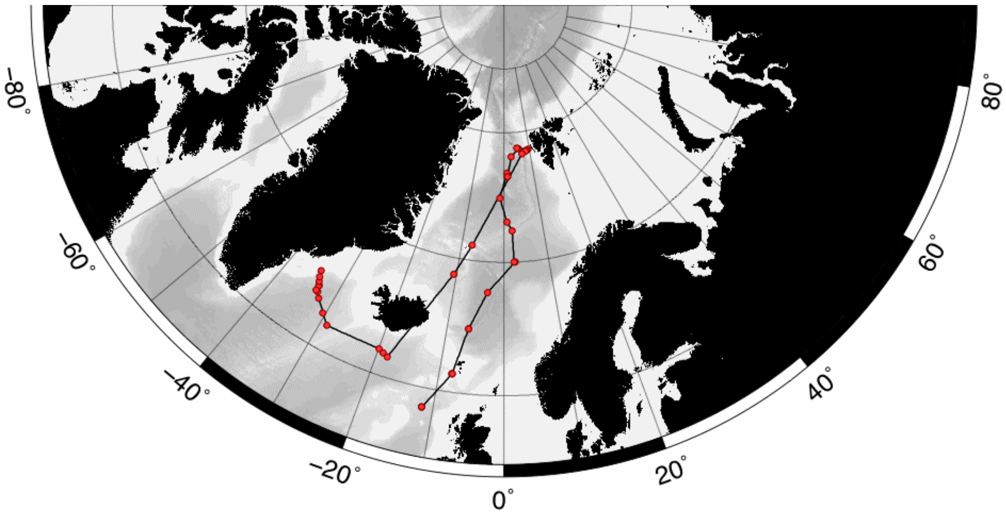
CRUISE REPORT: ANAS5

(Updated AUG 2011)



HIGHLIGHTS

CRUISE SUMMARY INFORMATION

Section Designation	**ANAS5**
Expedition designation (ExpoCodes)	**316N19810721**
Chief Scientists	**Taro Takahashi / LDGO** **Jim Swift / SIO** **William M. Smethie, Jr. / LDGO**
Dates	1981 July 21 - 1981 August 14
Ship	*KNORR*
Ports of call	Greenoch, Scotland - Reykjavik, Iceland
Geographic Boundaries	78° 46.4' N 34° 30.7' W — 9° 28.4' E 58° 34.3'N N
Stations	31
Floats and drifters deployed	0
Moorings deployed or recovered	0

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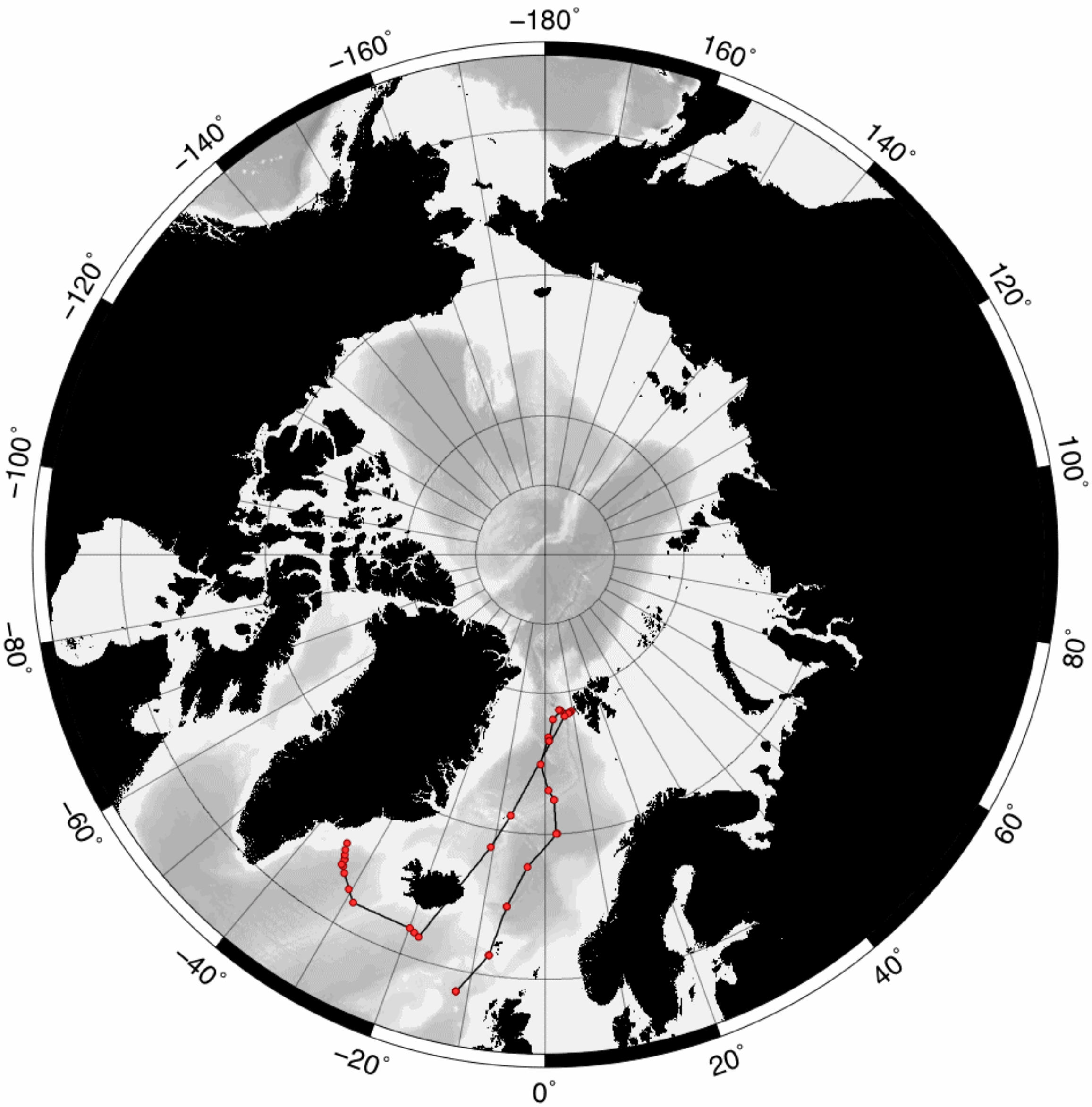
LINKS TO SELECT TOPICS

Shaded sections are not relevant to this cruise or were not available when this report was compiled

ANAS5 Takahashi/LDEO (KNORR 1981) – 316N19810721



TRANSIENT
TRACERS
IN THE
OCEAN

NORTH ATLANTIC STUDY

1 April - 19 October, 1981

Shipboard Physical and Chemical Data Report

Data Report Prepared by

Physical & Chemical Oceanographic Data Facility
Scripps Institution of Oceanography
University of California, San Diego
March 1986

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INTRODUCTION

In this report are published the shipboard hydrographic, radon, and freon data taken during the North Atlantic Study of the Transient Tracers in the Ocean program (TTO-NAS). Hydrographic data were taken by the Physical and Chemical Oceanographic Data Facility (PACODF) of Scripps Institution of Oceanography. The radon and freon data included in the final sections of this report were taken by William Smethie of Lamont-Doherty Geological Observatory, and Richard Gammon of University of Washington, respectively.

The field work was carried out aboard RV *KNORR*, operated by Woods Hole Oceanographic Institution (WHOI), on an expedition of 7 legs. The expedition began and ended at Woods Hole, Massachusetts, leaving port on 1 April and returning on 19 October 1981.

The cruise track constituted a more or less counter-clockwise circumnavigation of the North Atlantic, beginning with a number of sections across the western boundary current south to about 15°N latitude. A section between Bermuda and the Azores with an intensive survey of several "salt lenses" at intermediate depths south of the Azores, was followed by a survey of water mass characteristics in the North East Atlantic Basin. The *KNORR* then moved northward for a study of the sources of dense water in the North Atlantic Ocean, taking stations in the deep basins of the Norwegian and Greenland Seas, and reaching a latitude of 78°N. Returning into the Atlantic, additional sections were completed across the Irminger Sea, south of the Denmark Straits, the Labrador Sea, and across the North Atlantic Current. The final leg of the expedition ran down the western basin of the North Atlantic to 28°N, then turned northwest for a last section across the basin and through the western boundary current.

During the expedition many of the Geochemical Ocean Section Study (GEOSECS) stations taken in 1972 were reoccupied, and many of the parameters measured during the GEOSECS program were sampled again, some by the same personnel, some even with the same equipment, and of course, on the same ship. The chief scientists, most of whom were heavily involved in the GEOSECS program, prepared brief narratives for each leg which were published as introductions to the preliminary leg reports, and which are reproduced in the following section of this final report.

The original plan for the report included additional graphics presentations which do not appear in this publication. Both vertical sections and maps of properties on several density surfaces were desired, but for budgetary and other reasons, it became impractical to complete the volume as planned. After considerable discussion, there was not a clear consensus that TTO data alone is sufficiently dense in many areas to produce adequate horizontal maps. The production of an Atlantic atlas of contemporary hydrographic and tracer data from several sources may be more appropriate than attempting to include data from other expeditions in this final TTO-NAS report.

Many of the potential users of this report are familiar with GEOSECS data reports, the GEOSECS Atlas series [1], and the units and parameters used therein. While the tabular data format appearing here is similar to that found in GEOSECS publications, potential temperature and density-related parameters (sigma theta, 2, 4) published in this report will not be directly comparable with the same GEOSECS parameters.

The specific gravity equations of Cox et al. [2] and compressibility of Ekman [3] were used throughout the GEOSECS program to calculate sigma theta and sigma 4. At the time TTO-NAS was planned it was decided to use the new International Equation of State [4] from which absolute densities may be calculated, rather than specific gravities. The sigma quantities in this report are therefore potential densities in units of kilograms/cubic meter, from which 1000 has been subtracted.

Potential temperatures in the GEOSECS data were calculated according to Helland-Hansen [5]. In this report that parameter has been computed using Fofonoff's integration of Bryden's adiabatic temperature gradient equation [6]. The same routine is used to compute the temperature of water moved adiabatically to 2000 or 4000 decibars, for the subsequent calculations of sigma 2 or sigma 4.

A comparison of various calculations of sigmas, including the Knudsen equations [7] and potential. temperatures for NAS Station 6 was published in Volume I, TTO-NAS Preliminary Hydrographic Data Report. Typical differences are as follows:

P	T	S	POT T	SIC 0	SIC 2	SIG 4	SOURCES	
8	21.509	36.420	21.507	25.437	33.824	41.853	F-B	IES
			21.507	25.455	33.857	41.879	H-H	COX
				25.452	33.854	41.874		KNUD
2493	3.408	34.967	3.201	27.840	36.972	45.698	F-B	IES
			3.197	27.876	37.034	45.759	H-H	COX
				27.862	37.020	45.744		KNUD
5316	2.238	34.877	1.737	27.894	37.107	45.908	F-B	IES
			1.727	27.927	37.168	45.968	H-H	COX
				27.916	37.156	45.957		KNUD

Rosette cast pressure and temperature data given in this report were normally taken from the corrected CTD output at the time the bottles were tripped. Reversing thermometers provided pressure and temperature for Gerard and most shallow radon casts. Salinity has been calculated according to the equations of the Practical Salinity Scale of 1978 (8) from either CTD conductivity, temperature, and pressure, or conductivity ratio determined from bottle samples analyzed in duplicate with a Guildline Model 8400 laboratory salinometer. Dissolved oxygen was determined by a modified Winkler titration [9]. Nutrients (silicate, phosphate, nitrate and nitrite) were analyzed using a modified Technicon AutoAnalyzer and the methodologies employed during GEOSECS [1]. Alkalinity and Total CO2 were determined by potentiometric acid titration with hardware developed for the GEOSECS Indian Ocean Expedition [10] and the equations of Bradshaw and Brewer [11].

Casts taken during the expedition can generally be categorized in two types, small and large volume. Small volume casts employed a PACODF-designed multisampler based on a General Oceanics rosette pylon. On the multisampler were mounted 24 PVC sampling bottles of 10 liters volume, a Neil Brown Mark III CTD modified by PACODF, and a pinger. On many of these casts, a 1-meter beam transmissometer and/or a nephelometer were in use. On numerous casts, a second sampler was deployed 10 meters above the first unit. The second unit consisted of a General Oceanics 12-place rosette holding 30 liter Niskin bottles for the collection of bottom radon samples. On occasional stations 30 liter Niskin bottles were deployed serially on the hydro wire for collection of surface radon samples.

Large volume stations included the normal small volume sample acquisition plus the collection of samples for shorebased analysis of radiocarbon, Ra^{228}, Kr^{85}, and infrequently, Ar^{39}. These samples were collected in 270 liter stainless steel Gerard barrels deployed on the ship's trawl wire. Usually, 9 barrels were used on each cast. A 10 liter Niskin bottle was mounted on the outside of each Gerard barrel, and was linked to the Gerard closure mechanism so that the Gerard could not close without tripping the Niskin bottle as well.

The original intent of this system was to provide a verification of the Gerard tripping depths via the reversing thermometers mounted on the Niskin bottle, and by comparison of salinities taken from both samplers. For the TTO program a decision was made to draw the standard rosette samples from the Niskins used on large volume casts rather than interpolate property values from the rosette casts, as was done during the GEOSECS program. For some of the properties this technique was effective; however for dissolved oxygen and nutrients the results were not as good as had been anticipated. Nitrate and phosphate, in particular, were affected, probably by the flaking of small rust particles from the trawl wire. On some stations it will be noted that the merging of rosette and large volume cast data has produced profiles that are not as smooth as the profiles from small volume stations. The use of Niskins on Gerard barrels for other than depth verification should be considered carefully in the future.

Following the protocol established during the GEOSECS program, all samples were given a sample number which is equal to the cast X 100, plus the bottle number. For convenience, sampling bottles were numbered as follows:

1-24	10	liter rosette bottle
25-36	30	liter rosette bottle
40-47	10	liter bottle mounted on Gerard barrel
50-65	5	liter rosette bottle
70-78	30	liter bottle deployed on hydro wire
85-97	270	liter Gerard barrel

Throughout the data report alphabetic characters may be found in the tabular data. These characters have the following meaning.

D	A salinity value, normally from a bottle sample has been taken from CTD records.
H	A pressure or temperature value has been calculated from thermometric sources rather than from the CTD as is normally the case on rosette casts.
U	A data value is suspect, although no obvious reason has been found.

Listings of the subroutines used in the calculation of various parameters are included in Appendix I.

The hydrographic and CTD work was supported by the National Science Foundation, Division of Ocean Science Section, Grant #OCE 79-25890 and the Department of Energy, Office of Energy Research, Office of Basic Energy Sciences Carbon Dioxide Research Division to Physical and Chemical Oceanographic Data Facility, Scripps Institution of Oceanography.

Robert T. Williams
Acting Project Director
PACODF

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LEG 1

1 April - 13 April 1981

The week of preparation for the first leg of this major expedition saw an astonishing amount of work carried out. Noteworthy problems were the last minute swabbing of the ship by H.G. Ostlund to check C^{14} and tritium contamination (later revealed to be minimal), the nightmare that came true when the HP-1000 computer was dropped and damaged by airfreight handlers during shipment (eventually repaired) and the horrible problem of winding the new reel of conducting cable onto the GEOSECS winch. The wire refused to go on, even after heroic efforts in the dark, rain and cold of the night of March 31. Sailing had been planned for 0900 April 1; however, this was delayed to 1100, and eventually to 1800 due to the recalcitrant and all-important wire. At the fourth attempt success was achieved and the *KNORR* sailed at 1846, leaving a chilled group of friends and well wishers on the dock.

Due to the lateness of departure, the test of equipment originally planned for sailing + 5 hours, was delayed and people, tired out by long preparation turned in. The vessel was hove to at 0400 April 2 to test gear and the rosette package was put over the side at 0630 to test bottle trips. No station number was assigned to this stop, nor data archived, the purpose being to test readiness and to find problems in handling procedures, connectors, data transmission, etc. This location was left at 0841, the *KNORR* heading for TTO Station 1 (39°48.3'N, 70°05'W) and arriving at 1100. The first rosette was put over the side at 1200 and the station continued until 1600 hours in approximately 1200m water depth. This location was chosen to represent cold water north of the Gulf Stream and a full suite of samples (excluding Gerard barrels) was taken. On leaving this station the new trawl wire was streamed en- route to Station 2 with the ship slow ahead, the wire being wound on the drum under tension without incident.

Station 2 was reached at 0021 April 3, the rosette being over the side at 0108. The water depth of 3000m was selected so as to represent water at the upper extension of the western boundary undercurrent, a bottom potential temperature of 2.2°C being recorded. The station was completed by 0503, and the vessel departed for Station 3, reached at 0814. This was the first large volume station, chosen so as to sample the western boundary current, in about 4000m water depth. A full double rosette cast, and two Gerard casts were made. The Gerard barrels worked flawlessly (in contrast to the 1980 test cruise), evidence that the very extensive overhaul and testing prior to the cruise had paid off. The station work was finished by 0120 April 4.

Station 4 was reached at 0630 April 4; scheduled to be a CTD station only with minimal chemistry, the station was designed to serve for defining the outer edge of the undercurrent. A single rosette lowering to 4620m was made in deteriorating weather. Malfunctions in the rosette trip box occurred, so that bottle trips could not be confirmed. The station was delayed, with the package near the bottom, while efforts were made to remedy the problem. The package was raised with several bottles found to be untripped at the surface. The problem was solved en route to Station 5, this event proving to be the only malfunction of the entire leg.

Station 5, south of the Gulf Stream, was a reoccupation of GEOSECS 121. Reached at 2000 April 4, a double rosette cast was accomplished in sea state 4-5 presenting some of the most difficult handling problems of the entire leg, the station being over at 0337 April 5. Comparisons of TTO and GEOSECS data here should be particularly useful.

The next station (6) was reached at 1103 April 5. This represented the end of the first line of stations extending from the continental shelf to near Bermuda and was located on the Hatteras Abyssal Plain. Here a full large volume station was worked with extra Gerard cast for Ar^{39}. An eddy here caused the ship to be set strongly while on station during the rosette cast, and it was necessary to steam for 48 minutes to regain position while turning around the rosettes and rigging the trawl wire for Gerard caste. The station was finished by 0942 April 6. A CTD station that had tentatively been planned closer to Bermuda was eliminated, and course was set to the south for Station 7 which was to form the outer end of a second line of stations to be worked towards Cape Canaveral. The vessel headed into SSW winds and made labored progress, the transit time of 19 hours being a welcome respite from the hectic press of stations.

Station 7 was reached at 0500 April 7, a double rosette cast carried out and a Gerard cast followed. This was delayed a little due to problems with trawl winch meter wheel assembly. Chief Engineer Emilio Soto found a broken tooth on a gear wheel, and quickly fabricated a new gear, installed it, and the station continued. A later cast was marred when a pinger, clamped on the wire, became jammed in the railroad platform notch and a struggle to put things to rights took time. The vessel was underway at 2255 hours - a long hard day.

Station 8 in the Abyssal Plain was reached at 1256 April 8, however, minor problems with cabling and harness caused delays, and the first successful cast was not initiated until 1640, the station being completed by 2044 hours. Station 9, from 0507 - 0956 April 9, consisting of a rosette cast and a surface radon cast, was carried out without incident.

Station 10 was reached at 1135 April 9. This was a CTD lowering with extra samples for nutrients and tritium, designed to be on the outer edge of the western boundary undercurrent as it flows along the spur of the Blake-Bahama Outer Ridge. The station was completed by 1700 hours and Station 11 was reached at 1915 April 9. This large volume station was designed to be in the core of the undercurrent and was a reoccupation of the station previously occupied by Rhines in August 1977. Tritium values for the undercurrent at this point have been reported by Jenkins and Rhines (1980). The station began with a deep Gerard cast, followed by rosettes and further large volume sampling. Depth and position were monitored carefully throughout the station, which was finished by 0945 April 10.

A crossing of the Blake-Bahama Outer Ridge followed by Station 12 (1830 -2244 April 10) continued this line of stations, with shallow water on the Blake Plateau for Station 13 being reached at 0515 April 11.

