A Synopsis of Hydrographic Data from the TAMU Ship Of Opportunity Program:

XBT, CTD, and bottle data collected from the Gulf of Mexico
November 1989 - September 1993
by the Technical Support Services Group,
Department of Oceanography, TAMU

A Report to the US Minerals Management Service
under MMS Contract No. 14-35-0001-30501

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Published by

Department of Oceanography
Texas A&M University
College Station, TX 77843-3146

28 December 1993

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EXECUTIVE SUMMARY

In September 1989, the US Minerals Management Service (MMS) and the Department of Oceanography of Texas A&M University (TAMU) entered into a 4-year Cooperative Agreement 14-35-0001-30501 that contracted TAMU Marine and Electronics Technicians to collect CTD, XBT, and other Ship Of Opportunity Program (SOOP) hydrographic data from the Gulf of Mexico as science/station schedules allowed while they were at sea on research cruises. These data, which were published as a series of 18 technical reports that were each released 1-2 months after each cruise of opportunity, have been archived with NOAA's National Oceanographic Data Center (NODC) as LATEX supplement code 0215.

As summarized in Section 1 of this Synopsis, TAMU technicians made 373 CTD casts and 271 XBT drops of opportunity during 22 cruises of R/V *Gyre* and 1 cruise of R/V *Powell* between November 1989 and September 1993. The data collection from *Gyre* was done during NSF-, Navy-, and DOE-sponsored cruises, as well as during cruises dedicated to state-sponsored graduate training and research, and from *Powell* during a summer 1991 piston coring cruise. In addition, 23 CTD casts were made from an offshore gas production platform owned by Mobil Exploration & Production USA, at 27°54.2'N, 93°34.4'W in lease block HIA-389 during a 3-week period in summer 1991. All these CTD and XBT casts of opportunity were made in addition to those done at stations that are being revisited quarterly since April 1992 as part of the ongoing LATEX-Shelf hydrographic program that is being fielded from *Gyre* and *Powell* (see Wiesenburg, 1993).

Figure 1 shows that most of the TAMU-SOOP CTD stations of opportunity were concentrated on the LATEX shelf in the NW Gulf of Mexico, in particular along transects off Galveston and off Corpus Christi, TX that were revisited as part of the Texas Institutions Gulf Ecosystem Research initiative (see Biggs, 1989). In contrast, most of the TAMU-SOOP XBT stations are seaward of the LATEX shelf. Those over deep (> 2 km) water were dropped during basin wide transits of opportunity to/from Galveston and the Straits of Florida and Straits of Yucatan. These transits of opportunity crossed Quiet Eddy (Oct 90), Eddy Triton (Oct 91), Unchained Eddy/Eddy Vazquez (Oct 92), and Eddy Whopper (Jun 93). When Quiet Eddy reached the western Gulf, it was revisited in March 1991 during a follow-up cruise that was fielded as part of the TAMU-Mexico cooperative program Analysis Multidisciplinario de Investigaciones en el Golfo Occidental (AMIGO). Two other cruises in the western Gulf revisited Eddy Triton in May-June 1992 (see Biggs et al., 1993). AMIGO/TIGER cruises have also surveyed the companion cylonic eddies which appear to be created when these Loop Current rings experience the shoaling topography of the western Gulf and transfer mass/vorticity to the adjacent slope water (see Biggs et al., 1990).

Figure 2 summarizes the seasonal variability in the temperature-salinity (T/S) relationship for the Gulf of Mexico, as composited from 49 CTD casts in Dec-Jan-Feb (winter), 64 CTD casts in Mar-Apr-May (spring), 157 CTD casts in Jun-Jul-Aug (summer), and 103 CTD casts in Sep-Oct-Nov (autumn). These T/S summaries, along with the station locations that were used for each composite, are the subject of Section 1, while Section 2 presents T/S relationships for Loop Current eddies. CTD casts made near ring center show that Eddies Q, T, U, V, and W can be distinguished by the high salinity signature of their subsurface Caribbean Underwater (> 36.5 PSU in the range 24.5 - 26.5 sigma-theta). Section 3 summarizes T/S relationships at HIA-389.

At most of the CTD stations of opportunity, 12 or more bottle samples were collected on the upcast and analyzed for nutrients, dissolved oxygen, and chlorophyll/phaeopigments. Section 4 of this Synopsis presents examples of summary property-temperature plots to continue/extend the relationships first reported by Morrison et al. (1989).

We anticipate that hydrographic data from these TAMU-SOOP cruises will be utilized to initialize mathematical models of the general circulation of the Gulf of Mexico that will predict the trajectory of oil spills that might occur there (see Dietrich, 1990) and the climatology and simulation of eddies (see Schaudt et al., 1989, 1990). As summarized in Section 5 of this Synopsis, dynamic topography that has been computed from CTD and XBT data has been used to provide sea-truth for altimetric models of sea surface height (see also Leben et al., 1993), for studies of Loop Current Eddies (Fargion et al., 1993), and to provide seaward boundary conditions for descriptions of the local geostrophic circulation over the LATEX continental shelf (Cochrane, 1993).

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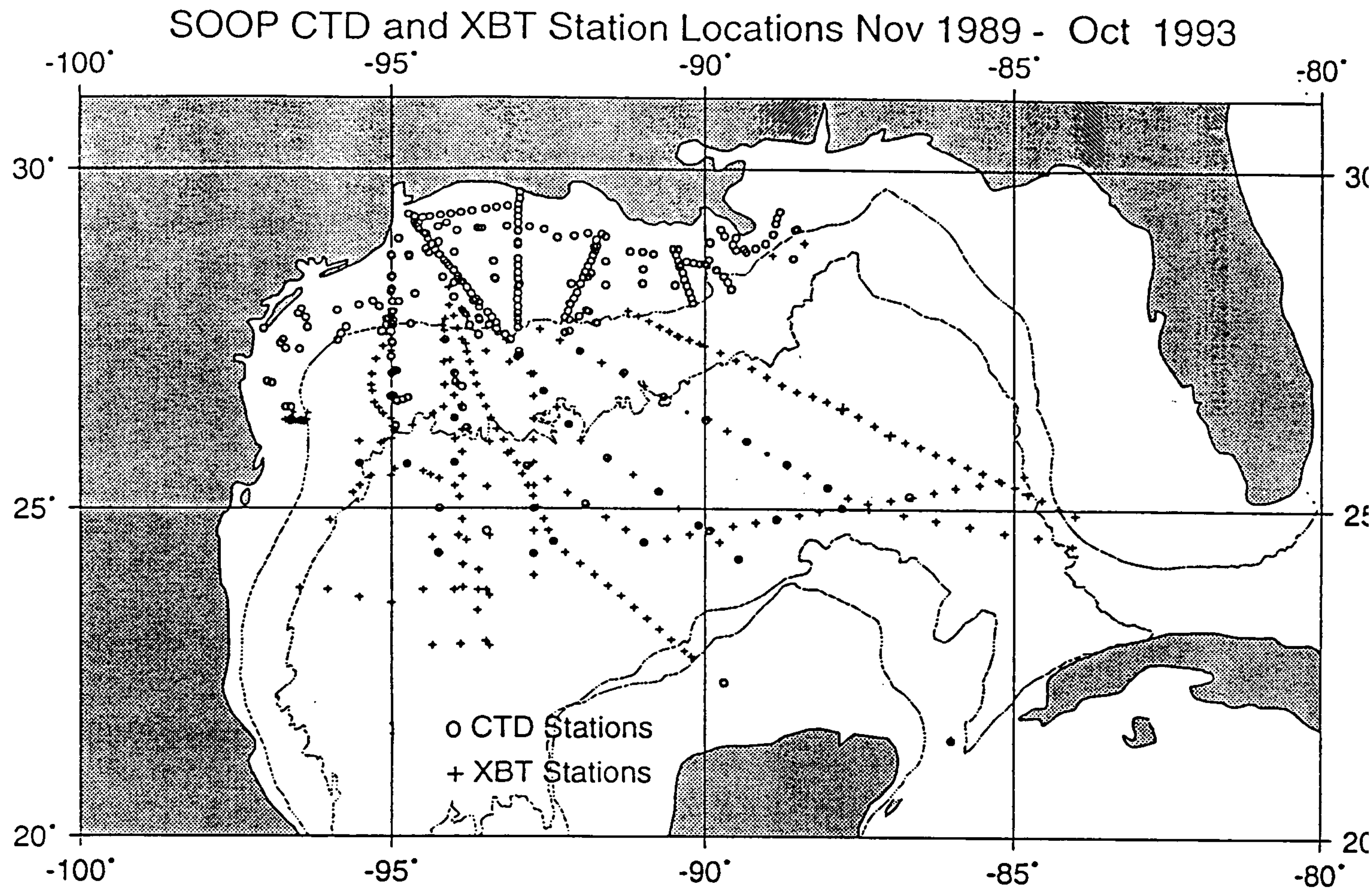


Figure 1: Locations of CTD + XBT stations made by TAMU Technical Support Services Group during 4-year Cooperative Agreement 14-35-0001-30501 between TAMU and MMS for the sharing of Ship Of Opportunity Program (SOOP) hydrographic data in the Gulf of Mexico, October 1989 through September 1993.