Station 14, the last station of TTO Leg 1, was in the core of the Florida Current off Cape Canaveral. The aim was to sample source properties for Gulf Stream waters in the jet that emerges through the Florida Straits. Station 14 was accordingly made in quasi-Lagrangian fashion at 2030 April 11, with a set to the north of 1 mile each 15 minutes being recorded. The CTD trace revealed very strong temperature gradients to a bottom temperature of 9°C at 500m. A single rosette cast and two gradients samples were taken and the station ended at 2314 hours.

From Station 14 course was set to Cape Canaveral to let off marine technician D. Muus to attend to sudden illness in his family. This melancholy occasion was brightened by the fortunate occurrence of the delayed launch of the space shuttle "Columbia", which was scheduled for lift off at 0700 April 12. The Canaveral harbor buoy was reached at 0500; all on board witnessed a magnificent spectacle as the rocket lifted off some 5 miles distance from the *KNORR*. A splendid end to a fine cruise.

D. Muus was taken off in a Coast Guard launch at 0800 and course was set for Freeport, arriving at 0800 April 13.

This first leg of TTO was a remarkable success. The ship and laboratory functions were carried out in first class manner with only minor delays and troubles occurring. The officers and crew of the *KNORR*, and all participants in the scientific party deserve to be congratulated.

Peter G. Brewer

LEG 2

16 April - 10 May 1981

Leg 2, the southernmost leg of the North Atlantic Study, covered a region where previous observations of tritium had indicated that the main thermocline is slower to be ventilated than anywhere else north of l5°N. Immediately below this the Antarctic intermediate water had, as of 1972, kept the water column essentially free of tritium up to about 30°N. One objective of this study was to document the changes in the transient tracers distribution in this region of the main thermocline. Previous studies had also shown entry of tritium below the Antarctic intermediate water giving rise to a maximum centered at 1250m in a portion of the region covered by this study. The other primary objectives were thus to document the changes in this part of the water column as well as at. the bottom, in the North Atlantic deep waters, where there were a variety of reasons to expect that tritium would now be present.

The *KNORR* left Freeport at 1600 on the 16th of April, one day earlier than planned, with the unanimous consent of the 23 scientists as well as the crew members, all of whom agreed that they would rather have an extra day in the rather more pleasant port of St. Georges, Bermuda.

The entire leg was marked by the smooth and untroubled operation of all equipment and personnel and the full cooperation of the weather. Only two Gerard barrels failed to trip out of several hundred samples collected, and there were some problems with one of the CTDs which resulted in the loss of a few hours. The weather was ideal the entire time and even provided for some diversion in the form of tropical storm "Arlene" which appeared to be heading on a collision course with us for a time as we occupied the last station before Bermuda.

Our first station, TTO 15, was at the western boundary near the Bahamas. We then proceeded southeast to Stations 16 to 20 starting at the Bahama Escarpment and going into the Hatteras Abyssal Plain along a section where Dr. F. Schott, of the University of Miami, had a set of current meter moorings at the time.

Our next set of stations took us to the east along 26°N (TTO 20 to 22) and then back to the western boundary at the Puerto Rico outer ridge (TTO 26), after crossing the Mares Abyssal Plain. At this point we decided that we had enough extra time to go across the Puerto Rico Trench to the inner wall, rather than proceeding directly to GEOSECS 36 as originally planned. After doing TTO 28 on the inner wall, we continued on to GEOSECS Station 36, doing a series of stations, one of which, TTO 29, was at the southernmost extension of the Puerto Rico Trench.

TTO 32, the reoccupation of GEOSECS 36, was our longest large volume station because of the two ^{39}Ar Gerard casts we did in addition to the two ^{14}C Gerard casts. This was our southernmost station and was at the point where the Demerara Abyssal Plain opens out into the North American Basin. We then proceeded to the north, reoccupying GEOSECS Stations 34, 33 and 32 successively, while doing TTO Stations 33 to 38. Our final set of three stations, TTO 39 to 41, was along a section between GEOSECS Station 32 and Bermuda.

We were able to occupy 27 stations during this leg, including all of the 15 stations originally planned. Of the 12 additional stations, 3 were put on the TTO 16 to 20 section on the Hatteras Abyssal Plain. The 9 remaining stations were all 1500-2000m stations spaced more or less evenly between originally scheduled large and small volume stations from TTO 20 to 38. Our intention was to provide greater resolution in the main thermocline and down through the 1250m tritium maximum. ^{14}C and ^{228}Ra profiles were measured at 9 stations, some of which were also sampled for ^{85}Kr and ^{39}Ar. ^{228}Ra, ^{85}Kr and/or ^{39}Ar samples were collected at 4 additional stations for a total of 13 large volume stations.

The *KNORR* arrived in Bermuda at 0900 on 10 May. We wish to thank both the scientific party and ship's crew for an excellent cruise. The efficient work of the marine technicians and ship's crew enabled us to do far more station work than we had thought possible. This put an added burden on the analysts which they undertook with their usual professional competence and good will. We feel that the results published herein and the additional results that will come out, as the longer term measurements are completed, will more than justify their efforts.

Jorge L. Sarmiento

Robert T. Williams

LEG 3

16 May - 14 June 1981

The big surprise of Leg 3 was the discovery of isolated compact blobs of relatively undiluted Mediterranean water, not just the smooth continuous distribution usually described. These blobs, discussed in more detail below, were extensively surveyed in addition to fulfilling all the initial goals of this leg. A transect across the North Atlantic was completed from Bermuda to the Azores at 33°N (Stations 42-47). Radon stations (46 and 47) were made (with R. Key) at the Atlantis Seamount to test the importance of bottom topography on deep ocean and thermocline mixing. The distribution of tracers was mapped in combination with detail synoptic hydrographic measurements in the Canary Basin (Stations 48-109). This leg included reoccupation of GEOSECS Station 30 (TTO Station 43) and METEOR Stations 515 (TTO Station 71) and 516 (TTO Station 68).

This was an extremely successful leg both technically and scientifically. Our success is due primarily to the enthusiasm and real professional skill of the Physical and Chemical Oceanographic Data Facility (PACODF). These people are the real heroes of TTO!

The first salt blob was encountered at Station 53. Profiles taken near the center (Station 60) of this blob are displayed in Figure 1. Note the large anomalously high (0.8 ‰) salinity between 800db and 1400db. Note also a sizeable signal in all other variables including a relatively strong density step at the bottom of the anomaly. A section made from the first transect (Stations 51-57) through the blob is shown in Figure 2; it clearly shows the magnitude of the anomalous region.

Three of these salt blobs (aka broken toilets) were found and surveyed on this leg. Their positions are shown in Figure 3. Displayed is the maximum salinity found at the Mediterranean Water salinity maximum (1100 db) for each station in the region (30-34°N, 21-28°W) where the blobs were found. The first blob encountered was to the southwest (Stations 53-65), the second to the southeast (Stations 87-95) end the third to the north (Stations 89-105). The maximum salinity found in the blobs was 36.30 ‰ indicating relatively pure Mediterranean water.

The shapes of the blobs are contoured in Figure 4 with the thickness taken as that of the salinity anomaly > 35.7 ‰ in the Mediterranean Water salinity maximum. The three blobs have diameters 70-80km and maximum thickness >800m.

It is now clear that the details of the dispersion of oceanic tracers cannot be treated with simple advective diffusive models alone. There also exist stable compact structures of which these Mediterranean Water salt blobs are the strongest examples found so far. We anxiously await the analysis of the tracers sampled within the blobs to provide time scales necessary to access their role in the general circulation and distribution of oceanic property fields.

Excellent weather prevailed during this entire leg. Thanks to Captain Hiller and the ship's crew for a smooth voyage and again to PACODF for their efficient and enthusiastic work. We all arrived in Ponta Delgada 0900 on 14 June a bit tired but very satisfied.

Laurence Armi

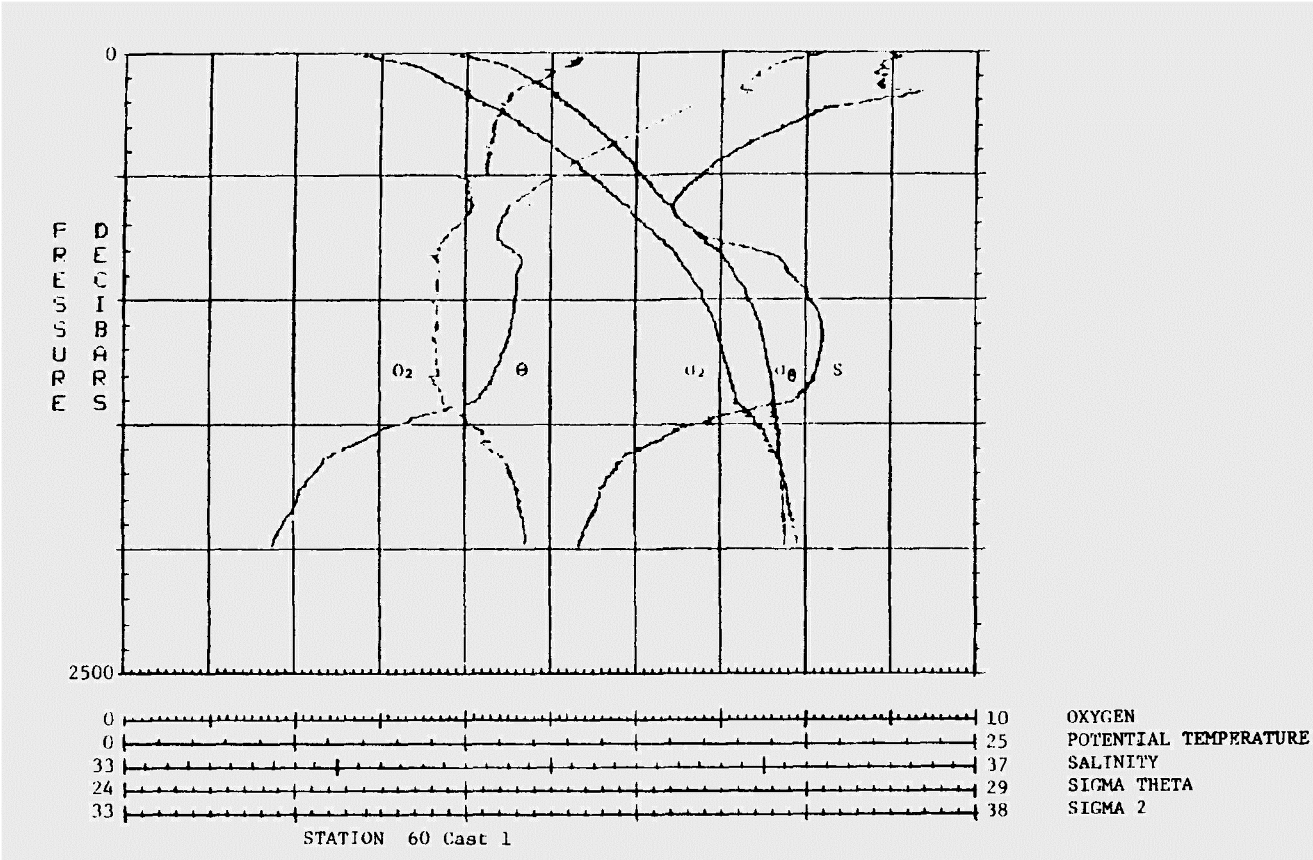

Figure 1. Vertical profiles of potential temperature (θ), salinity (S), oxygen (O_2), and density (σ_θ,O_2) at apparent center of first blob.

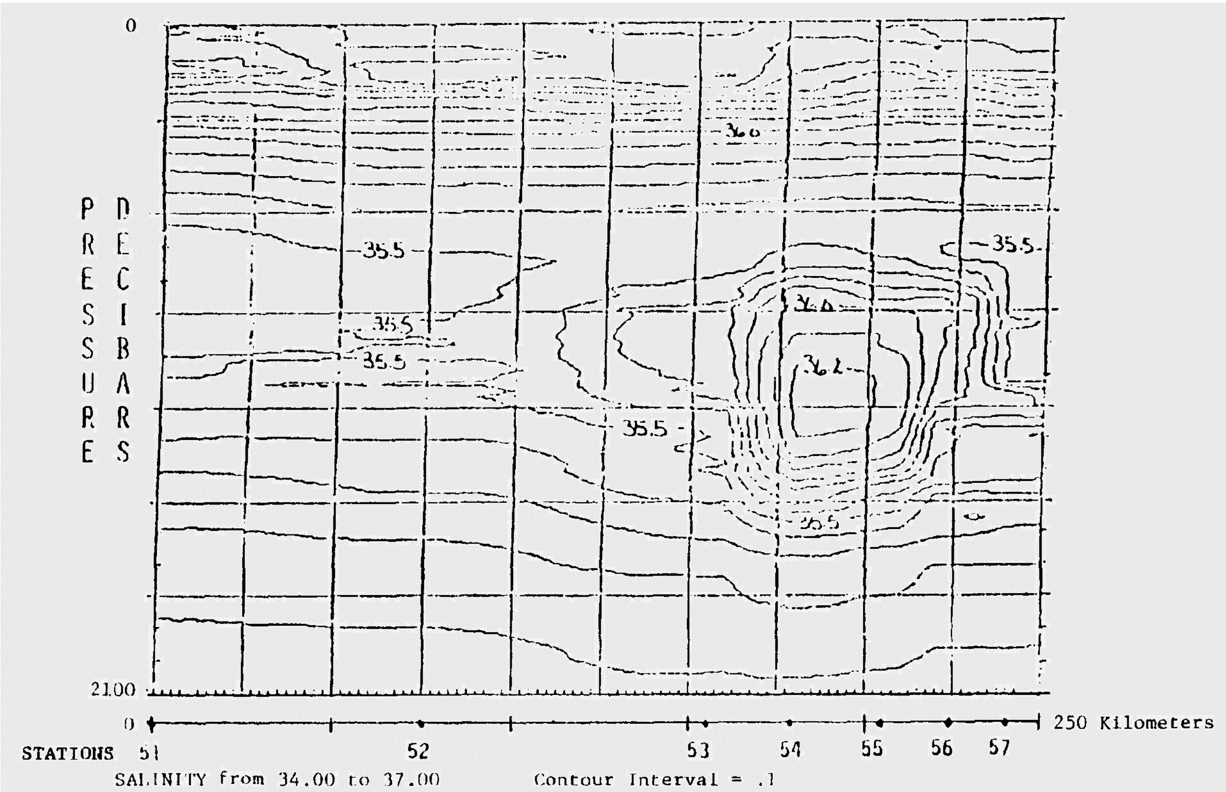

Figure 2. Section through first salinity blob along initial transect.

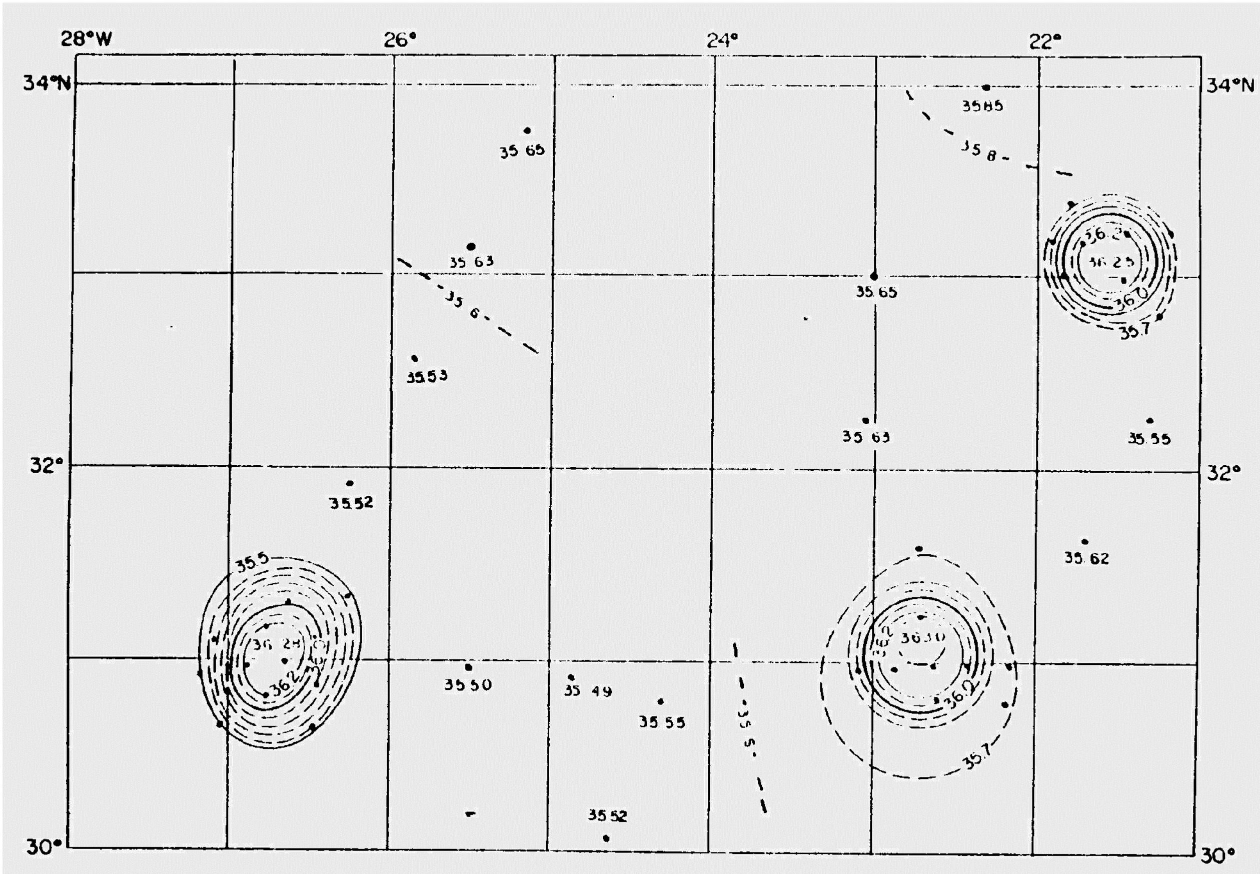

Figure 3. Maximum salinity found for Mediterranean Water (~110 db). Contoured at 0.1 ‰.

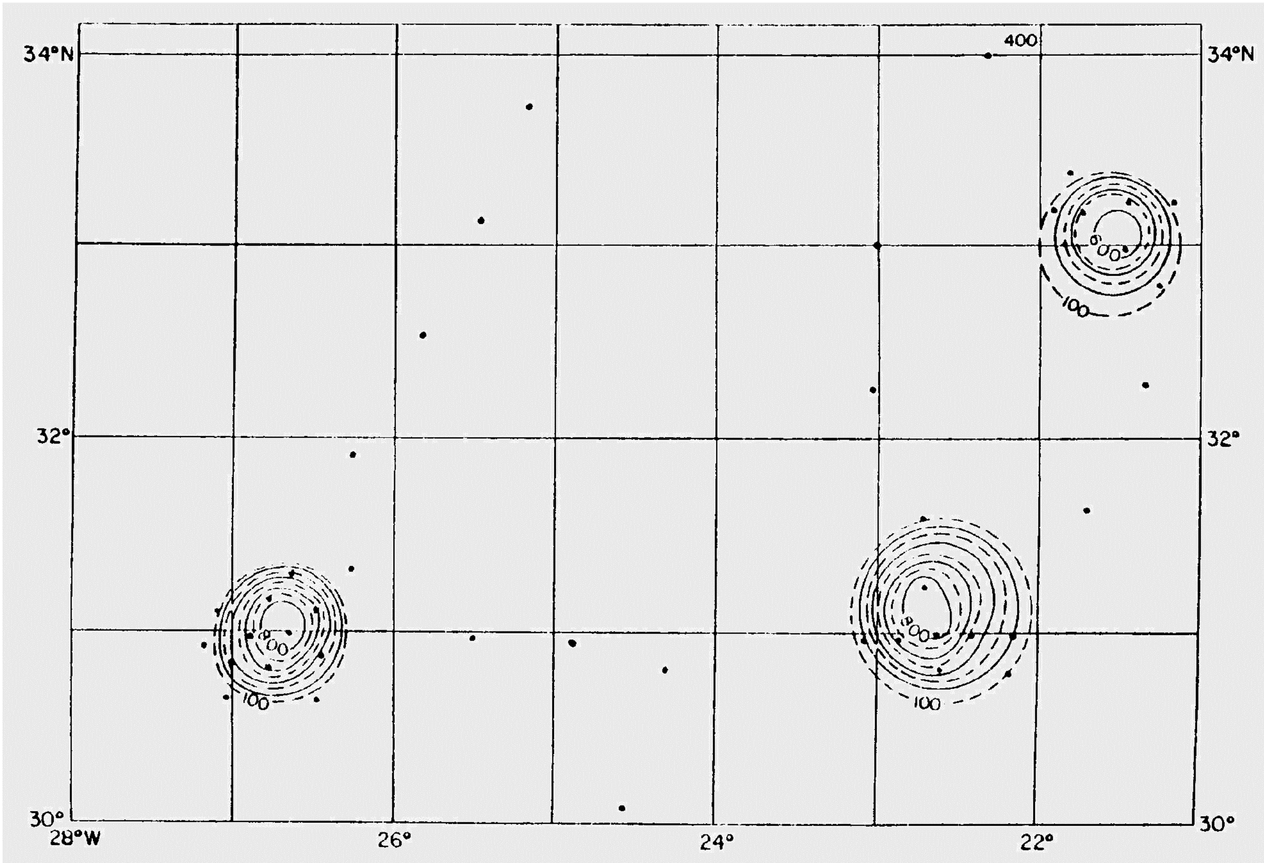

Figure 4. Thickness of regions with anomalously high salinity (> 35.7 ‰) in Mediterranean Water

LEG 4

19 June - 14 July 1981

The Rockall Channel exhibited conditions suggestive of substantial diapycnic mixing with long straight sections in the T-S diagram. In spite of this, pronounced influence of the southern component bottom water seemed evident in a combination of high silica and AOU with low bottom temperature. The westernmost station (135) in the channel showed distinctly enhanced salinity relative to the others. This is in contrast to the situation shown in the Fuglister Atlas, and may suggest that the Norwegian Sea outflow characteristics are tending towards the recent "normal" again.