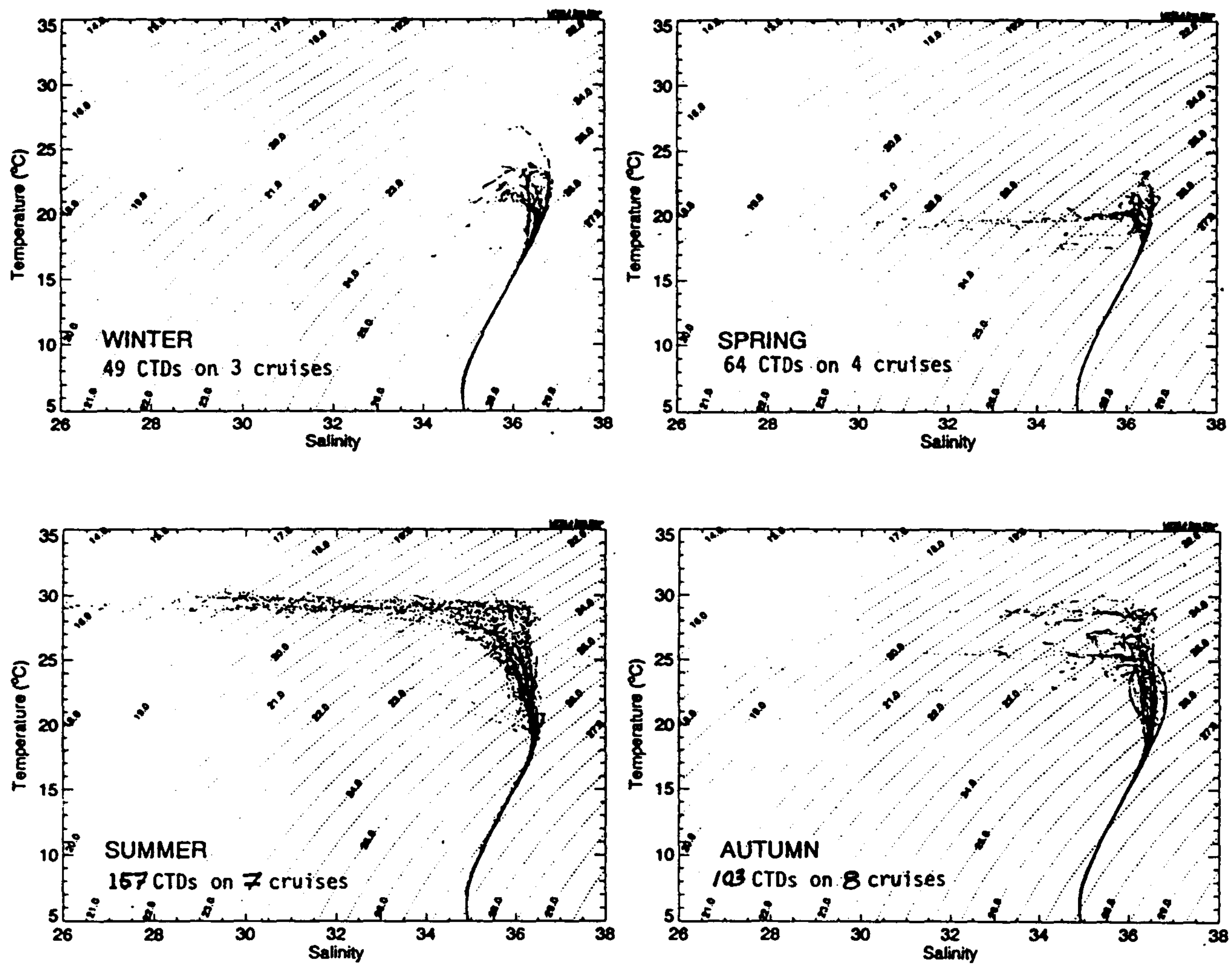


Figure 2: Temperature-Salinity (T/S) relationships for CTDs made in winter (Dec-Jan-Feb) versus spring (Mar-Apr-May), summer (Jun-Jul-Aug), and autumn (Sep-Oct-Nov).

Section 1

SUMMARY OF T/S RELATIONSHIPS

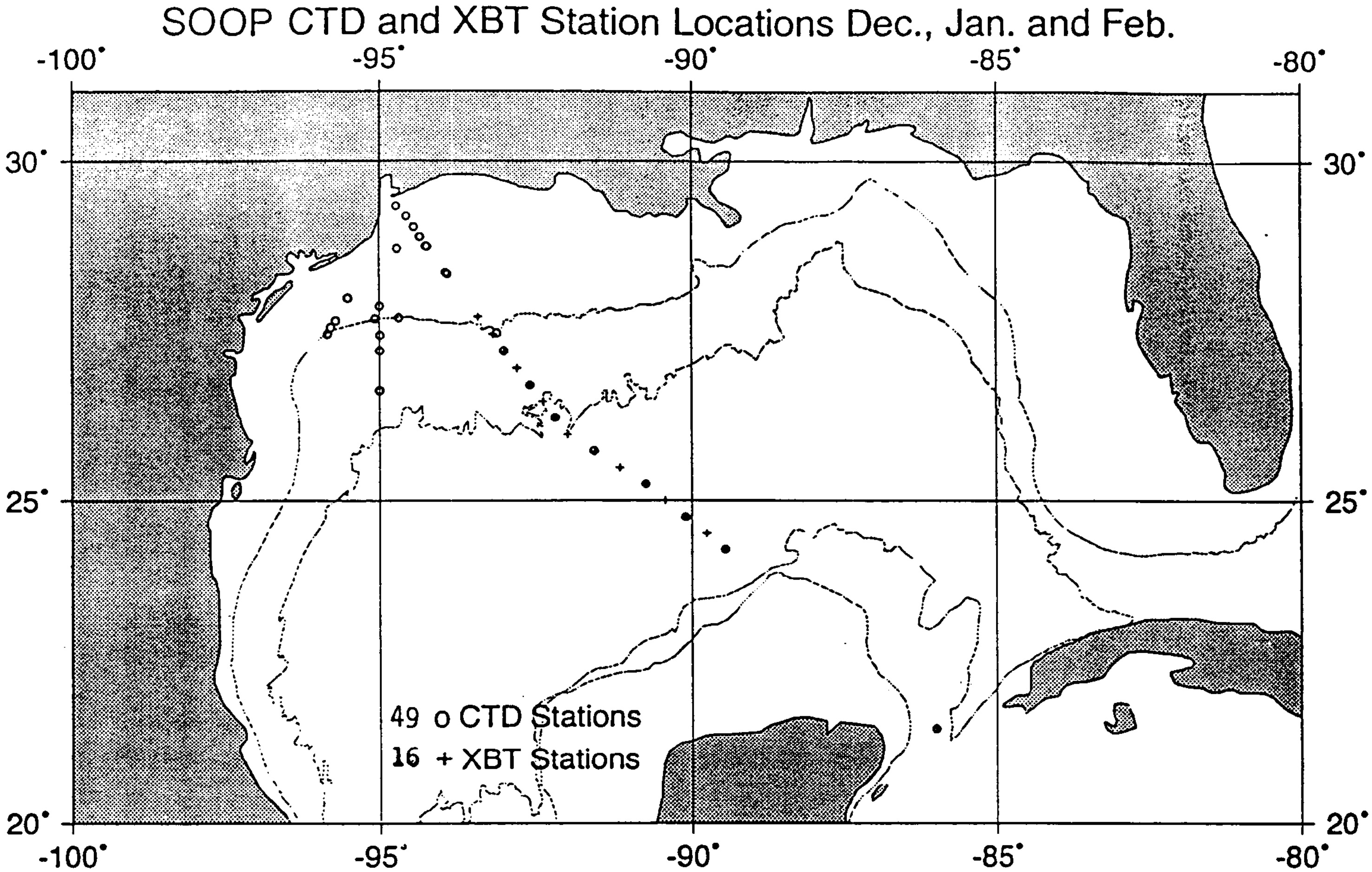
for

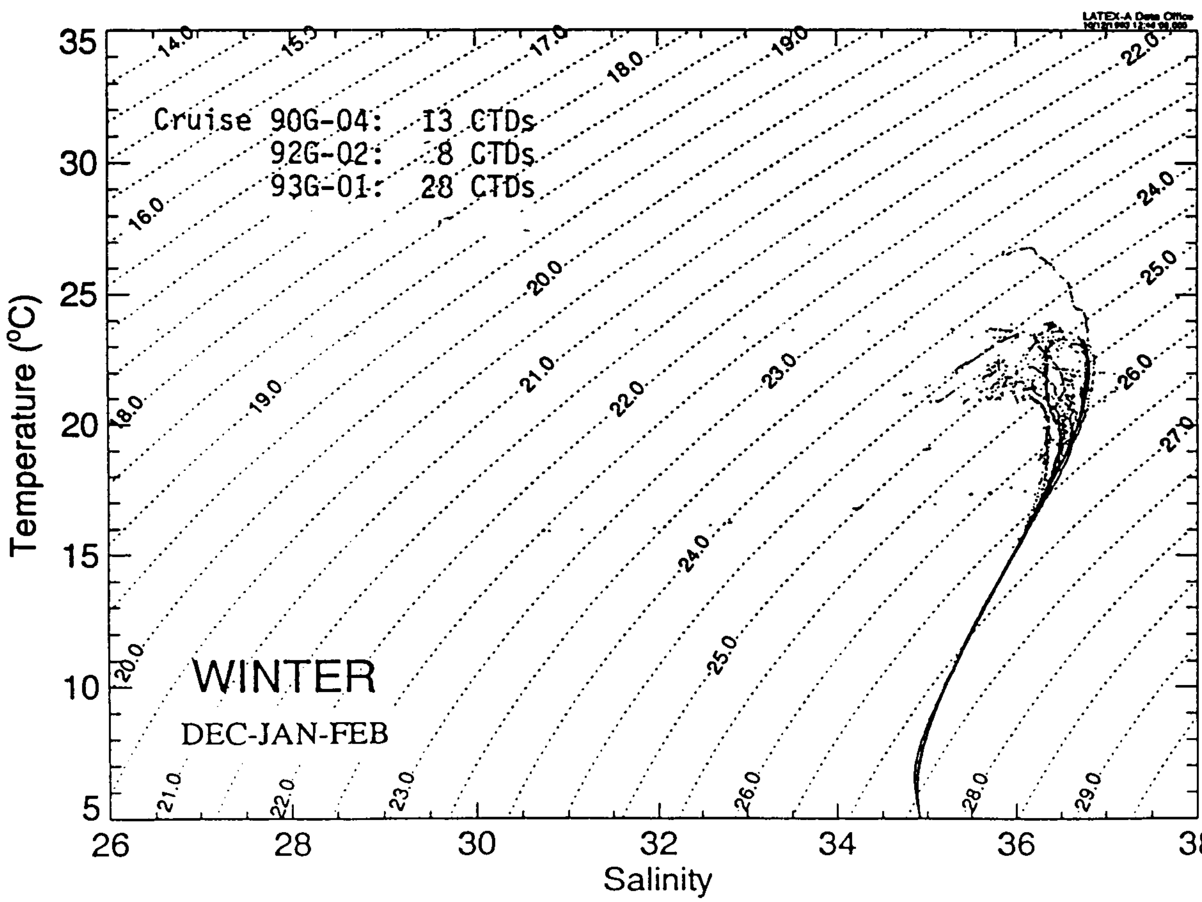
WINTER (Dec-Jan-Feb),

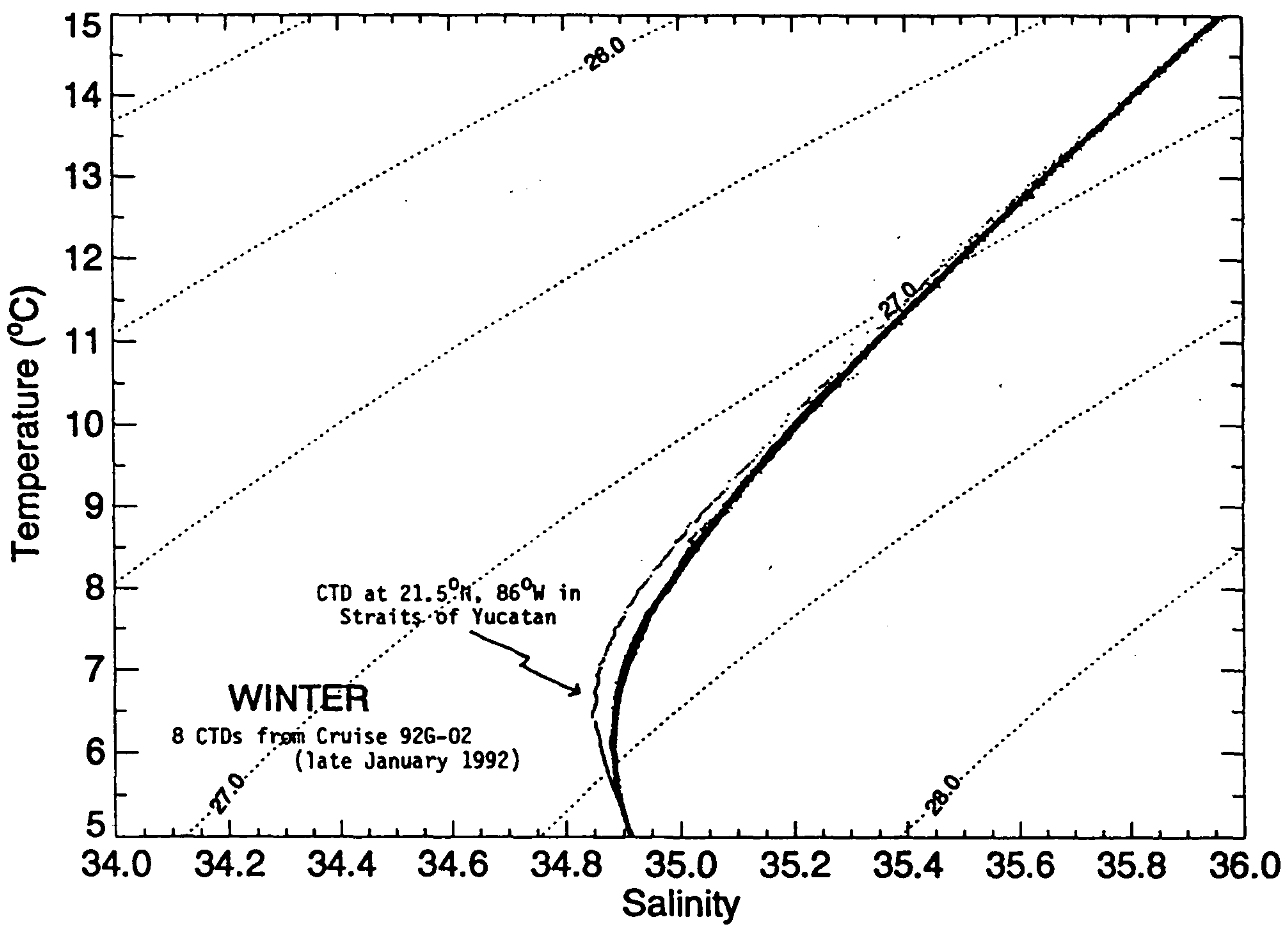