This leg, devoted to the water mass characteristics in the North East Atlantic Basin comprised essentially three zonal sections, at about 38, 50 and 58 degrees north respectively. These sections were connected meridionally along the Iberian Peninsula to the shelf off England and along the Reykjanes Ridge, thus following the northward progress of the Mediterranean water, and the southward spreading of the overflow water originating at the Iceland-Faeroe Ridge. The 50 degrees north section was distorted to follow the deepest connection between the two main sections of the Eastern Basin - The Maury Channel.

The *KNORR* departed Ponta Delgada in the Azores in fair weather in the earl afternoon of June 19, 1981. Stations 110 to 113 were all conducted in light conditions, allowing new personnel to settle comfortably into the work routine, and tempted the co-chief scientists to begin to plan optional work to absorb the rapidly accumulating contingency time. The closest approach to the Iberian Peninsula was limited to 65 nautical miles in accordance with permits from the government of Portugal. A water depth of circa 2800m was reached, allowing a reasonably well developed Mediterranean core at a salinity of up to 36.46 ppt to be reasonably observed.

During this first section of the cruise leg, the track and station plans were reconsidered in view of better station time estimates, and of recent discussions between the chief scientists and German oceanographers active in this region. It appeared that, timewise, a more squared track pattern with better emphasis on zonal sections than initially expected would be feasible. It was felt desirable to incorporate an intercalibration station off the Bay of Biscay for the purpose of interrelating a section run by the RV *METEOR* up the Central Eastern Basin with our pattern. It was also decided, time permitting, to extend our middle zonal section through the Gibbs Fracture Zone. This would more closely connect Legs 4 and 6 of TTO by providing repeat station opportunity, or alternatively give somewhat more time for Labrador Sea mapping on the latter.

As it turned out, fair weather conditions prevailed during much of the leg. While concern for cruising speed dictated caution in commitment to program expansion, our decision to emphasize a close section in the overflow influenced region in the northernmost part of our area of coverage was originally, at least in part, dictated by needs to maintain flexibility in optional station time as late in the leg as possible. It. was shown to be fortuitous, however, as the underway data picture unfolded.

While the core data set on tracers is inaccessible underway, some features of the classic hydrographic data form clues to what to look for, and perhaps to emphasize, in the tracer work. There are four water mass components of central interest to our endeavors: the Southern Abyssal Component, the Iceland Faeroe Overflow, the Mediterranean Water, and the Labrador Sea Water. T-S distribution as well as the pattern of apparent oxygen utilization, AOU, in the bottom waters clearly indicate that not only is northern component influence negligible in the bottom waters south of 50 degrees latitude, but also that some northward flow occurs in the Maury Channel. Most strikingly, however, we found that the entire Northern Basin part, including the Gibbs Fracture Zone and the flank of the Reykjanes Ridge, seems to have undergone a significant freshening since the IGY data sets were acquired. While present in the entire column, the observed salinity anomalies appear to be maximal at 3.5°C, suggesting a connection with the fresh water anomaly in the Greenland and Labrador Seas which has been shown to characterize much of the nineteen sixties.

Wallace S. Broecker

Claes G.H. Rooth

LEG 5

21 July - 14 August 1981

Our sampling during Leg 5 was focused upon characterizing two of the three principal northern sources of dense water to the North Atlantic Ocean (the third, Labrador Sea Water, will be studied during Leg 6). Our stations included the major basins north of the Greenland-Scotland Ridge as well as recently overflowed waters south of ridge. One observation of potentially major importance was that key portions of the water column in most regions surveyed were less saline than during GEOSECS or other past cruises. Because salinity variations in these cold waters may give rise to strong density variations, the long term effect of these salinity shifts upon the density field could be vast. We are also now faced with the necessity of considering the variations in the temperature, salinity, and density fields as elements of the transient tracer distribution. Another indication of unusual conditions was the extremely heavy ice conditions encountered, forcing cancellation of all of our planned work in or near the East Greenland Current north of Denmark Strait.

The *KNORR* departed Greenock, Scotland, at 1400 hours 21 July 1981 in cloudy, drizzly conditions soon joined by a rising wind. Swell and headwinds to force 6 slowed the ship, but by the time we arrived at our first station (141), the weather was rapidly improving.

Our first station (large volume) was sited to observe contributions of dense water to the northern Rockall Trough from either the Wyvill-Thomson Ridge or the channel between Faeroe Bank and Bill Bailey's Bank. We observed bottom water generally similar to that found on the western side of Rockall Trough during Leg 4.

Our second station (142, also large volume) was occupied in the Faeroe Bank Channel near or slightly upstream of the sill leading out to the North Atlantic. Our preliminary impression was that hydrographic conditions at this station matched those observed during earlier stations at this location. The Faeroe Bank Channel station followed a brief bathymetric survey to establish station position. The bathymetric surveys (average duration each 1 1/2 hours) became a near-standard element of our stations in those regions where we wished to sample above specific bathymetric features such as deep channels, rift valleys, and fracture zones.

We next began a series of eight sections (4 large-volume Stations 143 through 150) during which we studied the principal deep basins of the Norwegian and Greenland Seas and one rift valley/fracture zone region in the zone of transition between Norwegian Sea and Greenland Sea hydrographic properties. Norwegian Sea Deep Water appeared to be slightly colder and show higher dissolved oxygen and lower dissolved silica levels than during GEOSECS. In the Greenland Sea, only a faint trace of a deep salinity maximum was observed, in contrast to the prominence of this layer in the historical data base. A pair of stations (146-147) in the transition region showed interleaving of water masses at virtually all levels, including the deep water.

On our approach to our intended position for station 149, we first ran into sea ice, forcing a minor adjustment to our plans for that station. Because we could not proceed west to our intended section across the East Greenland Current, we headed north and east along the ice edge. During a trio of stations near the northern perimeter of the Greenland Sea (Stations 151-153), we observed outflow of Greenland Sea Deep Water toward the Arctic Ocean along a valley in the Molloy Fracture Zone. Profile variations in two CTD/rosette casts, at. different locations along the axis of this valley, established the direction of flow. This is a rare and important observation because Norwegian Sea Deep Water, not Greenland Sea Deep Water, is generally held to be the source of the deep and bottom water of the Arctic Ocean.

We next ran an east west section of four stations across the West Spitsbergen Current from the shelf edge to a deep valley near the Mid-ocean ridge (Stations 154-157). The last two stations (especially the deep valley) showed bottom water which was slightly warmer and much more saline than the deep water. One possibility was that this unusual bottom water is the product of cooling of Atlantic Water in the Barents Sea, followed by outflow, for example, at. the bottom of the Bear Island Channel. No Greenland Sea Deep Water was observed in the valley.

We next steamed south to the Iceland Plateau, stopping at the Jan Mayen Fracture Zone for a CTD/rosette cast (Station 158). This cast showed Norwegian Sea Deep Water at the bottom, although with marginally higher oxygen than in the Lofoten or Norwegian Basins. It is possible that this is younger Norwegian Sea type deep water entering the Norwegian Sea from the periphery of the Greenland Sea.

Our large volume station on the Iceland Plateau (Station 159) again showed no evidence of a deep salinity maximum.

Due to reports of extremely unfavorable ice conditions on Denmark Strait, we made our passage around Iceland along the east coast. Despite a gale, we had managed to accumulate sufficient contingency time to run a short section of three CTD/rosette stations (Stations 160-162) in the northeastern Atlantic to help determine if 35.0 ‰ deep water was in fact proceeding (as usual) along the east flank of the Mid-ocean ridge. In accord with Leg 4 findings further south, we found no 35.0 ‰ deep water.

We ended the cruise with an east west section across the Irminger Sea, south of Denmark Strait (Stations 163-170, plus 171 as a large-volume reoccupation of Station 166). We found abundant low temperature, low salinity, high density Denmark Strait Overflow Water. There were no obvious signs of Norwegian Sea Deep Water overflow. We also sampled the East Greenland Current south of Denmark Strait (Station 170).

We arrived in Reykjavik on schedule at 1000 hours, 16 August 1981. Other than adjustments due to unfavorable ice conditions, our problems during Leg 5 were few. The refrigeration system for the alkalinity-nutrient van air conditioning broke down, midway through the cruise, forcing us to operate the van with the door open, effectively destroying the temperature control necessary for the best nutrient and alkalinity analyses. On the positive side, the outstanding performance of the scientific staff and the ship's crew and officers enabled us to easily meet the demands of our evolving program.

The underway gas seawater equilibrator system was operated throughout Leg 5 except for periods when the bow-pump intake came out of water due to high swells (total of 30 hours). The surface water pCO_2 value decreased northward from about 310 µatm in the North Atlantic, 58 N, to about 170 µatm at the northernmost station, 78°N, as the surface water temperature decreased from 13°C to 0.5°C. The observed change in pCO_2 can be mostly attributed to the change in temperature. The atmospheric sampling and analysis system was operated virtually all the time. The atmospheric CO_2 concentration decreased from 335ppm on July 21 (58°N) to 331ppm on August 6 (63°N) with a day-to-day variability of about 2 to 3ppm. This observed trend with time appears to be consistent with the seasonal trend observed elsewhere in the northern high latitudes. However, the lowest atmospheric CO_2 concentration of 326ppm observed on August 3 (76°N) may be attributable to the low pCO_2 (180 220 µatm) of the surrounding surface water.

Taro Takahashi

James H. Swift

LEG 6

21 August - 17 September 1981

On Leg 6 we occupied 48 stations in waters ranging from less than 200m depth to in excess of 4500m. We reoccupied TTO Station 127 (our Station 172) and GEOSECS Station 3 (our Station 214). Six of the stations were full large volume stations, consisting of 2 Gerard casts plus a rosette cast, and eight of the stations were what we called "Medium Volume" stations, consisting of one Gerard cast and one rosette.

The leg was segmented into the five sections. The first consisted of 13 stations and cut across the Northwest Irminger Sea in a roughly northwest direction between the Bight Fracture Zone on the Reykjanes Ridge and the coast of Greenland. We hoped to look for evidence in the tracers of "leakage" of Iceland-Scotland Overflow Water (ISOW) through the Fracture Zone into the western basin. The section clearly delineated the Denmark Straits Overflow Water (DSOW) plastered against the deep part of the Greenland Continental slope. Potential temperatures below 1.1°C and salinities below 34.88 ‰ were seen in this water mass and silica was near 9.0 micromoles/kg.

By far the most striking feature of the section was the very much lower than expected salinities in the upper 1500m of the water column. With the exception of the two extreme ends of the section, the upper 1000m was below 34.9 ‰. There are two apparently correlated features to this overall freshness: the anomalous ice conditions encountered in the Denmark Straits during Leg 5 and the observed superabundance of a lower salinity, lower temperature mode of Labrador Sea Water (LSW) seen to some extent in this section and in the rest of this Leg. The underlying cause is clearly a climatological difference between conditions in the early 1960's and today.

The section was extended into shallow (200m) water to ensure sampling of the East Greenland Current for tritium, C^{14} and CO_2. Between this section and the second one we had the opportunity of steaming through the southern tip of Greenland via Prins Christians Sund. By going through the fjord rather than around Cape Farewell we not only saved time and fuel, we enjoyed some spectacular scenery.

Debauching into the Labrador Sea, we commenced the second section by occupying a shallow station in the West Greenland Current. The Labrador Sea section consisted of 15 stations and extended southwestward across to the Labrador Current. The freshness observed in the last section was observed here throughout the whole water column, with the column being as much as 0.02 ‰ fresher than 1962 (WW, 1970) and 1967 (Grant, 1968). The ISOW salinity maximum barely reached 34.93 ‰ here while the earlier data approached 34.95 ‰, and the DSOW was fully .02 ‰ fresher. The Labrador Sea Water mass was especially abundant, being as fresh as 34.83 ‰ and as cold as 3.15°C, i.e. about .05 ‰ fresher and .25°C colder than "textbook" LSW. Also importantly, the potential density anomaly of this water mass is 27.75 ‰ as opposed to the 27.78 ‰ characterized by Lazier (1973). This kind of climatic modulation associated with the overall shallow salinity budget of the Labrador Sea has been discussed by Lazier (1980) and has profound consequences for the CO_2 - TTO problem. How the reversion of LSW to the lighter mode affects its viability as an intermediate water mass in the temperate regions is unclear at this time, but the hydrographic and tracer data we are gathering this leg coupled with Legs 4 and 7 will prove a powerful tool for learning about this important mechanism.

The section from the center of the Labrador Sea (Stations 193 and 201 through 207) allowed us to track the southeastward flow of the LSW. The transition from the super-cold/fresh LSW to more "text-book" LSW occurred around Stations 203-204. The easternmost extension of the section came close to reoccupying Station 124 but was chosen for a deeper part of the northern channel of the Charlie-Gibbs Fracture Zone. The ISOW reached a salinity maximum of 34.97 ‰.

The fourth and fifth sections extended across the front of the North Atlantic Current (NAG) which separates the cyclonic circulation of the north from the great anticyclonic warm-water systems to the south. Here the upper-level boundary current leaves the coast as a semi permanent "ox-bow" meander. Though suffering a continual change in water properties through frontal mixing, this water contributes a warm salty signal to the eastern side of the Irminger Sea, which is visible all the way around to the Labrador Sea. The tracer evolution in this area should help to tag this meridional circulation and to distinguish it from recirculation about the upper-level gyres. This transgression, like the analogous events farther south at the Grand Banks, represents a controversial aspect of the general circulation.

Labrador Sea and Denmark Strait waters extend southward beneath the upper-level front. Dynamically there can be strong interaction between these levels, which may account for the massive eastward extension of LSW along 50 N, split off from its southward flow along the western boundary.

Section 4 ran from the western end of the Gibbs Fracture Zone (GFZ) south along 37°40'W, to the latitude (47°40'N) of St. Johns, Newfoundland. It allowed a relatively clean perpendicular crossing of the MAC. The station pattern was augmented through use of XBTs, satellite SST maps and ship's set information to locate the current and fronts. The broad hydrographic patterns here (and in the other four sections) agree well with the classic atlas treatments, particularly those of Worthington and Wright, Dietrich, Grant and Ivers; the disposition of the "ox-bow" was quite like that of the summer of 1958 (Dietrich atlas). Resolution of the interleaving water masses by the CTD adds much to these patterns, however. This interleaving is a necessary step in the poleward transformation of tracer properties.

Section 5 ran southwest from the GFZ to St. Johns. It is a familiar path (see plate 45 Worthington-Wright) cutting across the tip of the permanent meander of the MAC, with the Labrador Sea Water (LSW) bifurcating just below into its southward and eastward extensions. It coincides with 1975 (*KNORR* 54) tritium-helium section of Jenkins and Clarke.

At the tip of the meander GEOSECS Station 3 was reoccupied. While this frontal region would be too variable for climate inference from single stations, we can see from the envelope of Stations 204-218 (see track map) that the deep O-S properties in this area now seem significantly changed. The LSW is greatly freshened, as is the DSOW. The 2.8 salinity maximum occurs throughout the region and is more intense. Similar conclusions follow from comparison against the IGY 1958 8-S properties of the region. It seems that the northern North Atlantic is able to respond rapidly to climatic changes on the 10-yr. time scale even far from regions of surface formation. Taking either advective- or Kelvin/Rossby-wave models for the adjustment of the circulation, this rapid response is quite plausible in these relatively compact seas. For example, newly formed LSW, say at the 27.75 sigma theta level, could appear at section 5 750km away in less than a year, due to boundary intensified wave- and advective effects.

The amount of work carried out on this leg by the PACODF group was enormous. During the 27 days at sea they performed 48 stations consisting of 98 casts. For example, a total of 1077 samples were analyzed for nitrate, nitrite, phosphate and silicate, over 1900 salinities, 1500 oxygens, plus a large number of samples for shorebased analyses. The data obtained were superb. We were more than impressed with the competence, cooperation and extremely high degree of professionalism of the PACODF group. They worked long hard hours cheerfully and were exceptional ship-mates. Arnold Mantyla worked long and hard on the data and helped with salinity analyses. We were pleased to have worked with such a fine group.

William B. Jenkins

Peter Rhines

LEG 7

23 September - 19 October 1981

This last leg of the TTO cruise was planned so as to reoccupy a number of GEOSECS stations down the western basin of the North Atlantic. The test cruise of October 1980 had also covered some of this area so familiar territory was to be encountered. After only minor confusion surrounding the arrival of parts and supplies for the two freon programs (Gammon and Hammer), and for the new C02 measurement system (Weiss), the *KNORR* left the snug harbor of St. Johns at 1036 local time and sailed through the Narrows, under the ancient guns of Fort Amherst and Signal Hill, on a bright clear morning.

The first station (220) was occupied at 2230/23 September on the Grand Banks and in the Labrador Current. Here a massive temperature gradient was found, the summer water overriding the frigid Arctic water below. Clocks were retarded 1/2 hour to Z+3 so as to avoid the peculiarities of keeping Newfoundland time, and Station 221 on top of Flemish Cap was begun at 2115/24 September in good weather. From there, stations were worked down the slope (221-226) and across the western boundary undercurrent towards the line of GEOSECS stations and the work carried out on Leg 6. September 25 was a particularly busy day with stations at 0445 (222) 0825 (223) and 1313 (224) where 1.9°C water was encountered and the deep work begun.

The weather deteriorated and rough days lay ahead for Station 225 on the 26th and Station 226. Here winds of Force 7 and high seas caused problems. Underway to Station 228 heavy seas sweeping the fantail damaged Gerard barrel racks and smashed a ^{228}Ra tank frame. The winds increased to Force 8 from WNW, however, work continued and on Station 228 on 29 September the wind dropped and the station was finished in calm seas and still air. This calm was illusory, for tropical storm Irene had been charted as advancing exactly along our projected cruise track for some days, and would be on us with 100 knot winds in less than 12 hours. Thus on completion of Station 228 course was set due west and on the morning of 30 September the *KNORR* was 120 miles from the planned track. A vicious squall with confused seas and 50 knot winds gave but a hint of the fury that lay to our east. Course was set to the south below the storm and 1 October brought sunshine, calming seas, the first strands of sargassum weed, and two dolphin fish gleefully caught.

From there a few days of idyllic weather followed, with perfect rosette casts and Gerards that tripped every time as we approached the most southerly part of our cruise at Station 235 on 7 October. Turning north, course was set for Sable Island to provide a final section across the western North Atlantic Basin. At Station 236 on 8 October a medical emergency in the crew raised the possibility of an enforced port call in Bermuda. Thus Station 237 was re-scheduled about 100 miles to the west of its original position in order to prepare for this eventuality. Fortunately, radioed diagnoses and prompt medication solved the problem while station work was carried out on the Wyoming Seamount and course could be set for the original line. Station 240 apparently was set in the center of a cold core Gulf Stream ring. Here the 18° water was absent, the water chemistry was distinctly of northern origin and on leaving the station the *KNORR* was at once set at 1.75 knots in the direction of 217.