SPRING (Mar-Apr-May),

SUMMER (Jun-Jul-Aug),

and AUTUMN (Sep-Oct-Nov)

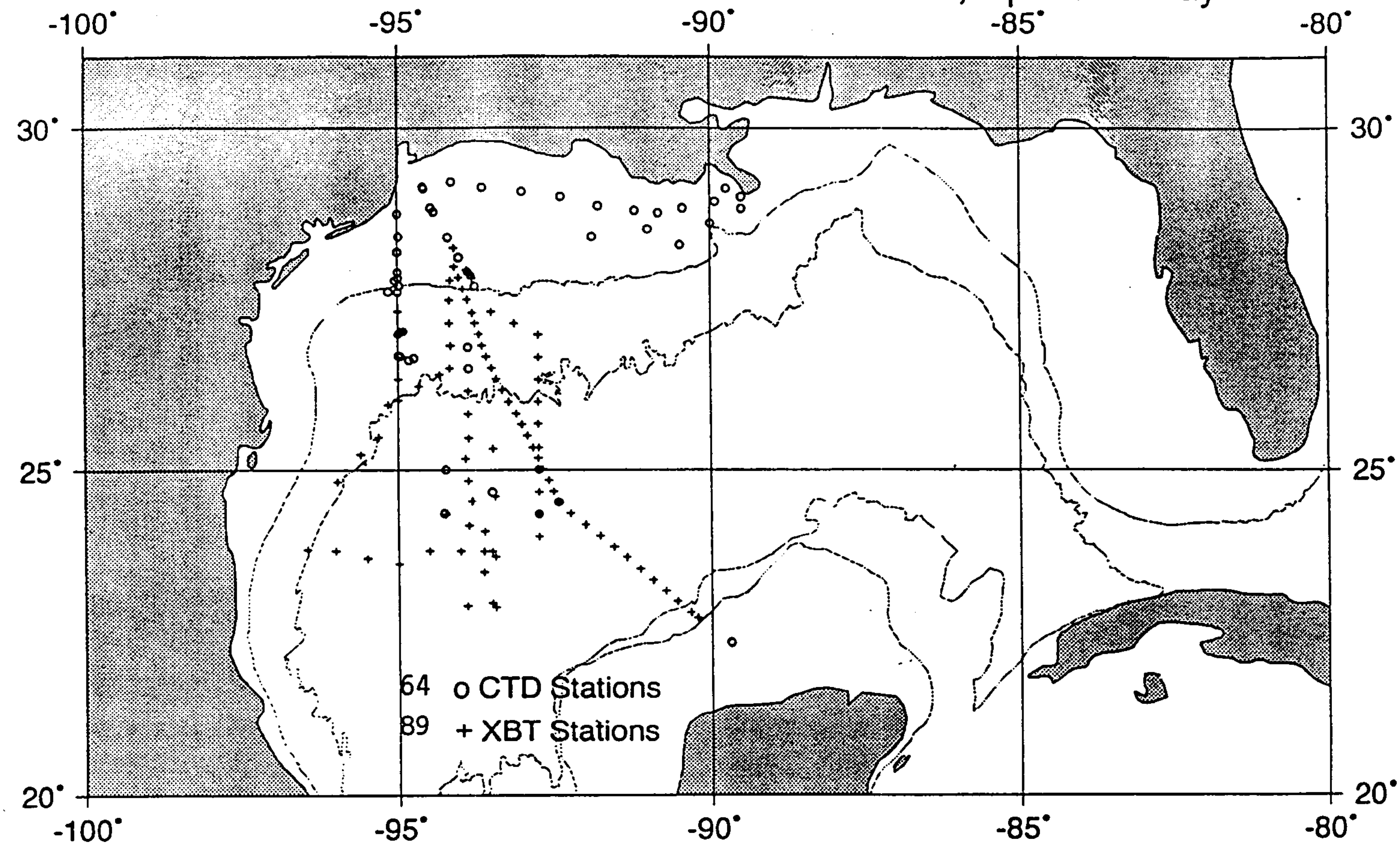

SOOP CTD and XBT Station Locations Dec., Jan. and Feb.
49 o CTD Stations
16 + XBT Stations