The broad band of the Gulf Stream was reached between Stations 242 and 243 and a detailed line of stations through the western boundary undercurrent was begun moving slowly up the slope towards Sable Island. The last station (250) at 43°36'N, 59°32'W in 150m of water was completed at 2302 on 16 October after a day of dense fog and blaring fog horns. The station work was finished none too soon, for the barometer had dropped all day, and a tired scientific party dozed through a night of 40 knot winds and lurching seas. Fair weather followed on 18 October, and the *KNORR* came home on the morning of 19 October after a job well done.

Peter G. Brewer

Concluding Comments

With this last leg of TTO North Atlantic Study it is appropriate to include some overall evaluation of the program. In the 200 days 17 hours 14 minutes of the voyage the *KNORR* steamed 23,745 miles. There were 66 days 4 hours and 26 minutes of station time for 250 stations, or 6 hours 21 minutes average time per station.

On these stations were taken approximately 9000 individual water samples, virtually all of which were analyzed for salinity, oxygen and nutrients. For shorebased samples there were collected 3715 tritium samples (Ostlund), 3485 helium-tritium samples (Jenkins), 1184 ^{14}C samples (Ostlund), 1300 ^{228}Ra samples (Sarmiento-Key), 375 ^{85}Kr samples (Broecker-Smethie), and 25 ^{39}Ar samples (Broecker-Smethie-Looslie) each of which consumed 6 whole Gerard barrels. At sea 900 ^{222}Rn samples were measured. For carbon dioxide measurements approximately 7000 alkalinity titrations were carried out, and approximately 5000 discrete samples were measured for pCO_2 (Takahashi); in addition to these measurements continuous underway pCO_2 pCH_4, and pH_2O were measured (Weiss) and shorebased samples for CO_2 analyses y Keeling (23), and Brewer and Bradshaw (222) were taken.

However, the voyage cannot be measured in these dry statistics alone. That during these 200 days not a single piece of equipment was lost, nor person injured, nor deadline missed, is extraordinary. It is a testimony first to the high degree of professional competence of the PACODF group, and indeed all of the 126 investigators from diverse institutions, but also to the rapport established with the ship's company and to careful planning. The whole was quite simply a first class operation.

Peter B. Brewer
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SCIENTIFIC PROGRAMS

Participating Institutions	Principal Investigators	Scientific Programs	Total Samples Collected
Lamont-Doherty Geological Observatory of Columbia Univ.	W.S. Broecker,	^{222}Rn	1326
	T.-H. Peng and W.M. Smethie, Jr.	^{85}Kr and modeling	380
	T. Takahashi	pCO_2 and carbonate chemistry	3371
Princeton University	J.L. Sarmiento, K. Bryan	Modeling of tracers	
	J.L. Sarmiento, and R.N. Key	^{228}Ra ^{226}Ra	1151 1072
Scripps Institution of Oceanography	R.F. Weiss	pCO_2 pN_2O	
	C.D. Keeling	Total CO_2	497
	L. D. Armi	Ocean mixing and circulation	
Physical & Chemical Oceanographic Data Facility	R. T. William	CTD Salinity Oxygen Nutrients Alkalinity and Total CO_2 Large volume sampling and ^{14}C extractions	 8670 6575 6117 3839 1183
University of Bern	J.H. Oeschger	^{39}Ar	57
University of Miami	H.G. Ostlund	^{3}H ^{14}C	3704 1183
University of South Carolina	W.S. Moore	^{228}Ra	1151
University of Washington	R.H. Gammon	Ocean freon tracers	297
Woods Hole Oceanographic Institution	W.J. Jenkins	^{3}H ^{3}He Ocean freon tracers	3704 3433
	P.G. Brewer, A.L. Bradshaw	Carbonate chemistry	207
	H. Livingston	^{137}Cs ^{90}Sr	145 87
	D. Mann	Be Se	90 103

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Richard V. Mead
Ronald G. Patrick
Raymond A. Rowe
Frank Sanchez
Edward J. Slater
Karen Sowell.
Paul R. Sweet
Robert T. Williams

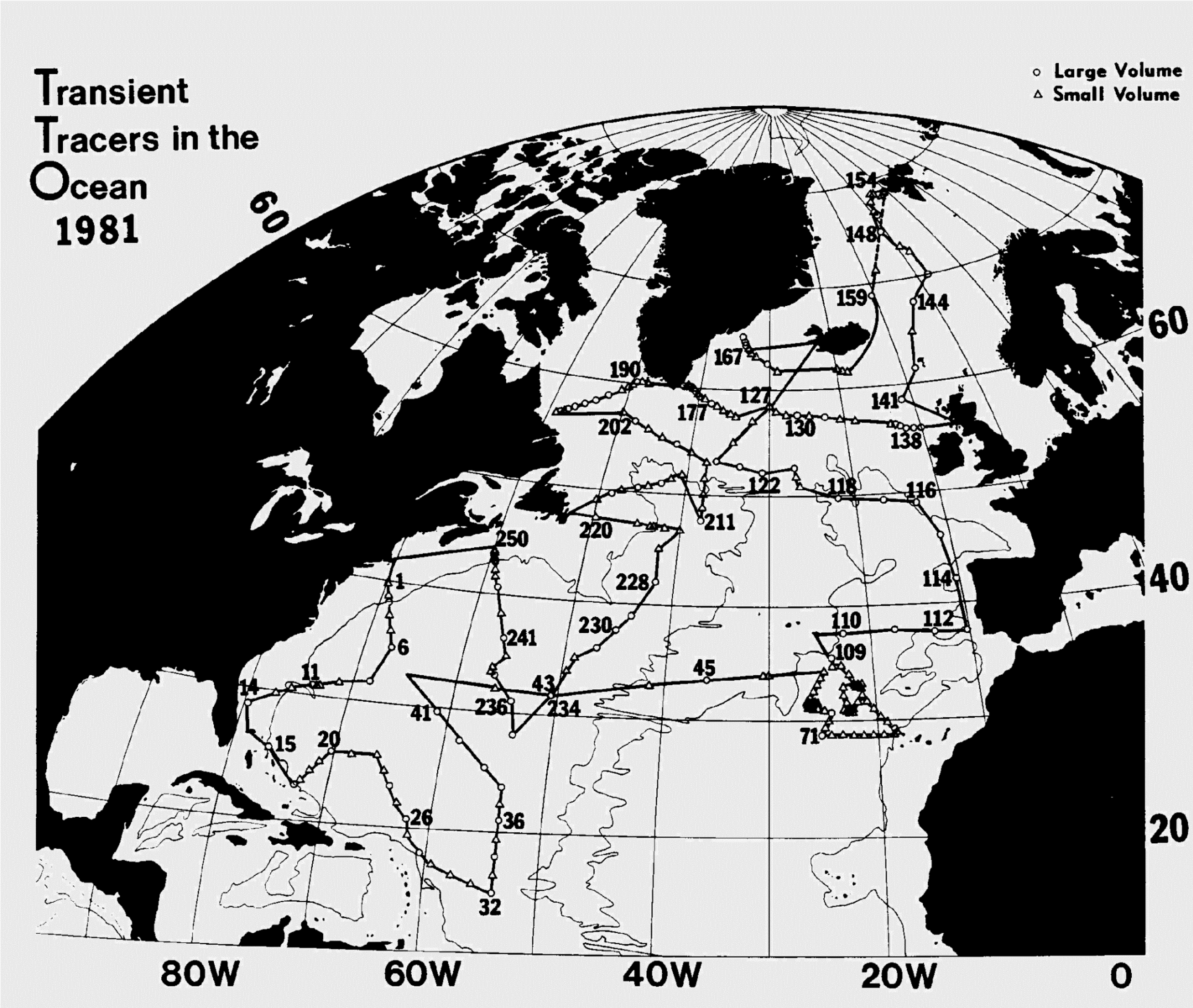
Woods Hole Oceanographic Institution

Paul N. Hammer

TRANSIENT TRACERS IN THE OCEAN

Itinerary Of The RV *Knorr*

	DEPART	ARRIVE
LEG 1	Woods Hole, Massachusetts 1 April 1981	Freeport, Bahamas 13 April 1981
LEG 2	Freeport, Bahamas 16 April 1981	St. Georges, Bermuda 10 may 1981
LEG 3	Hamilton, Bermuda 16 May 1981	Ponta Delgada, Azores 14 June 1981
LEG 4	Ponta Delgada, Azores 19 June 1981	Greenoch, Scotland 14 July 1981
LEG 5	Greenoch, Scotland 21 July 1981	Reykjavik, Iceland 14 August 1981
LEG 6	Reykjavik, Iceland 21 August 1981	St. Johns, Newfoundland 17 September 1981
LEG 7	St. Johns, Newfoundland 23 September 1981	Woods Hole, Massachusetts 19 October1981



LEG	STATIONS
1	1-14
2	15-41
3	42-109
4	110-140
5	141-171
6	172-219
7	220-250

SURFACE RADON PROFILES AND HYDROGRAPHY

Data Presented

This report contains ^{222}Rn and ^{226}Ra data collected during the TTO North Atlantic Study. The radon analyses were carried out on board ship by LDGO personnel. The accompanying potential temperature, salinity, and density data were collected on the same samples analyzed for radon. The PACODF group at Scripps was responsible for collection of this data and the temperature, salinity, and density data presented here were taken from preliminary cruise reports. The mixed layer depth, which was determined from the density data, is also presented.

Sample Collection And Analysis

Samples were collected using 30-liter Niskin bottles hung on a hydrowire. Generally 8-12 samples were collected per profile with samples spaced so that 3-5 samples were obtained from the surface mixed layer, 4-7 samples with a 3-m spacing between samples were obtained from the top of the pycnocline, and 1-2 samples were obtained 20-50 m below the base of the mixed layer. Each cast was preceded by either a CTD or XBT cast to determine the appropriate sample spacing.

Radon was extracted from the 19-1 water samples which were transferred from the 30-1 Niskin bottles to evacuated flint glass bottles. The extraction was done by recirculating helium through the sample at 1-2 liters/min. for 90 minutes and removing the radon from the circulating helium with a charcoal trap cooled to -60°C. At the end of the extraction the trapped radon was quantitatively transferred to a gas scintillation cell and the cell was placed on a counter to measure the radioactivity. Details of the technique are described in Mathieu (1). The precision of the measurement was generally ± 5%.

Temperature and salinity were measured on every radon sample. Temperature was measured using reversing thermometers and salinity measurements were made with an Autosal salinometer.

Determination Of The Mixed Layer Depth

The mixed layer depth was determined from the density data calculated from the temperature and salinity measurements made on the radon samples. The vertical profiles of density in the mixed layer and in the top of the pycnocline were linearly extrapolated until they intersected and the depth of this intersection was taken to be the depth of the mixed layer.

Determination Of The ^{226}RA Concentration

For each ^{226}Rn profile, generally three of the ^{222}Rn samples were analyzed for ^{226}Ra using the MnO_2 impregnated acrylic fiber technique [(Moore et al., (2); Key et al., (3)]. After the ^{222}Rn analysis at sea, the water was drained through a tube 1.9 cm ID x 15 cm long packed with MnO_2 impregnated fiber at a flow rate of less than 0.5 liters/minute. The fibers were returned to the laboratory where the MnO_2 and adsorbed ^{226}Ra were leached from the fiber in hot 6N HCl. The leachate, containing the ^{226}Ra was sea1ed in a glass stripper and allowed to equilibrate with ^{222}Rn. The ^{222}Rn was removed from solution by bubbling helium through the solution and then measured by the same techniques used to measure ^{222}Rn at sea. Each sample was analyzed at least 3 times by allowing ^{222}Rn to grow back into equilibrium after each analysis.

Beneath the radon deficit region, ^{222}Rn and, ^{226}Ra are in equilibrium. Thus, the ^{222}Rn radioactivity equals the ^{226}Ra radioactivity. At each station, the bottom sample was below the radon deficit and at most stations, several samples were below the radon deficit as indicated by a constant concentration. A typical profile is shown in Figure 1. The ^{226}Ra radioactivity beneath the mixed layer was taken to be equal to the mean *in situ* ^{222}Rn radioactivity in the region beneath the deficit where the ^{222}Rn radioactivity was constant. For stations where the *in situ* ^{222}Rn did not reach a constant value, the bottom point in the profile was taken to be equal to the ^{226}Ra radioactivity.

The ^{226}Ra radioactivity determined from *in situ* ^{222}Rn measurements beneath the radon deficit and from fiber samples co1lected beneath the radon deficit should agree. However, the *in situ* ^{222}Rn measurements are generally 10 to 15% higher than the fiber ^{226}Ra measurements (Figure 2). This is not caused by a calibration problem because the same measurement equipment and standards were used in the lab and at sea. We do not know the cause of this, but the same phenomenon was observed in ^{222}Rn and ^{226}Ra measurements made on the Warm Core Rings project [Orr et al., (4)]. Two possible causes come to mind: 1) The fibers did not remove ^{226}Ra from seawater at 100% efficiency. If this were the case, then differences in the water flow rate through the fiber column could result in different extraction efficiencies which would explain the scatter in Figure 2; 2) ^{226}Ra in suspended particulate matter plays an important role in supporting ^{222}Rn in the upper ocean, i.e., ^{222}Rn is produced from dissolved ^{226}Ra and ^{226}Ra in suspended particulate matter. Our sampling technique would undersample suspended particulate matter because some of the suspended particulate matter would settle below the spigot on the 30-1 Niskin bottle before the water sample was drawn. Although the fiber columns do collect suspended particulate matter since some of the particulate matter remains in the Niskin bottle, the ^{226}Ra measured by the fiber method would not represent the total amount of ^{226}Ra supporting water column ^{222}Rn. The amount of suspended particulate matter and the amount of ^{226}Ra contained in the suspended particulate matter would vary from station to station and could explain the scatter in Figure 2. There is very little data on ^{226}Ra in suspended particulate matter. A few measurements on suspended particulate matter in the Sargasso Sea reveal a maximum ^{226}Ra radioactivity of 0.2 dpm/100 kg of seawater [Bishop et al., (5)]. A radioactivity of 1 to 1.5 dpm/100 kg is required to explain the discrepancy that we observe between *in situ* ^{222}Rn and fiber ^{226}Ra measurements.

To use the fiber ^{226}Ra measurements, we have applied a correction factor to the fiber data. This factor was determined by fitting a straight line, forced through the origin, through the data presented in Figure 2. All data except 5 points where the fiber ^{226}Ra was greater than the *in situ* ^{222}Rn by 1 standard deviation, were used. The correction factor is the slope of the line, which is 1.114 ± 0.119 (Figure 2).

To determine the ^{226}Ra profile for each station, the *in situ* ^{222}Rn measurements were used for the region beneath the radon deficit and the fiber ^{226}Ra measurements (corrected by multiplying by 1.114 ± 0.119) were used for the mixed layer. If two fiber samples had been collected from the mix layer, they were averaged before applying the correction factor. ^{226}Ra values between the mixed layer value and the value determined from *in situ* ^{222}Rn were determined by linear interpolation. The errors reported were calculated by propagating the errors on the correction factor and the fiber ^{226}Ra measurement. The error on the ^{226}Ra determined from *in situ* ^{222}Rn measurements is the standard derivation of the mean where more than one measurement was used and is the error on the individual measurement when only one measurement was used. All errors reported are 1 standard derivation.

At stations 3, 5, 6, 7, and 13, ^{226}Ra was assumed to be constant with respect to depth and equal to the *in situ* ^{222}Rn beneath the radon deficit. The reason that this was done is that the fiber ^{226}Ra measurements appear to be too high for stations 3, 5, and 6 and no fiber ^{226}Ra data was obtained for stations 7 and 13. The silica difference between the surface mixed layer and water just beneath the mixed layer was less than 0.3 μM/kg which suggests that the ^{226}Ra should be constant over this depth range.

Data Reduction

All ^{222}Rn concentrations have been decay corrected to the time that the Niskin bottles were tripped. The data reduction is described in detail in Sarmiento et al. (6) and Smethie (7). The error reported is one standard deviation and is the result of propagating errors arising from counting statistics, uncertainty in counting efficiency, uncertainty in the background count rate, and uncertainty in the volume of the water sample. The error arising from counting statistics was calculated using the J factor as described by Lucas and Woodward (8) and Key (9).

Counting efficiencies were determined by running diluted aliquots of the NBS ^{226}Ra standard material #4953-C, and the error in the counting efficiency is the standard deviation of replicate runs made during the TTO/TAS expedition.

Acknowledgements

Radon analysts for the seven legs of TTO/NAS were:

Leg 1	Bill Smethie, Bob Trier, Owen Andersen (all LDGO)
Leg 2	Guy Mathieu, Sally Mathieu, Dee Breger (all LDGO)
Leg 3	Bob Key (Princeton), Owen Andersen (LDGO)
Leg 4	Guy Mathieu (LDGO), Sally Mathieu (LDGO), T.H. Peng (Oak Ridge)
Leg 5	Bill Smethie, Sherry Shiff, Marilyn Buchholtz (all LDGO)
Leg 6	John Goddard, Mike Amdurer (all LDGO)
Leg 7	Bob Key (Princeton), Jim White (LDGO), Greg Kolibas (LDGO)

Guy Mathieu and John Goddard were responsible for setting up the shipboard ^{222}Rn laboratory and the computer routines for data reduction. The ^{226}Ra samples returned to the laboratory were analyzed by Libby Ramage, Doug Maduro, and Ester Brady. Bob Key provided us with a Fortran program for the J-factor calculation.

This work was supported by NSF grant number OCE 79-25888 to Dr. W.S. Broecker and Dr. W.M. Smethie, Jr. of Lamont-Doherty Geological Observatory.

William M. Smethie, Jr.

Libby Ramage

References

[1] G.G. Mathieu, Rn-222 and Ra-226 technique of analyses, In: Transport and transfer rates in the waters of the continental shelf, Annual report to the Energy Research and Development Administration for Contract EY 76-S-02-2185, (June 1977).

[2] W.S. Moore, B.M. Key and J.L. Sarmiento, Techniques for precise mapping of ^{226}Ra and ^{228}Ra in the ocean, Journal of Geophysical Research, (1985) 90, 6983-6994.

[3] R.M. Key, R.L. Brewer, J.H. Stockwell, N.L. Guinasso, Jr. and D.R. Schink, Some improved techniques for measuring radon and radium in marine sediments and seawater, Marine Chemistry (1979) 7, 251-264.

[4] T.-H. Peng, W.S. Broecker, G.G. Mathieu, Y.-H. Li and A.E. Bainbridge, Radon evasion rates in the Atlantic and Pacific Oceans as determined during the GEOSECS program, Journal of Geophysical Research, (1979), 84(C5), 2471-2486.

[5] J.K.B. Bishop, J.M. Edmond, D.R. Ketten, M.P. Bacon and W.B. Silker, The chemistry, biology, and vertical flux of particulate matter from the upper 400 m of the equatorial Atlantic Ocean, Deep Sea Research, (1977), 24, 511-548.

[6] J.L. Sarmiento, D.E. Hammond and W.S. Broecker, The calculation of the statistical counting error for ^{222}Rn scintillation counting, Earth and Planetary Science Letters, (1976), 32, 351-356.

[7] W.M. Smethie, Jr., An investigation of vertical mixing rates in fjords using naturally occurring radon-222 and salinity as tracers, PhD thesis, University of Washington, (1979), 247 pp.

[8] H.F. Lucas and Woodward, Effect of long decay chains on the counting statistics in the analysis of Ra-224 and Rn-222, Journal of Applied Physics, (1964), 35.

[9] R.M. Key, Estimating the standard deviation for Rn-222 scintillation counting - a note concerning the paper by Sarmiento et al., Earth and Planetary Science Letter, (1977), 35, 184-187.