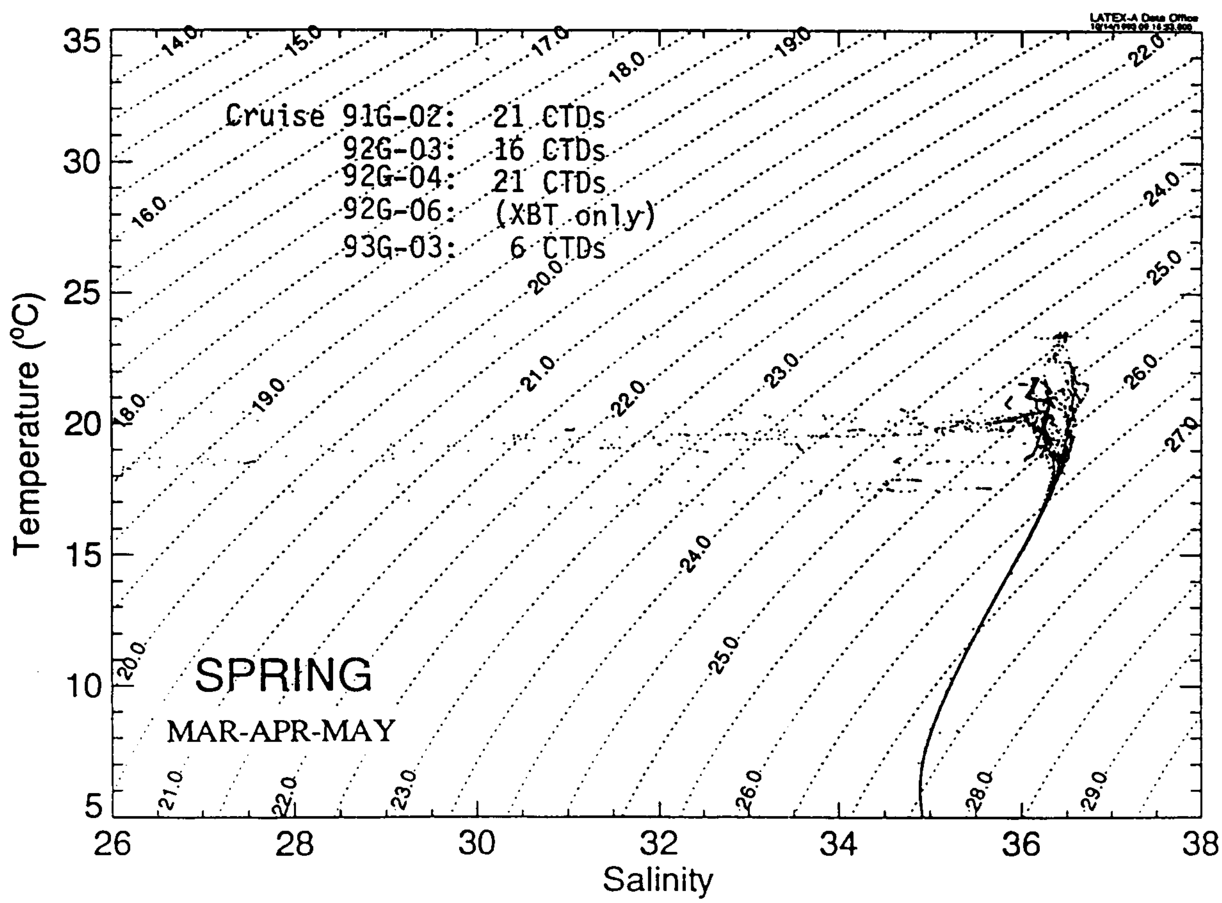

Cruise 90G-04: 13 CTDs
92G-02: 8 CTDs
93G-01: 28 CTDs
WINTER
DEC-JAN-FEB
Temperature (°C)
Salinity



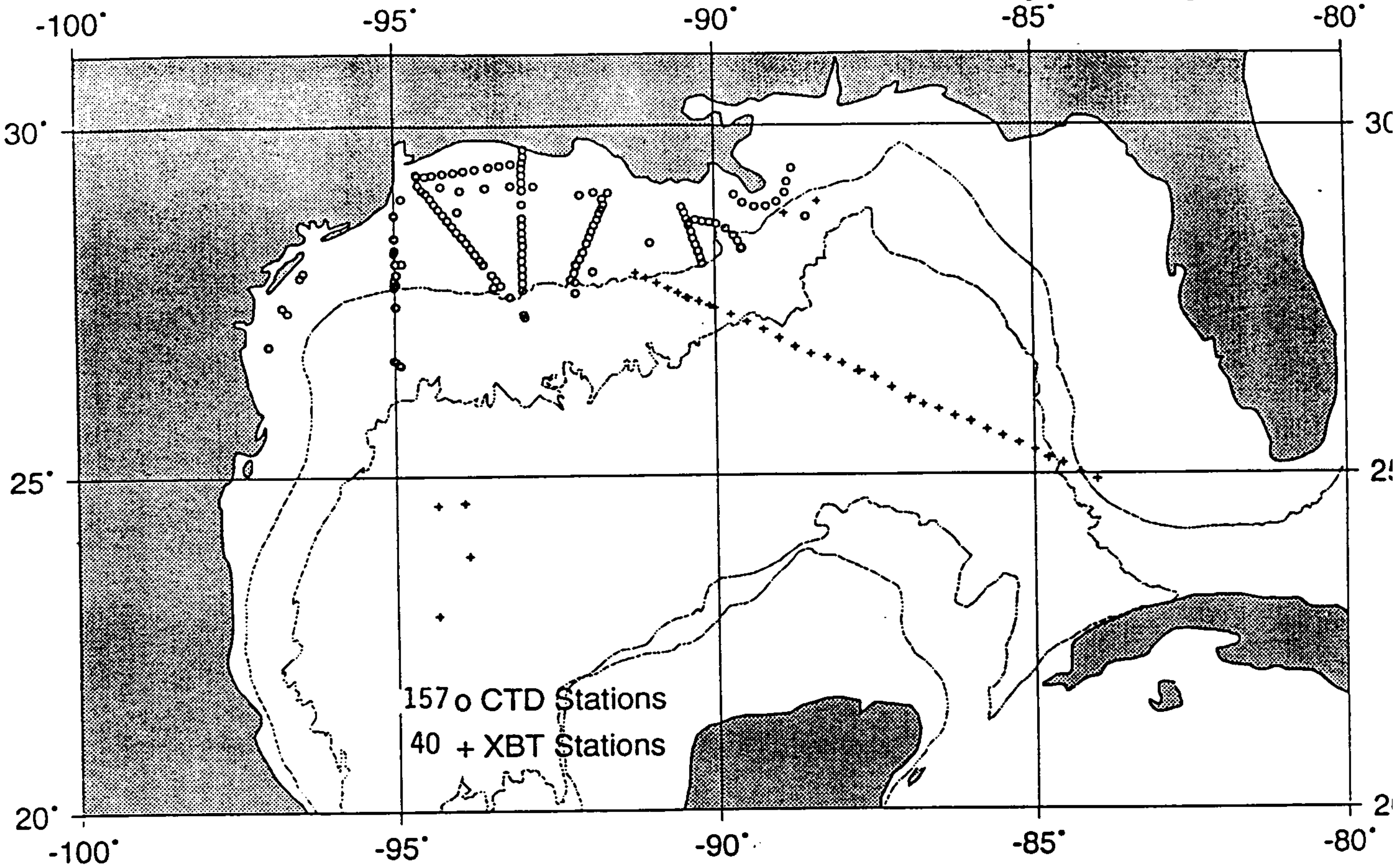
Temperature (°C)
Salinity
28.0
27.0
CTD at 21.5°N, 86°W in
Straits of Yucatan
WINTER
8 CTDs from Cruise 92G-02
(late January 1992)