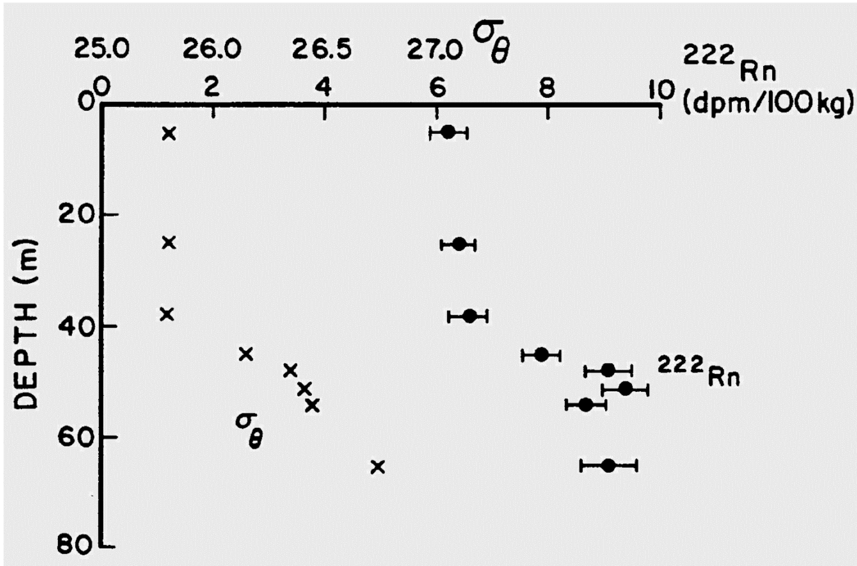


Figure 1. ^{222}Rn and σ_θ versus depth for TTO/NAS station 211.

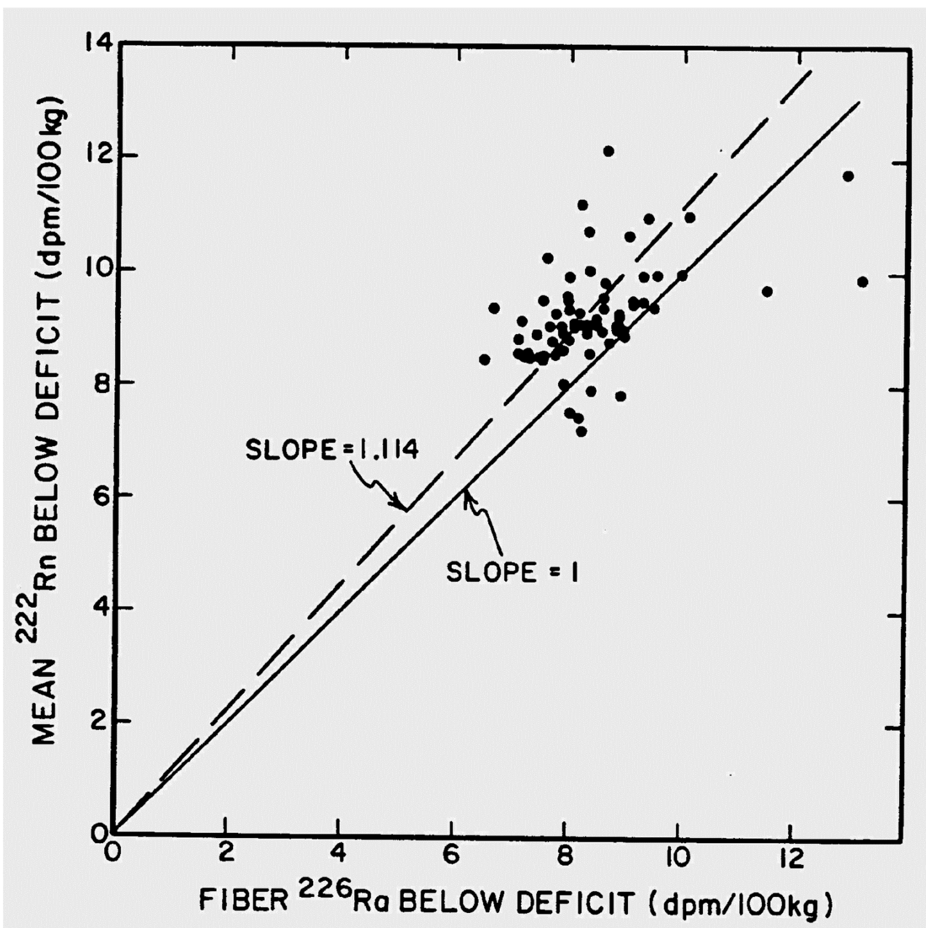


Figure 2. Shipboard ^{222}Rn versus fiber ^{226}Ra for samples beneath the radon deficit for TTO/NAS.

Extensive freon measurements were conducted on Leg 7 of TTO. The system built for this cruise performed very reliably. More than 500 water samples were analysed for both freons, F-11 and F-12, so that complete vertical profiles were obtained at 24 of the possible 30 field stations. In addition, more than 100 measurements of freon concentrations in the atmosphere were made as part of the calibration procedure, as well as for the subsequent determination of the degree of saturation of the surface waters.

Measurable concentrations of F-11 and F-12 were found at all depths for all stations except the southernmost (28 N). A well-defined freon maximum at the bottom (5000m) can be traced southward to GEOSECS Station 28 (39 N), remarkably like the deep tritium feature found during the North Atlantic GEOSECS study in 1972-3. In two different crossings of the Western Boundary Current (WBC), the freon signal revealed the WBC core at a depth of ~3600m (43 N, 60 W), and somewhat deeper, ~4200m, further to the northeast off St Johns, Newfoundland (47 N, 42 W).

The freon concentrations in the surface water were found to decrease with increasing sea surface temperature, remaining close to saturation equilibrium with the simultaneously measured atmospheric burden. There was no measurable latitude gradient of these gases in the marine troposphere from 47 to 28 N. The observed penetration of freon gases into the deep North Atlantic will lead to an improved understanding of the circulation and sink capacity of this ocean for man-made gases (freons, CO_2) critical to global changes.

This work was supported by the U.S. National Science Foundation Grant #OCE-7925889.

Richard H. Gammon

CCHDO Data Prcessing Notes, All Legs:

1987-04-07	*Unknown*	DELC14/TRITIUM	From CDIAC Website

```
                 TTO NAS TAS TRITIUM and C14 DATA              87/04/07
                           DOS DISK

     The files on the floppy disk include only samples on which C14 or T (or
both) have been measured.  Missing data are indicated by blanks.  Files are
ASCII characters, forming integers of the actual numbers, multiplied by FACTOR
below.

     File format is DOS, as it comes on the IBM PC.  One long string of
characters as follows:

BYTES   WIDTH   DATA, (right justified)                                 FACTOR

1-6     6       Station number                                              1
7-12    6       Cast, Niskin bottle number                                  1
13-18   6       Depth in m or pressure in dB, supplied by PACODF            1
19-24   6       Potential temp., see pg. 5 in Data Report 15             1000
25-30   6       Salinity, in S-units, supplied by PACODF                 1000
31-36   6       Sigma Theta, see pg.5 in Data Report 15                  1000
37-42   6       TU in old scale at time of sampling                      1000
43-48   6       Error, 1 Sigma, in TU                                    1000
49-54   6       TCO2 in  moles/kg. Note: On TTO there are TCO2           1000
                  data available on more samples, not listed here
55-60   6       dC13 (o/oo) vs PDB, of our CO2 preparations              1000
61-68   8       DC14 in internationally adopted scale                    1000
69-72   4       Gerard sampler #                                            1
73-78   6       Available                                                  -
79      1       CR                                                         -
80      1       LF                                                         -

     The Tritium Lab is responsible only for the TU, eTU,dC13 and DC14 data to
be accurate.  For up-to-date hydrography, TCO2, and other parameters, please
contact Scripps Data Facility.
```

1989-08-31	*Jenkins, William*	He/Tr	From CDIAC Website

WHOI Helium Isotope Lab
Data Release #3.0   August 31, 1989
Tritium and 3He from TTO-NAS and NATS 1981

Dear Colleague,

The files on this disk (TTO.DAT and NAT.DAT) are a listing of tritium, helium and hydrographic data taken on two expeditions which took place in the summer of 1981. The TTO North Atlantic Survey took place on the KNORR on seven legs with a variety of chief scientists (see the data report published by Scripps Institution of Oceanography, ref SIO No. 86-15). The NATS (North Atlantic Tracer Section) data (AT-109, legs 1-3) were taken with C.Wunsch, H.Stommel and D.Roemmich as chief scientists. We are indebted to all for their help. This work was supported by the National Science Foundation, grants No. OCE79-21378 and OCE81-17998. You are free to use this data as you see fit, but an acknowledgement of its source would be appreciated in any resulting publications.

There are a total of 3235 tritium and 2893 helium measurements. The data are organized as simple ascii files with two kinds of records in a repeating pattern: a station header record, followed by a number of depth records. Ancillary hydrographic information is included for your convenience only, and we make no claim as to its accuracy. Cast and bottle numbers are included to permit referencing the actual hydrographic data released by the PACODF group. We present the helium-3 data in two "units" for use at your own discretion. Null values are indicated as -99. We have made every attempt to ensure that there are no errors in the data (eg due to mis-labelling), but if you find any "fliers", please notify us (telemail W.Jenkins) of the cast and bottle number and what the problem appears to be, and we will investigate. Don't forget to include the data release number.

The data can be read by the following fortran statements (contained in the file "test.for"):

```
      open(unit=3,file='TTO.DAT',status='old')
 100  read(3,110,end=300)ista,ndeps,stalat,stalon,id,im,iy
 110  format(2i3,2f8.3,3i3)
      do 200 i=1,ndeps
          read(3,120)icast,ibott,pres,temp,salt,oxy,trit,sigt,he3,del3,che
 120      format(2i2,f6.0,2f8.3,f5.0,3f7.2,f7.1,f7.2)
 200    continue
      go to 100
c
c   ................................
c
 300  close(unit=3)
c
c
```

The program test.for has been succesfully used under both SUN OS v4.0 and Microsoft (MSDOS) v5.0 fortran compilers.

The variables read are:

```
    STATION HEADER:
          ista     station number
          ndeps     number of depths to be read
          stalat     station latitude (N positive) in decimal degrees
          stalon     station longitude (W positive) in dec. degrees
          id,im,iy   station date (day, month, year)

    DEPTH RECORDS:
          icast     cast number
          ibott     bottle number
          pres     pressure in decibars
          temp     in situ temperature (deg. C)
          salt     salinity (PSU)
          oxygen     dissolved oxygen (uM/Kg)
          trit     tritium (T.U.) at time of station
          sigt     uncertainty in tritium (T.U.)
          he3     excess helium-3 (T.U.)*
          del3     helium isotope ratio anomaly (permil)**
          che     helium concentration (ncc/g)***

     * the excess helium-3 is computed according to Jenkins (1987).
          Uncertainty is .035 T.U.
     ** relative to the atmospheric ratio.  Uncertainty is 1.5 permil.
     *** uncertainty is 0.1 ncc/g [ncc = 10^-9 cc(STP)].
```

The data reported here are the result of the work of a number of people (both present and past) in the Helium Isotope Laboratory. They are:

Richard D. Boudreau
Marcia W. Davis (Pratt)
Philip A. DesJardin
Peggy A. Dickinson (O'Brien)
Heidi Hinds
William J. Jenkins
Danuta G. Kaminski
Dempsey E. Lott III
Gary Newhart

References:

Jenkins, W.J. (1987) 3H and 3He in the Beta Triangle: observations of gyre ventilation and oxygen utilization rates. J. Phys. Oceanogr. 17, 763-783.

Lott, D.E. and W.J. Jenkins (1984) An automated cryogenic charcoal trap system for helium isotope mass spectrometry. Rev. Sci. Instrum. 55, 1982-1988.

CCHDO Data Prcessing Notes, Leg 1 only:

2006-02-10	*Muus, Dave*	CTD/BTL/SUM	From CDIAC Website

NAS Leg1 notes

Original bottle data from CDIAC website Feb 10, 2006.

http://cdiac.ornl.gov/oceans/datmet.html

TTO_1981_recalc_DIC_ALK.csv

Contains pressure, temperature, salinity, nutrients, alkalinity and total carbon.

No machine readable data available from SIO/ODF.

Helium tritium merge file: nas_he3-tu.orig.Z from WHOI P.I.: W.J. Jenkins

Received from J.L.Reid office Jan 19, 2006.

Added missing NB 69 from PACODF data report SIO Ref. #86-15

Tritium merge file: nas1-7.c14.orig.Z Believed to be from Univ. of Miami; P.I.: H.G Ostlund

Received from J.L.Reid office Jan 19, 2006.

No Miami rosette sample data for Leg 1.

Notes for Leg1:

Temperature for Station 2, sample 101, 14db is Reversing Thermometer not CTD temperature and appears 3 deg low.

Original CTD data from NODC Mar 8, 2006 ocldb1141845224.17339.CTD.csv.gz

Low Temperature and Salinity on Station 2 above 120db are as shown in NODC data. Left as is.

CCHDO Data Prcessing Notes, Leg 2 only:

2006-09-13	*Muus, Dave*	CTD/BTL/SUM	From CDIAC Website

```
NAS notes for Leg2:

Original bottle data from CDIAC website Feb 10, 2006.

  http://cdiac.ornl.gov/oceans/datmet.html

        TTO_1981_recalc_DIC_ALK.csv

  Contains pressure, temperature, salinity, nutrients, alkalinity and
      total carbon.

  No machine readable data available from SIO/ODF.

Helium tritium merge file:    nas_he3-tu.orig.Z   from WHOI P.I.: W.J.
Jenkins
  Received from J.L.Reid office Jan 19, 2006.

Tritium merge file:   nas1-7.c14.orig.Z   Believed to be from Univ. of
Miami; P.I.: H.G Ostlund
  Received from J.L.Reid office Jan 19, 2006.
  Note with data says: "TU in old scale at time of sampling"
```

Tritium samples taken by both WHOI and U. of Miami. WHOI values used if available. U. of Miami values used if WHOI values not available. If both WHOI and U. of Miami tritium values available for the same sample the WHOI value is flagged "6" and the U. of Miami value is shown on the following list:

STNNBR	CASTNO	BTLNBR	CTDPRS DBAR	TRITUM W TU	TRITER W TU	DEPTH M	TRITUM MoldTU	TRITER MoldTU	W-M Tr diffTU
15	2	1	11.0	3.46	0.06	8.0	2.87	0.11	0.59
15	2	5	300.0	4.42	0.07	296.0	3.74	0.12	0.68
15	2	6	348.0	3.85	0.06	344.0	3.55	0.13	0.30
15	2	7	447.0	4.61	0.11	443.0	3.53	0.11	1.08
15	2	8	547.0	3.80	0.10	542.0	2.67	0.10	1.13
15	2	9	642.0	3.21	0.10	639.0	2.10	0.07	1.11
15	2	10	743.0	1.12	0.07	734.0	0.89	0.05	0.23
15	2	11	791.0	0.97	0.04	782.0	0.91	0.06	0.06
15	2	13	932.0	0.64	0.04	923.0	0.69	0.08	-0.05
15	2	20	2141.0	0.22	0.04	2117.0	0.18	0.06	0.04
15	2	23	2773.0	0.22	0.03	2736.0	0.24	0.06	-0.02
15	2	27	3149.0	0.45	0.04	3106.0	0.67	0.06	-0.22
15	2	28	3277.0	0.39	0.04	3233.0	0.37	0.06	0.02
15	2	29	3396.0	0.55	0.04	3349.0	0.43	0.05	0.12
15	2	30	3654.0	0.44	0.03	3603.0	0.48	0.06	-0.04
15	2	31	3916.0	0.35	0.03	3857.0	0.33	0.06	0.02
15	2	34	4449.0	0.47	0.04	4377.0	0.29	0.06	0.18
15	2	35	4659.0	0.42	0.04	4582.0	0.18	0.06	0.24
15	2	36	4764.0	0.31	0.03	4684.0	0.24	0.09	0.07

List of U. of Miami tritium values where no WHOI value available:

			*****WHOI*****		********MIAMI*********			*
STNNBR	CASTNO	BTLNBR	CTDPRS DBAR	TRITUM TU	DEPTH M	TRITUM old TU	TRITER old TU	Q1 *
15	2	4	195.0	-9.00	193.0	3.30	0.10	2
15	2	12	888.0	-9.00	881.0	0.49	0.05	2
15	2	15	1183.0	-9.00	1172.0	0.91	0.07	2
15	2	17	1399.0	-9.00	1385.0	1.02	0.07	2
15	2	19	1836.0	-9.00	1821.0	0.50	0.06	2
15	2	21	2348.0	-9.00	2320.0	0.33	0.06	2
15	2	32	4185.0	-9.00	4120.0	0.33	0.06	2
15	2	33	4348.0	-9.00	4280.0	0.30	0.05	2
32	2	24	3675.0	-9.00	3622.0	-0.10	0.07	2
32	2	27	4453.0	-9.00	4382.0	0.02	0.06	2
33	2	33	995.0	-9.00	989.0	0.02	0.05	2
33	2	34	1249.0	-9.00	1241.0	0.14	0.05	2
33	2	35	1652.0	-9.00	1641.0	0.11	0.05	2
34	2	14	1169.0	-9.00	1165.0	0.15	0.05	2

34	2	15	1374.0	-9.00	1368.0	0.11	0.04	2
34	2	16	1582.0	-9.00	1574.0	0.14	0.04	2
34	2	19	2501.0	-9.00	2479.0	0.00	0.05	2
34	2	20	2993.0	-9.00	2962.0	-0.06	0.05	2
35	1	10	648.0	-9.00	648.0	0.89	0.07	2
35	1	18	1403.0	-9.00	1400.0	0.12	0.05	2
35	1	19	1604.0	-9.00	1598.0	-0.01	0.04	2
35	1	23	1806.0	-9.00	1797.0	0.09	0.04	2
35	1	24	2010.0	-9.00	1997.0	0.01	0.04	2
36	2	1	12.0	-9.00	19.0	2.10	0.09	2
36	2	3	61.0	-9.00	69.0	2.78	0.11	2
36	2	5	198.0	-9.00	205.0	3.21	0.11	2
36	2	6	255.0	-9.00	280.0	3.61	0.14	2
36	2	7	368.0	-9.00	374.0	3.39	0.13	2
36	2	8	471.0	-9.00	476.0	3.12	0.10	2
36	2	11	840.0	-9.00	849.0	0.06	0.05	2
36	2	12	1003.0	-9.00	1005.0	0.05	0.06	2
36	2	13	1183.0	-9.00	1183.0	0.06	0.05	2
36	2	14	1378.0	-9.00	1382.0	0.14	0.04	2
36	2	15	1608.0	-9.00	1604.0	0.00	0.05	2
36	2	16	1997.0	-9.00	1985.0	-0.06	0.04	2
36	2	18	2967.0	-9.00	2940.0	-0.01	0.00	2
36	2	20	3964.0	-9.00	3915.0	0.00	0.05	2
38	2	22	-9.0	-9.00	3751.0	-0.07	0.05	2
39	2	18	1833.0	-9.00	1813.0	-0.02	0.04	2
39	2	20	2601.0	-9.00	2569.0	-0.07	0.04	2
39	2	22	3601.0	-9.00	3548.0	0.16	0.05	2
39	2	24	4631.0	-9.00	4552.0	0.14	0.04	2
39	2	28	5451.0	-9.00	5349.0	-0.10	0.04	2

Original CTD data from NODC Mar 8, 2006 ocldb1141845224.17339.CTD.csv.gz

No CTD data for following casts:

Station	Cast	Max Press
15	2	4763
16	2	4773
19	1	5625
20	2	5617
24	2	5943
25	1	1630
26	2	5192
27	4	1620
27	5	151
35	1	2017
35	2	52
36	2	4894
38	2	5816
39	2	5702
40	2	5943
41	1	5432

CTD data in NODC file for Station 23 Cast 2 is bad and was left out:

```
(    P      T      S          )
(    5      22.23  33.664     )
(steady increase in T and S to:)
( 1519     612.05 960.93      )
```

CCHDO Data Prcessing Notes, Leg 3 only:

2006-09-13	*Muus, Dave*	CTD/BTL/SUM	From CDIAC Website

```
NAS Leg 3 notes:

Original bottle data from CDIAC website Feb 10, 2006.
   http://cdiac.ornl.gov/oceans/datmet.html
        TTO_1981_recalc_DIC_ALK.csv
   Contains pressure, temperature, salinity, nutrients, alkalinity and
        total carbon.
   No machine readable data available from SIO/ODF.

Helium tritium merge file:   nas_he3-tu.orig.Z  from WHOI P.I.: W.J.
Jenkins
  Received from J.L.Reid office Jan 19, 2006.
  Added missing NB 69 from PACODF data report SIO Ref. #86-15

Tritium merge file:  nas1-7.c14.orig.Z  Believed to be from Univ. of Miami;
      P.I.: H.G Ostlund
  Received from J.L.Reid office Jan 19, 2006.
  Note with data says: "TU in old scale at time of sampling"
  Station 105 Ca 1 Bottle 21 depth given as 3493.
     ODF Report SIO Ref. No. 86-15 depth is 1024.
            "          "          press is 1034.
        Miami tritium 1.190
            & triter  0.065 for this sample not used.
```

Tritium samples taken by both WHOI and U. of Miami. WHOI values used if available. U. of Miami values used if WHOI values not available. If both WHOI and U. of Miami tritium values available for the same sample the WHOI value is flagged "6" and the U. of Miami value is shown on the following list:

STNNBR	CASTNO	BTLNBR	CTDPRS DBAR	TRITUM W TU	TRITER W TU	DEPTH M	TRITUM MoldTU	TRITER MoldTU	W-M Tr diffTU
43	4	1	10.0	4.01	0.07	8.0	3.81	0.13	0.20
43	4	2	408.0	3.76	0.06	403.0	3.60	0.14	0.16
43	4	3	605.0	3.15	0.07	598.0	2.70	0.10	0.45
43	4	4	801.0	1.62	0.06	791.0	1.66	0.08	-0.04
43	4	6	1207.0	0.68	0.05	1191.0	0.67	0.05	0.01
43	4	7	1311.0	1.08	0.05	1293.0	0.74	0.05	0.34
43	4	8	1415.0	0.74	0.04	1395.0	0.54	0.05	0.20
43	4	9	1518.0	0.49	0.04	1497.0	0.46	0.05	0.03
43	4	10	1619.0	0.56	0.04	1597.0	0.47	0.06	0.09
43	4	11	1722.0	0.28	0.07	1697.0	0.19	0.05	0.09
43	4	12	1824.0	0.14	0.04	1798.0	0.23	0.04	-0.09
43	4	19	4373.0	0.03	0.03	4286.0	0.10	0.04	-0.07
54	1	11	512.0	4.04	0.11	500.0	3.55	0.12	0.49
54	1	12	612.0	4.43	0.11	598.0	3.60	0.12	0.83
54	1	13	712.0	3.82	0.11	698.0	2.93	0.11	0.89
54	1	14	811.0	3.19	0.10	797.0	2.42	0.10	0.77
54	1	15	911.0	3.28	0.10	896.0	2.28	0.10	1.00
54	1	16	1010.0	3.22	0.10	996.0	2.21	0.10	1.01
54	1	17	1109.0	2.93	0.09	1095.0	2.70	0.12	0.23
54	1	18	1209.0	2.90	0.05	1193.0	2.34	0.08	0.56
54	1	19	1309.0	2.41	0.05	1292.0	1.90	0.09	0.51
54	1	21	1503.0	1.08	0.04	1484.0	0.81	0.07	0.27
54	1	22	1590.0	0.62	0.04	1569.0	0.39	0.05	0.23
54	1	23	1781.0	0.27	0.03	1759.0	0.28	0.05	-0.01
54	1	24	1973.0	0.05	0.03	1950.0	0.11	0.05	-0.06
55	1	14	1117.0	3.02	0.10	1101.0	2.50	0.11	0.52
99	2	14	1628.0	0.63	0.07	1607.0	0.64	0.05	-0.01
109	2	1	4.0	4.49	0.05	2.0	4.18	0.13	0.31
109	2	17	2008.0	0.30	0.02	1977.0	0.43	0.06	-0.13

List of U. of Miami tritium values where no WHOI value available:

			*****WHOI*****		********MIAMI*********			
STNNBR	CASTNO	BTLNBR	CTDPRS	TRITUM	DEPTH	TRITUM	TRITER	Q1
			DBAR	TU	M	old TU	old TU	
51	1	9	1018.0	-9.00	1008.0	0.97	0.07	2
52	2	12	1122.0	-9.00	1104.0	0.85	0.07	2
52	2	14	1324.0	-9.00	1303.0	0.59	0.00	2
52	2	16	1627.0	-9.00	1602.0	0.27	0.05	2
52	2	18	2036.0	-9.00	2003.0	0.01	0.05	2
53	1	11	1010.0	-9.00	995.0	1.81	0.07	2
54	1	20	1407.0	-9.00	1389.0	1.55	0.08	2
56	1	23	960.0	-9.00	950.0	2.04	0.09	2
57	1	20	1012.0	-9.00	1000.0	1.07	0.08	2
68	2	5	393.0	-9.00	384.0	3.94	0.11	2
68	2	7	587.0	-9.00	575.0	3.55	0.12	2
68	2	9	780.0	-9.00	766.0	1.69	0.07	2
68	2	11	984.0	-9.00	968.0	1.02	0.07	2
68	2	13	1303.0	-9.00	1283.0	0.68	0.05	2
68	2	15	1627.0	-9.00	1603.0	0.27	0.05	2
68	2	17	2020.0	-9.00	1992.0	-0.11	0.05	2
71	2	5	416.0	-9.00	406.0	4.16	0.14	2
71	2	7	616.0	-9.00	604.0	3.08	0.10	2
71	2	9	813.0	-9.00	798.0	1.47	0.06	2
71	2	13	1319.0	-9.00	1299.0	0.27	0.05	2
71	2	15	1624.0	-9.00	1601.0	0.07	0.05	2
77	1	10	895.0	-9.00	885.0	0.66	0.06	2
77	1	12	1148.0	-9.00	1135.0	0.43	0.06	2
80	2	2	113.0	-9.00	105.0	4.26	0.12	2
80	2	4	314.0	-9.00	304.0	4.07	0.13	2
80	2	6	514.0	-9.00	501.0	3.71	0.22	2
80	2	8	711.0	-9.00	696.0	1.45	0.08	2
80	2	10	913.0	-9.00	895.0	0.45	0.06	2
80	2	12	1118.0	-9.00	1099.0	0.32	0.05	2
80	2	14	1321.0	-9.00	1299.0	0.25	0.05	2
80	2	16	1522.0	-9.00	1498.0	0.08	0.05	2
87	1	8	1117.0	-9.00	1097.0	0.99	0.05	2
89	1	17	1111.0	-9.00	1092.0	2.13	0.09	2
90	1	16	1116.0	-9.00	1097.0	2.24	0.10	2
90	1	18	1299.0	-9.00	1279.0	2.08	0.08	2
91	1	17	1013.0	-9.00	997.0	2.47	0.08	2
91	1	19	1218.0	-9.00	1200.0	2.18	0.09	2
93	1	17	1119.0	-9.00	1102.0	1.96	0.08	2
94	1	9	408.0	-9.00	400.0	3.88	0.12	2
94	1	11	610.0	-9.00	598.0	3.29	0.12	2
94	1	13	814.0	-9.00	799.0	2.75	0.10	2
94	1	15	1016.0	-9.00	999.0	2.47	0.09	2
94	1	17	1220.0	-9.00	1200.0	2.22	0.10	2
94	1	19	1425.0	-9.00	1402.0	1.78	0.09	2
94	1	21	1627.0	-9.00	1601.0	0.58	0.06	2
96	1	9	1022.0	-9.00	1004.0	0.78	0.06	2
98	1	2	110.0	-9.00	107.0	3.82	0.12	2
98	1	4	307.0	-9.00	303.0	4.04	0.13	2
98	1	6	505.0	-9.00	498.0	3.70	0.13	2
98	1	8	699.0	-9.00	690.0	2.94	0.10	2
98	1	10	1007.0	-9.00	988.0	1.38	0.07	2
98	1	12	1511.0	-9.00	1486.0	0.61	0.06	2
99	2	1	7.0	-9.00	1.0	4.12	0.13	2
99	2	3	418.0	-9.00	411.0	3.93	0.13	2
99	2	5	618.0	-9.00	610.0	4.08	0.13	2
99	2	7	820.0	-9.00	810.0	2.25	0.09	2
99	2	9	1022.0	-9.00	1010.0	2.44	0.09	2
99	2	11	1225.0	-9.00	1210.0	1.57	0.08	2
99	2	13	1426.0	-9.00	1408.0	1.26	0.07	2
102	1	16	904.0	-9.00	891.0	2.53	0.11	2
102	1	18	1311.0	-9.00	1289.0	1.55	0.08	2
104	1	14	715.0	-9.00	699.0	2.80	0.11	2
104	1	16	916.0	-9.00	898.0	2.83	0.11	2
104	1	18	1118.0	-9.00	1099.0	2.15	0.09	2
104	1	20	1323.0	-9.00	1302.0	1.63	0.07	2
104	1	22	1626.0	-9.00	1602.0	0.86	0.06	2
106	1	7	1012.0	-9.00	999.0	1.48	0.07	2

106	1	9	1215.0	-9.00	1200.0	1.12	0.07	2
106	1	11	1418.0	-9.00	1400.0	0.74	0.05	2
107	1	10	1111.0	-9.00	1103.0	1.23	0.06	2
109	2	2	114.0	-9.00	106.0	4.45	0.14	2
109	2	4	316.0	-9.00	304.0	4.06	0.13	2
109	2	6	517.0	-9.00	503.0	3.84	0.11	2
109	2	8	718.0	-9.00	702.0	2.70	0.11	2
109	2	10	921.0	-9.00	903.0	1.46	0.06	2
109	2	12	1123.0	-9.00	1103.0	1.31	0.06	2
109	2	14	1428.0	-9.00	1404.0	0.85	0.05	2
109	2	16	1828.0	-9.00	1800.0	1.19	0.07	2

Original CTD data from NODC Mar 8, 2006 ocldb1141845224.17339.CTD.csv.gz
ocldb1141845224.17339.CTD2.csv.gz
ocldb1141845224.17339.CTD3.csv.gz

No CTD data for following casts:

Station	Cast	Max Press
46	1	2944
63	1	1703
64	1	2012
65	1	1993
67	1	1706
75	1	1783
83	1	4926
93	1	2507
99	2	5405
100	1	1997
101	1	1993
102	1	3148
103	3	2013
105	1	1975
109	2	4988

CCHDO Data Prcessing Notes, Leg 4 only:

2006-09-13	*Muus, Dave*	CTD/BTL/SUM	From CDIAC Website

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NAS notes Leg4:

Original bottle data from CDIAC website Feb 10, 2006.
   http://cdiac.ornl.gov/oceans/datmet.html
        TTO_1981_recalc_DIC_ALK.csv
   Contains pressure, temperature, salinity, nutrients, alkalinity and
        total carbon.
   No machine readable data available from SIO/ODF.

Helium tritium merge file:   nas_he3-tu.orig.Z  from WHOI P.I.: W.J.
Jenkins
  Received from J.L.Reid office Jan 19, 2006.