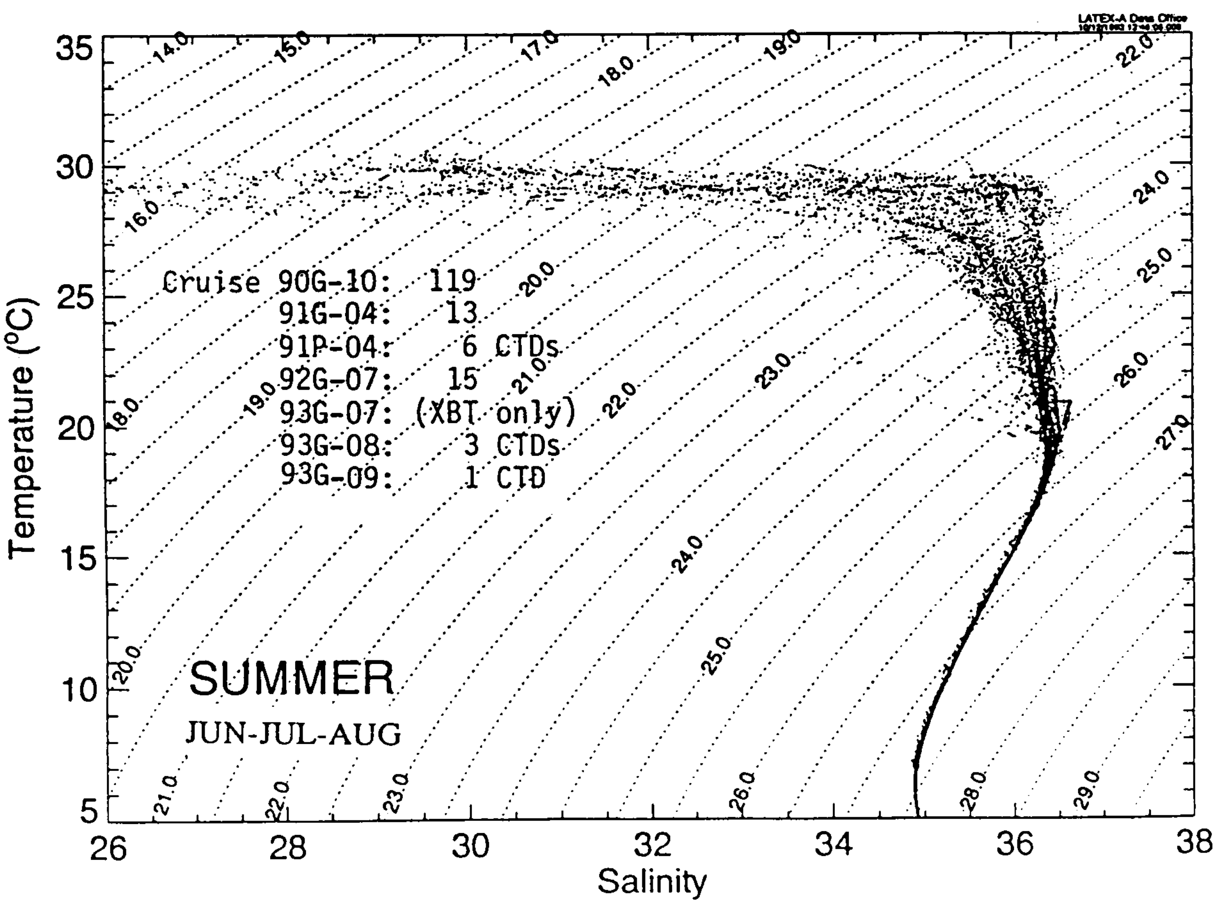
SOOP CTD and XBT Station Locations March, April and May