Tritium merge file:  nas1-7.c14.orig.Z  Believed to be from Univ. of
Miami; P.I.: H.G Ostlund
  Received from J.L.Reid office Jan 19, 2006.
  Note with data says: "TU in old scale at time of sampling"
```

Tritium samples taken by both WHOI and U. of Miami. WHOI values used if available. U. of Miami values used if WHOI values not available. If both WHOI and U. of Miami tritium values available for the same sample the WHOI value is flagged "6" and the U. of Miami value is shown on the following list:

STNNBR	CASTNO	BTLNBR	CTDPRS DBAR	TRITUM W TU	TRITER W TU	DEPTH M	TRITUM MoldTU	TRITER MoldTU	W-M Tr diffTU
110	4	1	15.0	4.80	0.14	9.0	3.63	0.13	1.17
110	4	3	52.0	4.55	0.13	48.0	4.11	0.14	0.44
110	4	4	73.0	4.52	0.13	68.0	3.58	0.14	0.94
110	4	17	1479.0	1.38	0.08	1452.0	1.14	0.08	0.24
110	4	18	2044.0	0.34	0.06	2007.0	0.29	0.06	0.05
110	4	19	2697.0	0.15	0.05	2648.0	0.05	0.05	0.10
110	4	20	3180.0	0.09	0.05	3120.0	-0.02	0.06	0.11
110	4	21	3583.0	0.10	0.04	3513.0	0.26	0.05	-0.16
110	4	22	3983.0	0.07	0.05	3903.0	0.00	0.05	0.07
110	4	23	4380.0	-0.04	0.04	4290.0	-0.17	0.06	0.13
110	4	24	4770.0	0.16	0.05	4669.0	-0.07	0.04	0.23
111	4	7	569.0	3.83	0.05	556.0	3.45	0.13	0.38
111	4	8	721.0	2.43	0.04	706.0	2.13	0.10	0.30
111	4	14	1623.0	0.69	0.03	1597.0	0.57	0.06	0.12
112	4	7	152.0	0.00	0.00	149.0	4.32	0.14	-4.32
112	4	8	270.0	5.54	0.18	265.0	4.08	0.14	1.46
112	4	9	340.0	4.40	0.15	334.0	4.13	0.14	0.27
112	4	10	410.0	4.64	0.16	403.0	3.88	0.13	0.76
112	4	11	646.0	3.30	0.13	630.0	2.55	0.10	0.75
112	4	12	874.0	2.87	0.12	855.0	2.29	0.10	0.58
112	4	13	1418.0	1.18	0.10	1393.0	1.10	0.07	0.08
112	4	14	1639.0	0.58	0.08	1611.0	0.49	0.05	0.09
112	4	15	1909.0	0.31	0.07	1878.0	0.16	0.05	0.15
112	4	16	2225.0	-0.01	0.06	2189.0	-0.09	0.05	0.08
112	4	17	2662.0	-0.07	0.07	2619.0	-0.04	0.05	-0.03
113	2	5	196.0	4.46	0.09	191.0	4.65	0.16	-0.19
113	2	6	316.0	4.33	0.08	308.0	4.09	0.14	0.24
113	2	7	464.0	4.58	0.15	453.0	3.58	0.12	1.00
113	2	8	632.0	3.62	0.14	619.0	3.12	0.11	0.50
113	2	9	673.0	3.67	0.13	659.0	2.88	0.11	0.79
113	2	10	776.0	2.80	0.11	760.0	2.52	0.10	0.28
113	2	13	995.0	2.51	0.07	976.0	2.20	0.08	0.31
113	2	14	1061.0	2.35	0.11	1041.0	2.28	0.09	0.07
113	2	15	1174.0	2.55	0.12	1152.0	2.10	0.10	0.45
113	2	16	1271.0	2.68	0.11	1248.0	2.13	0.09	0.55
118	2	17	1473.0	2.54	0.11	1447.0	2.17	0.11	0.37
118	2	18	1642.0	0.00	0.00	1614.0	2.01	0.11	-2.01
118	2	19	1876.0	1.94	0.10	1845.0	1.58	0.11	0.36
118	2	20	2131.0	1.14	0.08	2097.0	1.08	0.08	0.06
118	2	21	2495.0	0.87	0.08	2453.0	0.57	0.07	0.30

118	2	22	2873.0	0.50	0.07	2825.0	0.57	0.06	-0.07
119	1	9	662.0	3.08	0.04	652.0	2.59	0.11	0.49
119	1	10	834.0	3.26	0.04	822.0	3.05	0.13	0.21
119	1	11	1030.0	3.19	0.04	1015.0	2.74	0.12	0.45
119	1	12	1476.0	2.54	0.04	1456.0	2.38	0.11	0.16
119	1	13	2022.0	1.64	0.03	1993.0	1.55	0.09	0.09
119	1	14	2453.0	0.00	0.00	2416.0	1.16	0.09	-1.16
119	1	15	2967.0	1.02	0.03	2918.0	0.81	0.08	0.21
119	1	16	3350.0	0.00	0.00	3293.0	0.70	0.06	-0.70
119	1	17	3554.0	0.84	0.03	3492.0	0.77	0.07	0.07
119	1	18	3718.0	0.00	0.00	3652.0	0.51	0.07	-0.51
121	2	8	512.0	3.39	0.04	503.0	3.30	0.15	0.09
122	3	1	14.0	5.20	0.05	9.0	4.66	0.16	0.54
122	3	3	65.0	5.06	0.05	63.0	4.57	0.16	0.49
122	3	5	100.0	5.17	0.05	97.0	4.65	0.15	0.52
122	3	7	176.0	4.39	0.05	172.0	4.05	0.13	0.34
123	1	2	58.0	5.49	0.17	56.0	4.65	0.15	0.84
123	1	9	1446.0	1.95	0.06	1417.0	1.91	0.09	0.04
123	1	10	1662.0	1.58	0.06	1630.0	1.47	0.07	0.11
123	1	11	1998.0	1.13	0.06	1960.0	1.34	0.08	-0.21
123	1	12	2283.0	1.53	0.10	2240.0	1.05	0.08	0.48
123	1	13	2706.0	1.59	0.06	2654.0	1.35	0.07	0.24
123	1	20	3774.0	1.51	0.06	3697.0	1.55	0.09	-0.04
123	1	26	4026.0	1.36	0.03	3942.0	1.41	0.09	-0.05
123	1	31	4231.0	1.45	0.03	4141.0	1.22	0.06	0.23
124	3	1	14.0	5.08	0.05	7.0	4.80	0.14	0.28
124	3	2	66.0	4.94	0.05	58.0	4.74	0.14	0.20
124	3	4	115.0	4.74	0.05	106.0	4.21	0.13	0.53
124	3	7	293.0	4.01	0.05	280.0	3.69	0.13	0.32
124	3	11	627.0	3.13	0.04	608.0	2.85	0.11	0.28
124	3	14	1307.0	2.08	0.04	1282.0	1.62	0.08	0.46
124	3	15	1574.0	1.85	0.03	1546.0	1.72	0.09	0.13
124	3	20	2673.0	1.83	0.04	2628.0	1.93	0.08	-0.09
124	3	22	2874.0	1.68	0.03	2825.0	1.68	0.07	0.00
124	3	24	3010.0	1.76	0.03	2959.0	1.40	0.08	0.36
127	2	2	26.0	4.67	0.16	23.0	4.07	0.16	0.60
127	2	3	53.0	4.85	0.16	51.0	4.58	0.13	0.27
127	2	4	80.0	4.62	0.09	77.0	4.07	0.12	0.55
127	2	5	105.0	4.20	0.09	103.0	3.93	0.12	0.27
127	2	6	155.0	4.32	0.08	152.0	3.47	0.11	0.85
127	2	7	206.0	4.20	0.08	202.0	4.25	0.12	-0.05
127	2	9	307.0	4.19	0.08	302.0	4.16	0.11	0.03
127	2	11	408.0	3.96	0.08	401.0	3.79	0.12	0.17
127	2	15	742.0	3.33	0.08	731.0	3.09	0.08	0.24
127	2	16	813.0	3.27	0.08	802.0	3.20	0.11	0.07
127	2	17	895.0	3.07	0.07	882.0	3.13	0.10	-0.06
127	2	18	965.0	2.81	0.07	951.0	2.38	0.09	0.43
127	2	21	1228.0	2.45	0.07	1208.0	2.23	0.10	0.22
127	2	20	1302.0	2.35	0.07	1580.0	1.82	0.08	0.53
127	2	23	1807.0	2.33	0.06	1780.0	2.35	0.10	-0.02
127	2	24	1878.0	2.39	0.07	1850.0	2.23	0.08	0.16
130	2	1	5.0	5.08	0.09	2.0	4.39	0.15	0.69
130	2	2	50.0	4.99	0.16	47.0	4.71	0.14	0.28
130	2	3	96.0	5.09	0.17	93.0	4.54	0.13	0.55
130	2	4	142.0	4.88	0.16	139.0	4.14	0.12	0.74
130	2	5	197.0	3.40	0.11	193.0	4.44	0.12	-1.04
130	2	6	248.0	4.27	0.16	243.0	3.92	0.12	0.35
130	2	7	309.0	4.49	0.15	304.0	4.05	0.13	0.44
130	2	8	403.0	4.10	0.15	396.0	3.67	0.13	0.43
130	2	9	507.0	3.77	0.14	500.0	3.53	0.12	0.24
130	2	10	607.0	3.62	0.14	597.0	3.10	0.10	0.52
130	2	11	683.0	3.35	0.14	673.0	2.97	0.11	0.38
130	2	12	810.0	3.30	0.13	791.0	2.80	0.09	0.50
130	2	13	1006.0	3.31	0.14	985.0	2.70	0.09	0.61
130	2	14	1243.0	2.67	0.13	1220.0	2.49	0.09	0.18
130	2	15	1516.0	2.45	0.12	1489.0	2.17	0.09	0.28
130	2	16	1789.0	1.98	0.12	1760.0	1.71	0.08	0.27
130	2	18	2196.0	1.82	0.11	2161.0	1.55	0.08	0.27
130	2	21	2531.0	1.40	0.11	2491.0	1.23	0.09	0.17
130	2	22	2683.0	1.67	0.11	2639.0	1.42	0.09	0.25

130	2	23	2782.0	2.02	0.12	2736.0	1.86	0.08	0.16
130	2	24	2842.0	2.16	0.12	2794.0	1.84	0.10	0.32
134	1	13	5.0	4.93	0.05	2.0	4.96	0.16	-0.03
134	1	14	50.0	5.02	0.10	47.0	4.91	0.15	0.11
134	1	15	80.0	4.82	0.10	76.0	4.52	0.16	0.30
134	1	16	156.0	4.46	0.05	151.0	4.41	0.13	0.05
134	1	17	287.0	4.28	0.05	282.0	4.06	0.14	0.22
134	1	18	456.0	4.02	0.05	449.0	3.60	0.16	0.42
134	1	19	549.0	4.08	0.05	541.0	3.71	0.11	0.37
134	1	20	757.0	2.89	0.04	739.0	2.74	0.10	0.15
134	1	21	898.0	2.63	0.04	879.0	2.66	0.12	-0.03
134	1	22	1069.0	2.41	0.04	1047.0	2.45	0.11	-0.04
134	1	23	1170.0	2.23	0.04	1147.0	1.85	0.09	0.38
134	1	24	1274.0	2.06	0.04	1250.0	1.29	0.11	0.77
138	1	13	12.0	4.91	0.10	7.0	4.27	0.18	0.64
138	1	15	253.0	4.31	0.09	242.0	3.99	0.17	0.32
138	1	16	596.0	4.24	0.09	581.0	3.67	0.16	0.57
138	1	17	739.0	4.46	0.09	720.0	4.06	0.11	0.40
138	1	18	1020.0	3.88	0.09	1000.0	3.67	0.16	0.21
138	1	19	1249.0	2.73	0.08	1226.0	2.51	0.11	0.22
138	1	20	1726.0	1.98	0.07	1697.0	1.85	0.09	0.13
138	1	21	2131.0	0.94	0.06	2098.0	1.15	0.09	-0.21
138	1	22	2686.0	0.31	0.04	2643.0	0.12	0.06	0.19
138	1	24	2843.0	0.14	0.04	2796.0	0.29	0.05	-0.15

List of U. of Miami tritium values where no WHOI value available:

			*****WHOI*****		********MIAMI*********			
STNNBR	CASTNO	BTLNBR	CTDPRS	TRITUM	DEPTH	TRITUM	TRITER	Q1
			DBAR	TU	M	old TU	old TU	
113	2	11	829.0	-9.00	812.0	2.29	0.09	2
113	2	12	904.0	-9.00	886.0	2.49	0.11	2
123	1	18	3569.0	-9.00	3498.0	1.34	0.07	2
123	1	24	4329.0	-9.00	4236.0	1.27	0.07	2
124	3	9	483.0	-9.00	465.0	3.16	0.11	2
130	2	19	2322.0	-9.00	2284.0	1.76	0.07	2

Original CTD data from NODC Mar 8, 2006 ocldb1141845224.17339.CTD3.csv.gz

No CTD data for following casts:

Station	Cast	Max Press
116	1	2007
118	2	4298
120	2	3891
121	2	3763
122	3	4385
124	3	3005
129	1	2384
130	2	2838
131	1	2845

CCHDO Data Prcessing Notes, Leg 5 only:

2006-11-22	*Muus, Dave*	CTD/BTL/SUM	From CDIAC Website

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NAS Leg 5 notes:

Original bottle data from CDIAC website Feb 10, 2006.
   http://cdiac.ornl.gov/oceans/datmet.html
        TTO_1981_recalc_DIC_ALK.csv
   Contains pressure, temperature, salinity, nutrients, alkalinity and
      total carbon.
   No machine readable data available from SIO/ODF.

Helium tritium merge file:   nas_he3-tu.orig.Z  from WHOI P.I.: W.J.
Jenkins
  Received from J.L.Reid office Jan 19, 2006.

Tritium merge file:  nas1-7.c14.orig.Z  Believed to be from Univ. of
Miami; P.I.: H.G Ostlund
  Received from J.L.Reid office Jan 19, 2006.
  Note with data says: "TU in old scale at time of sampling"
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Tritium samples taken by both WHOI and U. of Miami. WHOI values used if available. U. of Miami values used if WHOI values not available. If both WHOI and U. of Miami tritium values available for the same sample the WHOI value is flagged "6" and the U. of Miami value is shown on the following list:

STNNBR	CASTNO	BTLNBR	CTDPRS DBAR	TRITUM W TU	TRITER W TU	DEPTH M	TRITUM MoldTU	TRITER MoldTU	W-M Tr diffTU
141	2	1	14.0	4.84	0.09	12.0	4.88	0.17	-0.04
141	2	6	231.0	4.33	0.09	220.0	4.14	0.14	0.19
141	2	10	443.0	4.38	0.09	429.0	4.44	0.13	-0.06
141	2	16	1149.0	2.97	0.10	1129.0	2.69	0.09	0.28
141	2	24	1775.0	2.01	0.09	1749.0	2.04	0.13	-0.03
142	1	1	3.0	4.70	0.11	3.0	3.86	0.16	0.84
142	1	20	742.0	1.82	0.08	730.0	1.76	0.09	0.06
143	4	2	31.0	4.72	0.12	26.0	4.91	0.16	-0.19
143	4	12	519.0	3.52	0.10	502.0	3.27	0.12	0.25
143	4	14	819.0	2.07	0.09	799.0	1.91	0.11	0.16
143	4	16	1022.0	1.32	0.07	1000.0	1.44	0.07	-0.12
143	4	17	1124.0	1.08	0.07	1100.0	1.05	0.07	0.03
143	4	19	1832.0	0.28	0.04	1797.0	0.34	0.06	-0.06
143	4	20	2239.0	0.28	0.04	2199.0	0.33	0.05	-0.05
143	4	23	3508.0	0.26	0.06	3441.0	0.28	0.06	-0.02
144	2	1	498.0	4.78	0.09	480.0	4.26	0.14	0.52
144	2	3	699.0	3.68	0.08	679.0	3.55	0.11	0.13
144	2	8	1256.0	1.23	0.06	1229.0	1.13	0.06	0.10
144	2	9	1408.0	0.78	0.06	1380.0	0.76	0.08	0.02
144	2	20	3240.0	0.21	0.05	3179.0	0.32	0.05	-0.11
144	2	17	3694.0	0.22	0.04	3622.0	0.25	0.06	-0.03
144	2	15	3748.0	0.17	0.05	3675.0	0.25	0.05	-0.08
145	5	20	921.0	4.44	0.09	902.0	4.03	0.13	0.41
145	2	36	1411.0	1.58	0.07	1387.0	1.43	0.10	0.15
145	2	35	1718.0	1.60	0.06	1688.0	1.37	0.10	0.23
145	2	34	2022.0	0.85	0.06	1988.0	0.86	0.06	-0.01
145	2	32	2633.0	0.36	0.05	2586.0	0.43	0.04	-0.08
146	1	1	10.0	4.98	0.09	7.0	4.76	0.11	0.22
146	1	35	2118.0	0.78	0.05	2081.0	0.73	0.05	0.05
146	1	34	2423.0	0.81	0.05	2379.0	0.69	0.07	0.12
146	1	33	2730.0	0.75	0.05	2679.0	0.69	0.06	0.06
146	1	28	3106.0	0.76	0.05	3047.0	0.90	0.06	-0.14
146	1	22	3198.0	0.79	0.05	3137.0	0.87	0.05	-0.08
148	2	3	30.0	3.78	0.08	28.0	3.56	0.12	0.22
148	2	11	306.0	2.67	0.07	301.0	2.33	0.09	0.34
148	2	13	451.0	2.27	0.06	443.0	1.92	0.10	0.35
148	2	15	608.0	1.89	0.06	598.0	2.01	0.09	-0.12
148	2	19	1062.0	1.61	0.06	1043.0	1.46	0.07	0.15
148	2	21	1500.0	1.47	0.06	1475.0	1.21	0.07	0.26
148	2	22	3761.0	1.16	0.05	3685.0	1.18	0.06	-0.02

149	2	31	2826.0	0.90	0.05	2773.0	0.80	0.07	0.10
149	2	20	3260.0	0.91	0.05	3198.0	1.21	0.08	-0.30
152	1	1	4.0	6.42	0.11	2.0	6.09	0.14	0.33
152	1	24	2490.0	0.77	0.03	2445.0	0.74	0.05	0.03
153	1	2	48.0	4.84	0.05	41.0	4.64	0.10	0.20
153	1	24	2718.0	0.77	0.03	2668.0	0.73	0.06	0.04
158	1	1	5.0	9.76	0.16	2.0	10.08	0.23	-0.32
158	1	3	19.0	7.37	0.14	16.0	6.52	0.26	0.85
158	1	9	96.0	4.60	0.12	91.0	4.77	0.15	-0.17
158	1	11	148.0	4.48	0.11	142.0	4.36	0.12	0.12
158	1	12	233.0	3.94	0.11	226.0	4.10	0.12	-0.16
158	1	14	360.0	3.44	0.10	351.0	3.38	0.12	0.06
158	1	16	512.0	3.02	0.10	500.0	3.01	0.08	0.01
158	1	21	914.0	1.91	0.09	899.0	2.02	0.10	-0.11
158	1	26	2204.0	0.74	0.07	2166.0	0.80	0.08	-0.06
158	1	25	2222.0	0.69	0.07	2184.0	0.92	0.07	-0.23
159	2	13	100.0	4.38	0.10	98.0	4.11	0.12	0.27
159	2	15	307.0	4.09	0.10	302.0	3.83	0.10	0.26
160	1	3	102.0	4.54	0.10	101.0	4.99	0.19	-0.45
160	1	5	301.0	4.49	0.10	298.0	4.13	0.17	0.36
160	1	7	558.0	4.05	0.10	549.0	4.26	0.18	-0.21
160	1	11	1166.0	2.92	0.09	1148.0	2.41	0.12	0.51
160	1	16	1722.0	1.94	0.07	1695.0	1.99	0.09	-0.05
160	1	18	1924.0	1.77	0.08	1893.0	1.62	0.11	0.15
160	1	20	2097.0	2.45	0.08	2064.0	2.23	0.10	0.22
160	1	23	2316.0	2.39	0.08	2277.0	2.14	0.09	0.25
164	1	1	5.0	4.59	0.10	7.0	4.21	0.17	0.38
164	1	5	37.0	4.55	0.09	35.0	3.97	0.13	0.58
164	1	7	105.0	4.38	0.09	102.0	6.04	0.22	-1.66
164	1	10	506.0	3.40	0.09	498.0	3.08	0.09	0.32
164	1	24	2563.0	2.41	0.07	2521.0	1.58	0.09	0.83
165	1	1	9.0	4.56	0.09	10.0	4.61	0.18	-0.05
165	1	3	50.0	4.13	0.09	51.0	3.97	0.16	0.16
165	1	5	162.0	3.91	0.09	160.0	3.53	0.15	0.38
165	1	6	307.0	3.81	0.09	303.0	3.59	0.15	0.22
165	1	12	1066.0	2.98	0.08	1050.0	2.63	0.12	0.35
165	1	13	1272.0	2.73	0.08	1253.0	2.47	0.10	0.26
165	1	16	1828.0	1.94	0.07	1800.0	1.66	0.08	0.28
165	1	17	2031.0	1.53	0.06	1999.0	1.43	0.07	0.10
165	1	19	2436.0	1.67	0.06	2396.0	2.89	0.09	-1.22
165	1	20	2613.0	1.92	0.07	2569.0	3.02	0.11	-1.10
167	1	1	10.0	4.50	0.05	8.0	4.11	0.13	0.39
167	1	5	98.0	4.07	0.05	95.0	4.13	0.12	-0.06
167	1	9	560.0	3.75	0.05	551.0	3.77	0.11	-0.02
167	1	15	1623.0	2.06	0.04	1598.0	2.02	0.09	0.04
167	1	17	2031.0	1.49	0.03	1998.0	1.38	0.07	0.11
167	1	18	2133.0	2.11	0.04	2098.0	2.01	0.10	0.10
167	1	19	2194.0	3.38	0.05	2158.0	2.89	0.14	0.49
167	1	20	2247.0	4.04	0.05	2210.0	3.45	0.09	0.59
167	1	22	2299.0	3.32	0.09	2261.0	3.03	0.13	0.29
167	1	24	2354.0	3.02	0.04	2315.0	2.78	0.09	0.24
169	1	1	10.0	4.41	0.05	10.0	4.17	0.16	0.24
169	1	7	50.0	4.14	0.05	49.0	4.26	0.17	-0.12
169	1	8	98.0	4.05	0.05	96.0	3.99	0.16	0.06
169	1	10	244.0	3.98	0.05	241.0	3.97	0.16	0.01
169	1	16	979.0	3.58	0.05	965.0	3.24	0.11	0.34
169	1	24	1301.0	2.86	0.04	1281.0	2.50	0.12	0.36
170	1	9	5.0	17.26	0.10	2.0	16.32	0.55	0.94

List of U. of Miami tritium values where no WHOI value available:

			*****WHOI*****		*******MIAMI*********			
STNNBR	CASTNO	BTLNBR	CTDPRS	TRITUM	DEPTH	TRITUM	TRITER	Q1
			DBAR	TU	M	old TU	old TU	
142	1	2	10.0	-9.00	11.0	4.39	0.12	2
142	1	3	26.0	-9.00	26.0	3.86	0.15	2
142	1	4	61.0	-9.00	60.0	4.13	0.16	2
142	1	5	91.0	-9.00	90.0	4.23	0.19	2
142	1	6	121.0	-9.00	120.0	4.14	0.16	2
142	1	7	152.0	-9.00	150.0	3.90	0.15	2
142	1	8	192.0	-9.00	189.0	3.81	0.14	2

142	1	9	242.0	-9.00	239.0	3.70	0.15	2
142	1	10	304.0	-9.00	299.0	4.21	0.17	2
142	1	11	356.0	-9.00	350.0	4.00	0.16	2
142	1	12	407.0	-9.00	401.0	3.98	0.16	2
142	1	13	459.0	-9.00	452.0	3.93	0.14	2
142	1	14	500.0	-9.00	492.0	3.91	0.16	2
142	1	15	550.0	-9.00	542.0	3.80	0.14	2
142	1	17	642.0	-9.00	631.0	3.36	0.14	2
142	1	18	685.0	-9.00	674.0	2.75	0.13	2
142	1	24	823.0	-9.00	809.0	1.58	0.08	2
143	4	1	9.0	-9.00	6.0	4.87	0.15	2
143	4	3	60.0	-9.00	55.0	4.05	0.11	2
143	4	4	90.0	-9.00	83.0	4.15	0.16	2
143	4	5	127.0	-9.00	118.0	4.96	0.15	2
143	4	7	199.0	-9.00	188.0	4.74	0.14	2
143	4	9	295.0	-9.00	283.0	4.17	0.14	2
143	4	11	435.0	-9.00	419.0	3.49	0.13	2
143	4	13	618.0	-9.00	600.0	2.46	0.10	2
143	4	18	1426.0	-9.00	1398.0	0.54	0.06	2
143	4	21	2646.0	-9.00	2597.0	0.59	0.07	2
143	4	22	3054.0	-9.00	2998.0	0.50	0.08	2
143	4	24	3916.0	-9.00	3838.0	0.31	0.07	2
144	2	2	600.0	-9.00	581.0	4.02	0.13	2
144	2	6	999.0	-9.00	976.0	1.90	0.08	2
145	5	2	39.0	-9.00	36.0	4.47	0.15	2
145	5	22	1091.0	-9.00	1072.0	3.13	0.09	2
145	5	24	1293.0	-9.00	1272.0	1.90	0.07	2
145	2	31	3002.0	-9.00	2946.0	0.37	0.06	2
145	2	29	3106.0	-9.00	3045.0	0.39	0.04	2
145	2	27	3207.0	-9.00	3145.0	0.25	0.07	2
146	1	4	101.0	-9.00	94.0	4.72	0.13	2
146	1	8	275.0	-9.00	262.0	4.09	0.11	2
146	1	10	401.0	-9.00	385.0	4.18	0.11	2
146	1	12	484.0	-9.00	467.0	3.20	0.10	2
146	1	14	608.0	-9.00	589.0	2.87	0.09	2
146	1	16	768.0	-9.00	748.0	1.99	0.09	2
146	1	18	969.0	-9.00	946.0	1.80	0.09	2
146	1	20	1328.0	-9.00	1301.0	0.77	0.06	2
146	1	32	2887.0	-9.00	2833.0	0.77	0.06	2
148	2	6	124.0	-9.00	120.0	3.06	0.11	2
148	2	8	185.0	-9.00	180.0	2.75	0.10	2
148	2	12	356.0	-9.00	350.0	2.25	0.08	2
148	2	14	507.0	-9.00	498.0	2.03	0.09	2
149	2	2	11.0	-9.00	7.0	6.09	0.17	2
149	2	36	1402.0	-9.00	1378.0	1.65	0.09	2
152	1	4	58.0	-9.00	56.0	4.43	0.11	2
152	1	6	134.0	-9.00	132.0	3.97	0.12	2
152	1	8	226.0	-9.00	222.0	4.33	0.11	2
152	1	10	327.0	-9.00	322.0	3.85	0.10	2
152	1	12	480.0	-9.00	471.0	2.96	0.09	2
152	1	14	662.0	-9.00	649.0	2.32	0.08	2
152	1	16	962.0	-9.00	946.0	1.50	0.07	2
152	1	18	1361.0	-9.00	1337.0	0.98	0.06	2
152	1	20	1949.0	-9.00	1914.0	0.60	0.05	2
152	1	22	2087.0	-9.00	2050.0	0.73	0.06	2
152	1	23	2365.0	-9.00	2321.0	0.62	0.06	2
153	1	1	6.0	-9.00	2.0	6.63	0.14	2
153	1	3	90.0	-9.00	81.0	4.47	0.12	2
153	1	5	265.0	-9.00	250.0	4.70	0.13	2
153	1	7	418.0	-9.00	400.0	4.07	0.11	2
153	1	9	620.0	-9.00	600.0	3.09	0.11	2
153	1	11	973.0	-9.00	950.0	1.54	0.07	2
153	1	12	1225.0	-9.00	1200.0	1.26	0.07	2
153	1	16	2138.0	-9.00	2099.0	0.64	0.05	2
153	1	19	2423.0	-9.00	2379.0	0.51	0.05	2
153	1	23	2687.0	-9.00	2637.0	0.46	0.26	2
156	1	4	49.0	-9.00	48.0	5.35	0.14	2
156	1	10	306.0	-9.00	301.0	4.62	0.14	2
156	1	11	407.0	-9.00	400.0	4.58	0.11	2
156	1	16	1018.0	-9.00	1001.0	1.95	0.09	2

```
     156       1       17  1170.0   -9.00  1151.0    1.15     0.06  2
     156       1       19  1456.0   -9.00  1431.0    0.60     0.07  2
     158       1        4    22.0   -9.00    18.0    6.58     0.16  2
     158       1        6    46.0   -9.00    42.0    5.70     0.16  2
     158       1       13   284.0   -9.00   276.0    3.49     0.10  2
     158       1       18   612.0   -9.00   602.0    2.70     0.09  2
     158       1       19   713.0   -9.00   701.0    2.66     0.12  2
     158       1       20   815.0   -9.00   801.0    2.17     0.10  2
     158       1       36  1009.0   -9.00   992.0    1.87     0.08  2
     158       1       34  1211.0   -9.00  1191.0    1.49     0.06  2
     158       1       32  1617.0   -9.00  1590.0    0.95     0.05  2
     158       1       29  2083.0   -9.00  2047.0    0.79     0.06  2
     158       1       22  2231.0   -9.00  2193.0    0.71     0.05  2
     159       2        1     5.0   -9.00     2.0    4.36     0.13  2
     159       2        6    26.0   -9.00    22.0    4.51     0.13  2
     159       2       12    50.0   -9.00    49.0    4.31     0.14  2
     159       2       16   368.0   -9.00   362.0    3.06     0.14  2
     160       1        2    52.0   -9.00    52.0    5.57     0.21  2
     160       1        4   203.0   -9.00   199.0    4.15     0.16  2
     160       1        6   399.0   -9.00   393.0    3.67     0.16  2
     160       1        8   702.0   -9.00   689.0    3.83     0.16  2
     160       1        9   861.0   -9.00   847.0    3.62     0.15  2
     160       1       12  1318.0   -9.00  1298.0    2.44     0.12  2
     160       1       14  1520.0   -9.00  1497.0    1.83     0.12  2
     160       1       21  2179.0   -9.00  2145.0    1.59     0.10  2
     164       1        3    30.0   -9.00    28.0    4.18     0.17  2
     164       1        6    54.0   -9.00    52.0    5.62     0.22  2
     164       1        9   357.0   -9.00   350.0    3.50     0.14  2
     164       1       23  2405.0   -9.00  2365.0    1.42     0.07  2
     165       1        2    34.0   -9.00    34.0    4.02     0.16  2
     165       1        4   100.0   -9.00    99.0    3.72     0.15  2
     165       1        8   510.0   -9.00   502.0    3.52     0.15  2
     165       1       10   737.0   -9.00   725.0    3.65     0.13  2
     165       1       15  1625.0   -9.00  1600.0    2.08     0.10  2
     165       1       18  2233.0   -9.00  2197.0    1.44     0.09  2
     167       1        2    30.0   -9.00    28.0    3.74     0.12  2
     167       1        4    69.0   -9.00    67.0    3.87     0.12  2
     167       1        6   205.0   -9.00   200.0    3.72     0.11  2
     167       1       10   711.0   -9.00   700.0    3.61     0.10  2
     167       1       12  1015.0   -9.00   999.0    2.81     0.11  2
     167       1       14  1420.0   -9.00  1397.0    2.44     0.09  2
     167       1       16  1827.0   -9.00  1798.0    1.48     0.07  2
     167       1       21  2274.0   -9.00  2237.0    3.40     0.14  2
     167       1       23  2332.0   -9.00  2294.0    2.77     0.08  2
```

Miami tritium has different depths from Whoi tritium on Station 165

```
   STNNBR  CASTNO  BTLNBR   DEPTH   TRITUM  TRITER  QF
Miami 165       1      21   2237.0   1.300   0.070  2
      165       1      22   2261.0   1.790   0.090  2
      165       1      23   2294.0   2.020   0.070  2
      165       1      24   2315.0   3.130   0.130  2

                            CTDPRS
Whoi  165       1      21   2711.0   -9.00   -9.00  9
      165       1      22   2806.0   -9.00   -9.00  9
      165       1      23   2871.0   -9.00   -9.00  9
      165       1      24   2890.0   -9.00   -9.00  9

~
                            CTDPRS  DEPTH
ODF   165       1      21   2708    2665
Reprt 165       1      22   2803    2759
      165       1      23   2867    2821
      165       1      24   2887    2841
```

Original Miami data for Station 165:

```
63150N032130W810812                                                     165  1
   165   101    10 10221 34809 26765  4610   180                               3
   165   102    34  8370 34908 27146  4020   160                               3
   165   103    51  6488 34935 27438  3970   160                               3
   165   104    99  5445 34984 27610  3720   150                               3
```

165	105	160	5220	34996	27646	3530	150	3
165	106	303	4382	34939	27697	3590	150	3
165	108	502	3828	34895	27721	3520	150	3
165	110	725	3592	34879	27732	3650	130	3
165	112	1050	3507	34895	27753	2630	120	3
165	113	1253	3463	34910	27769	2470	100	3
165	115	1600	3352	34925	27792	2080	100	3
165	116	1800	3317	34937	27805	1660	80	3
165	117	1999	3188	34950	27828	1430	70	3
165	118	2197	3027	34948	27841	1440	90	3
165	121	2237	977	34853	27929	1300	70	3
165	122	2261	804	34871	27955	1790	90	3
165	123	2294	240	34880	27996	2020	70	3
165	124	2315	226	34881	27998	3130	130	3
165	119	2396	2834	34944	27856	2890	90	3
165	120	2569	2556	34928	27868	3020	110	3

Deleted Miami tritium for Station 165 Cast 1 Bottles: 21, 22, 23 & 24

Original CTD data from NODC Mar 8, 2006 ocldb1141845224.17339.CTD3.csv.gz
ocldb1141845224.17339.CTD4.csv.gz

No CTD data for following casts:

Station	Cast	Max Press
144	2	3767
149	2	3256
153	1	2714
163	1	1787
168	1	1935

NODC CTD data have no values for negative temperatures. NODC negative temps shown as ---.---

Stations with negative temps this leg are 142, 143, 145_2, 145_5, 146, 148, 150, 151, 152, 154, 155, 156, 157, 158 and 159.

CTD data for these stations were obtained from Sarilee Anderson (PORD/SIO) on Oct 18, 2006,

in a file named tto_nas.ctd. Positive temperature data appear to be the same on both NODC and Anderson files.

The data originator (ODF/SIO) has no ctd data available. 9-track tapes unreadable.

CCHDO Data Prcessing Notes, Leg 6 only:

2006-02-10	*Muus, Dave*	CTD/BTL/SUM	From CDIAC Website

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NAS notes for Leg6:

Original bottle data from CDIAC website Feb 10, 2006.
   http://cdiac.ornl.gov/oceans/datmet.html
        TTO_1981_recalc_DIC_ALK.csv
   Contains pressure, temperature, salinity, nutrients, alkalinity and
      total carbon.
   No machine readable data available from SIO/ODF.

Helium tritium merge file: nas_he3-tu.orig.Z  from WHOI P.I.: W.J. Jenkins
  Received from J.L.Reid office Jan 19, 2006.

Tritium merge file:  nas1-7.c14.orig.Z  Believed to be from Univ. of
Miami; P.I.: H.G Ostlund
  Received from J.L.Reid office Jan 19, 2006.
  Note with data says: "TU in old scale at time of sampling"
```

Tritium samples taken by both WHOI and U. of Miami. WHOI values used if available. U. of Miami values used if WHOI values not available. If both WHOI and U. of Miami tritium values available for the same sample the WHOI value is flagged "6" and the U. of Miami value is shown on the following list:

STNNBR	CASTNO	BTLNBR	CTDPRS DBAR	TRITUM W TU	TRITER W TU	DEPTH M	TRITUM MoldTU	TRITER MoldTU	W-M Tr diffTU
173	1	1	15.0	5.22	0.12	13.0	4.27	0.14	0.95
173	1	5	195.0	4.32	0.11	192.0	3.94	0.13	0.38
173	1	9	570.0	3.97	0.10	561.0	4.12	0.17	-0.15
173	1	12	963.0	3.94	0.10	948.0	3.43	0.11	0.51
173	1	14	1065.0	4.16	0.10	1049.0	3.32	0.14	0.84
173	1	20	1701.0	2.26	0.08	1675.0	2.02	0.11	0.24
179	1	1	13.0	4.63	0.05	11.0	4.61	0.15	0.02
179	1	6	409.0	4.35	0.05	403.0	4.03	0.10	0.32
179	1	12	1205.0	2.93	0.04	1186.0	2.62	0.10	0.31
179	1	19	2719.0	2.96	0.04	2673.0	2.85	0.09	0.11
179	1	24	2966.0	3.38	0.05	2915.0	2.89	0.10	0.49
181	1	15	1678.0	2.36	0.04	1651.0	2.05	0.10	0.31

List of U. of Miami tritium values where no WHOI value available:

			*****WHOI*****		********MIAMI*********			
STNNBR	CASTNO	BTLNBR	CTDPRS DBAR	TRITUM TU	DEPTH M	TRITUM old TU	TRITER old TU	Q1
173	1	6	286.0	-9.00	282.0	3.94	0.13	2
173	1	11	813.0	-9.00	800.0	3.53	0.15	2
173	1	16	1166.0	-9.00	1148.0	3.78	0.10	2
173	1	21	1901.0	-9.00	1872.0	1.77	0.09	2
181	1	10	810.0	-9.00	796.0	3.33	0.14	2

```
Original CTD data from NODC Mar 8, 2006  ocldb1141845224.17339.CTD4.csv.gz
                                         ocldb1141845224.17339.CTD5.csv.gz
  No CTD data for following casts: Station  Cast  Max Press
                                     183      1     1951
                                     184      1     1644
                                     189      3     3006
                                     198      1     1429
                                     211      2     4700
                                     212      1     3622

  NODC CTD data have no values for negative temperatures. NODC negative temps
  shown as
            ---.---
```

Stations with negative temps this leg are 199, 200 and 219. CTD data for these stations were obtained from Sarilee Anderson (PORD/SIO) on Oct 18, 2006, in a file named tto_nas.ctd. Positive temperature data appear to be the same on both NODC and Anderson files. The data originator (ODF/SIO) has no ctd data available. 9-track tapes unreadable.

CCHDO Data Prcessing Notes, Leg 7 only:

2006-12-05	*Muus, Dave*	CTD/BTL/SUM	From CDIAC Website

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NAS Leg 7 notes:

Original bottle data from CDIAC website Feb 10, 2006.
   http://cdiac.ornl.gov/oceans/datmet.html
        TTO_1981_recalc_DIC_ALK.csv
   Contains pressure, temperature, salinity, nutrients, alkalinity and
      total carbon.
   No machine readable data available from SIO/ODF.

Helium tritium merge file:   nas_he3-tu.orig.Z  from WHOI P.I.: W.J.
Jenkins
  Received from J.L.Reid office Jan 19, 2006.

Tritium merge file:  nas1-7.c14.orig.Z  Believed to be from Univ. of
Miami; P.I.: H.G Ostlund
  Received from J.L.Reid office Jan 19, 2006.
  Note with data says: "TU in old scale at time of sampling"
```

Tritium samples taken by both WHOI and U. of Miami. WHOI values used if available. U. of Miami values used if WHOI values not available. If both WHOI and U. of Miami tritium values available for the same sample the WHOI value is flagged "6" and the U. of Miami value is shown on the following list:

STNNBR	CASTNO	BTLNBR	CTDPRS DBAR	TRITUM W TU	TRITER W TU	DEPTH M	TRITUM MoldTU	TRITER MoldTU	W-M Tr diffTU
224	1	1	8.0	12.68	0.19	10.0	11.25	0.26	1.43
224	1	2	33.0	10.52	0.07	31.0	9.74	0.24	0.78
224	1	6	228.0	4.79	0.13	226.0	4.21	0.17	0.58
224	1	8	403.0	4.47	0.13	401.0	4.11	0.11	0.36
224	1	13	1202.0	3.28	0.11	1190.0	2.90	0.10	0.38
224	1	14	1411.0	2.94	0.10	1396.0	2.56	0.08	0.38
224	1	17	2019.0	2.07	0.04	1995.0	1.87	0.09	0.20
224	1	18	2267.0	2.00	0.09	2238.0	1.52	0.07	0.48
225	3	1	15.0	12.34	0.18	10.0	9.53	0.23	2.81
225	3	2	39.0	11.53	0.17	34.0	9.58	0.24	1.95
225	3	4	107.0	6.91	0.14	102.0	5.86	0.14	1.05
225	3	6	305.0	5.25	0.13	300.0	4.38	0.12	0.87
225	3	7	407.0	3.62	0.11	401.0	3.07	0.11	0.55
225	3	9	758.0	3.64	0.04	748.0	3.25	0.10	0.39
225	3	10	1008.0	3.23	0.04	994.0	3.03	0.09	0.20
225	3	11	1257.0	2.63	0.04	1241.0	2.56	0.10	0.07
225	3	12	1510.0	1.86	0.03	1490.0	1.51	0.07	0.35
225	3	13	1763.0	2.00	0.09	1739.0	1.72	0.08	0.28
225	3	14	2012.0	1.38	0.08	1984.0	1.29	0.06	0.09
225	3	15	2265.0	1.33	0.08	2233.0	1.24	0.06	0.09
225	3	16	2520.0	1.67	0.09	2483.0	1.66	0.07	0.01
225	3	17	2777.0	1.26	0.08	2735.0	1.17	0.07	0.09
225	3	18	3035.0	1.27	0.08	2987.0	0.97	0.06	0.30
225	3	19	3292.0	1.30	0.08	3239.0	1.23	0.07	0.07
225	3	20	3550.0	1.32	0.08	3490.0	1.21	0.08	0.11
225	3	21	3805.0	1.62	0.09	3739.0	1.56	0.07	0.06
225	3	22	4053.0	2.36	0.10	3979.0	1.65	0.07	0.71
225	3	23	4190.0	2.62	0.10	4114.0	2.13	0.09	0.49
225	3	24	4286.0	3.20	0.11	4207.0	2.64	0.08	0.56
228	3	2	55.0	3.82	0.04	52.0	3.43	0.11	0.39
228	3	3	153.0	3.52	0.04	150.0	3.29	0.11	0.23
228	3	5	304.0	3.89	0.13	301.0	3.66	0.12	0.23
228	3	6	503.0	3.62	0.04	499.0	3.18	0.11	0.44
228	3	8	802.0	1.54	0.09	795.0	1.54	0.10	0.00
228	3	9	903.0	2.28	0.03	895.0	2.10	0.10	0.18
228	3	14	1584.0	2.53	0.04	1567.0	2.31	0.12	0.22
228	3	16	2191.0	1.15	0.03	2164.0	0.78	0.06	0.37
228	3	20	3352.0	0.44	0.07	3302.0	0.42	0.05	0.02
228	3	21	3749.0	0.44	0.07	3690.0	0.34	0.06	0.10
228	3	23	4711.0	0.98	0.08	4625.0	0.79	0.07	0.19
233	1	1	6.0	3.66	0.04	6.0	3.42	0.12	0.24

233	1	7	497.0	3.62	0.04	493.0	3.07	0.11	0.55
233	1	9	698.0	2.29	0.03	692.0	1.87	0.09	0.42
233	1	11	901.0	1.30	0.03	893.0	1.03	0.07	0.27
233	1	13	1098.0	1.00	0.02	1088.0	0.90	0.07	0.10
233	1	15	1391.0	1.46	0.03	1378.0	1.29	0.06	0.17
233	1	19	2002.0	0.29	0.02	1980.0	0.26	0.04	0.03
233	1	21	2407.0	0.18	0.02	2378.0	0.16	0.06	0.02
233	1	23	2810.0	0.11	0.02	2774.0	0.10	0.04	0.01
233	1	25	3205.0	0.16	0.02	3160.0	0.09	0.05	0.07
233	1	27	3611.0	0.17	0.02	3557.0	0.04	0.05	0.13
233	1	29	4016.0	0.09	0.01	3952.0	0.06	0.05	0.03
233	1	33	4940.0	0.31	0.02	4852.0	0.00	0.06	0.31
233	1	35	5149.0	0.08	0.01	5054.0	0.16	0.07	-0.08
234	2	8	1250.0	1.19	0.03	1238.0	1.06	0.08	0.13
234	2	24	5462.0	0.04	0.02	5361.0	0.00	0.05	0.04
235	2	3	148.0	3.61	0.04	145.0	3.34	0.11	0.27
235	2	8	699.0	2.76	0.03	695.0	2.60	0.10	0.16
235	2	10	1250.0	0.53	0.02	1239.0	0.47	0.07	0.06
241	2	3	153.0	3.56	0.04	150.0	3.19	0.11	0.37
241	2	22	5282.0	0.46	0.02	5183.0	0.35	0.06	0.11
241	2	24	5543.0	0.34	0.02	5436.0	0.38	0.05	-0.04
243	2	1	15.0	5.19	0.05	11.0	4.75	0.15	0.44
243	2	3	232.0	1.87	0.03	228.0	2.09	0.09	-0.22
243	2	4	406.0	1.23	0.03	402.0	1.18	0.08	0.05
243	2	5	606.0	1.48	0.03	600.0	1.48	0.08	0.00
243	2	17	3693.0	0.33	0.02	3634.0	0.28	0.05	0.05

List of U. of Miami tritium values where no WHOI value available:

			*****WHOI*****		********MIAMI*********			
STNNBR	CASTNO	BTLNBR	CTDPRS	TRITUM	DEPTH	TRITUM	TRITER	Q1
			DBAR	TU	M	old TU	old TU	
225	3	5	206.0	-9.00	201.0	5.37	0.15	2
225	3	8	508.0	-9.00	500.0	2.91	0.11	2
228	3	10	947.0	-9.00	938.0	2.15	0.08	2
228	3	24	4955.0	-9.00	4862.0	1.22	0.06	2
233	1	2	56.0	-9.00	54.0	3.55	0.12	2
233	1	4	197.0	-9.00	194.0	3.17	0.11	2
233	1	6	398.0	-9.00	395.0	3.22	0.11	2
233	1	16	1543.0	-9.00	1527.0	1.10	0.06	2
233	1	17	1697.0	-9.00	1679.0	1.07	0.06	2
233	1	18	1851.0	-9.00	1830.0	0.34	0.06	2
233	1	20	2204.0	-9.00	2178.0	0.15	0.05	2
233	1	26	3407.0	-9.00	3358.0	0.07	0.04	2
233	1	30	4271.0	-9.00	4200.0	0.01	0.05	2
233	1	31	4527.0	-9.00	4451.0	0.26	0.05	2
233	1	32	4785.0	-9.00	4701.0	0.08	0.05	2
233	1	36	5289.0	-9.00	5191.0	0.06	0.05	2
234	2	9	1351.0	-9.00	1339.0	0.50	0.05	2
234	2	17	3232.0	-9.00	3188.0	0.02	0.06	2
235	2	2	69.0	-9.00	66.0	2.85	0.08	2
235	2	4	198.0	-9.00	195.0	3.26	0.11	2
235	2	11	1372.0	-9.00	1358.0	0.47	0.06	2
235	2	12	1487.0	-9.00	1474.0	0.32	0.05	2
235	2	13	1705.0	-9.00	1688.0	0.19	0.05	2
235	2	14	2054.0	-9.00	2033.0	0.10	0.05	2
235	2	16	2622.0	-9.00	2591.0	0.00	0.04	2
235	2	19	3716.0	-9.00	3662.0	-0.08	0.05	2
235	2	20	4072.0	-9.00	4011.0	0.02	0.04	2
235	2	21	4643.0	-9.00	4566.0	0.20	0.04	2
235	2	23	5229.0	-9.00	5135.0	0.25	0.06	2
241	2	15	2801.0	-9.00	2764.0	0.19	0.06	2
241	2	16	3254.0	-9.00	3207.0	0.16	0.05	2
241	2	18	3854.0	-9.00	3794.0	0.39	0.06	2
243	2	2	106.0	-9.00	101.0	4.61	0.17	2
243	2	16	3205.0	-9.00	3159.0	0.27	0.06	2
243	2	19	4224.0	-9.00	4152.0	0.36	0.09	2
243	2	24	5180.0	-9.00	5081.0	0.48	0.05	2
247	1	1	10.0	-9.00	9.0	12.43	0.24	2
247	1	2	224.0	-9.00	222.0	3.16	0.12	2
247	1	4	503.0	-9.00	499.0	2.18	0.10	2
247	1	6	805.0	-9.00	798.0	2.43	0.10	2

247	1	8	1194.0	-9.00	1183.0	1.78	0.08	2
247	1	10	1612.0	-9.00	1594.0	0.51	0.06	2
247	1	11	1816.0	-9.00	1795.0	0.80	0.06	2
247	1	13	2259.0	-9.00	2231.0	0.66	0.06	2

```
Original CTD data from NODC Mar 8, 2006  ocldb1141845224.17339.CTD5.csv.gz
                                         ocldb1141845224.17339.CTD6.csv.gz
  No CTD data for following casts: Station  Cast  Max Press
                                     220      1       89
                                     230      3     5231
                                     239      1     4730
                                     246      3     4008

  The data originator (ODF/SIO) has no ctd data available. 9-track tapes
  unreadable.
```