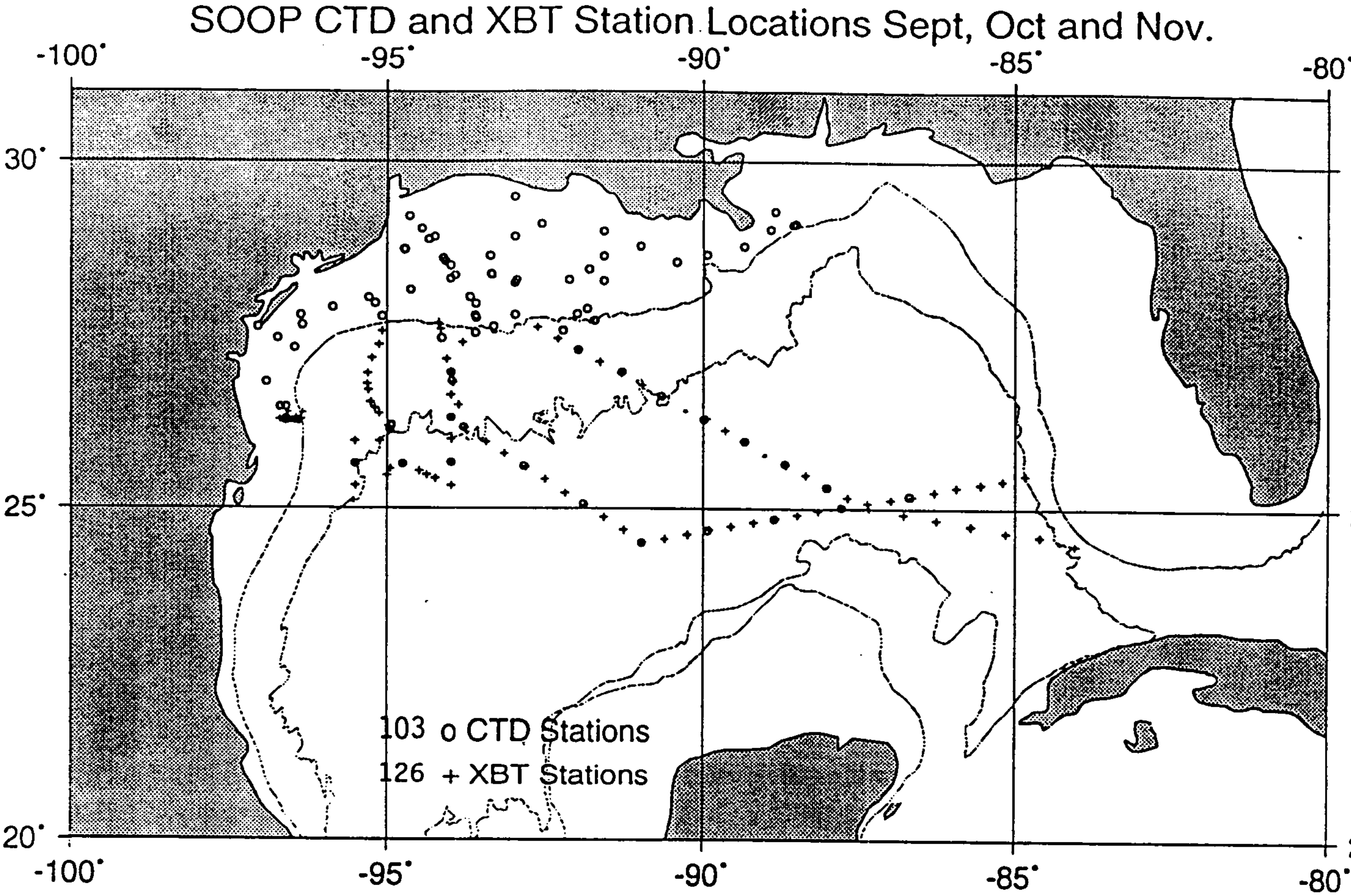


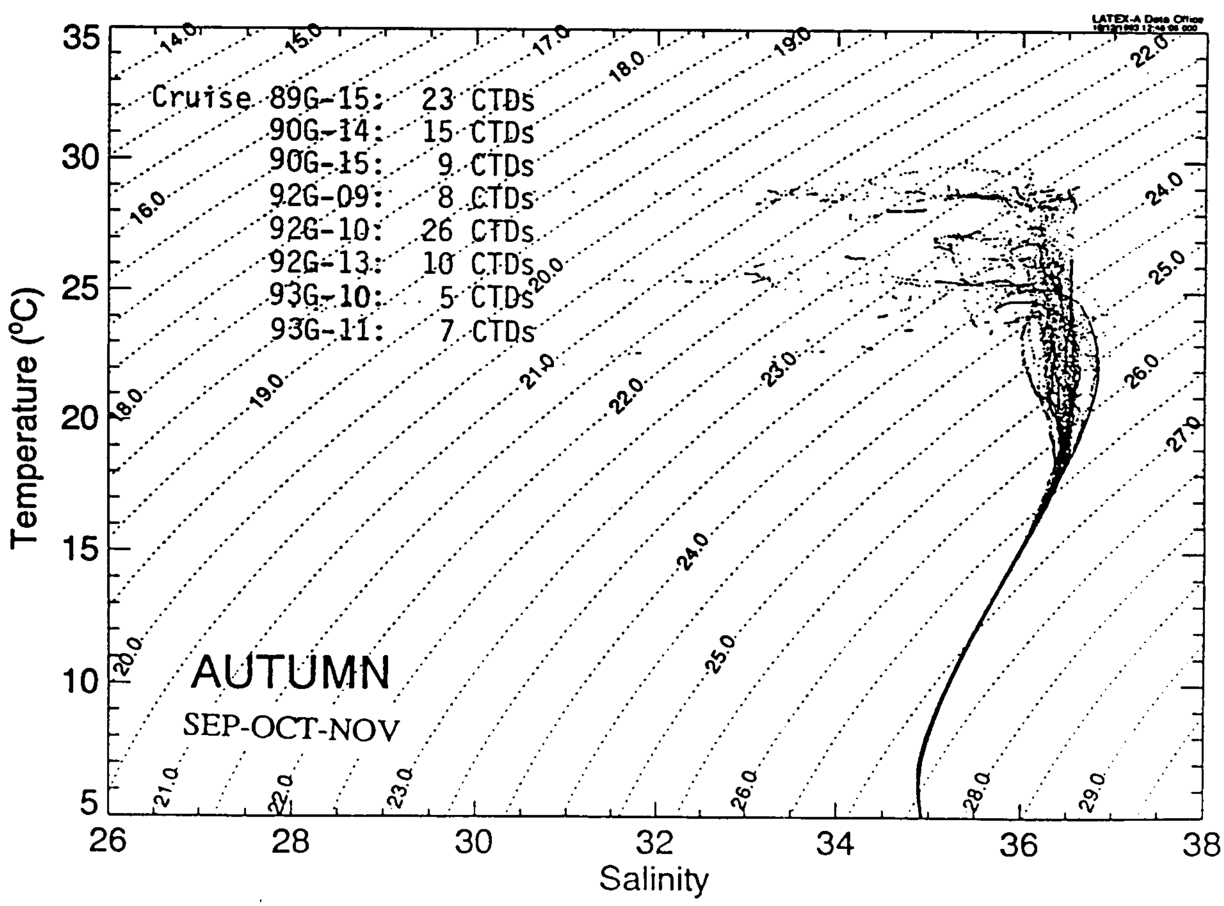


SOOP CTD and XBT Station Locations June, July and August





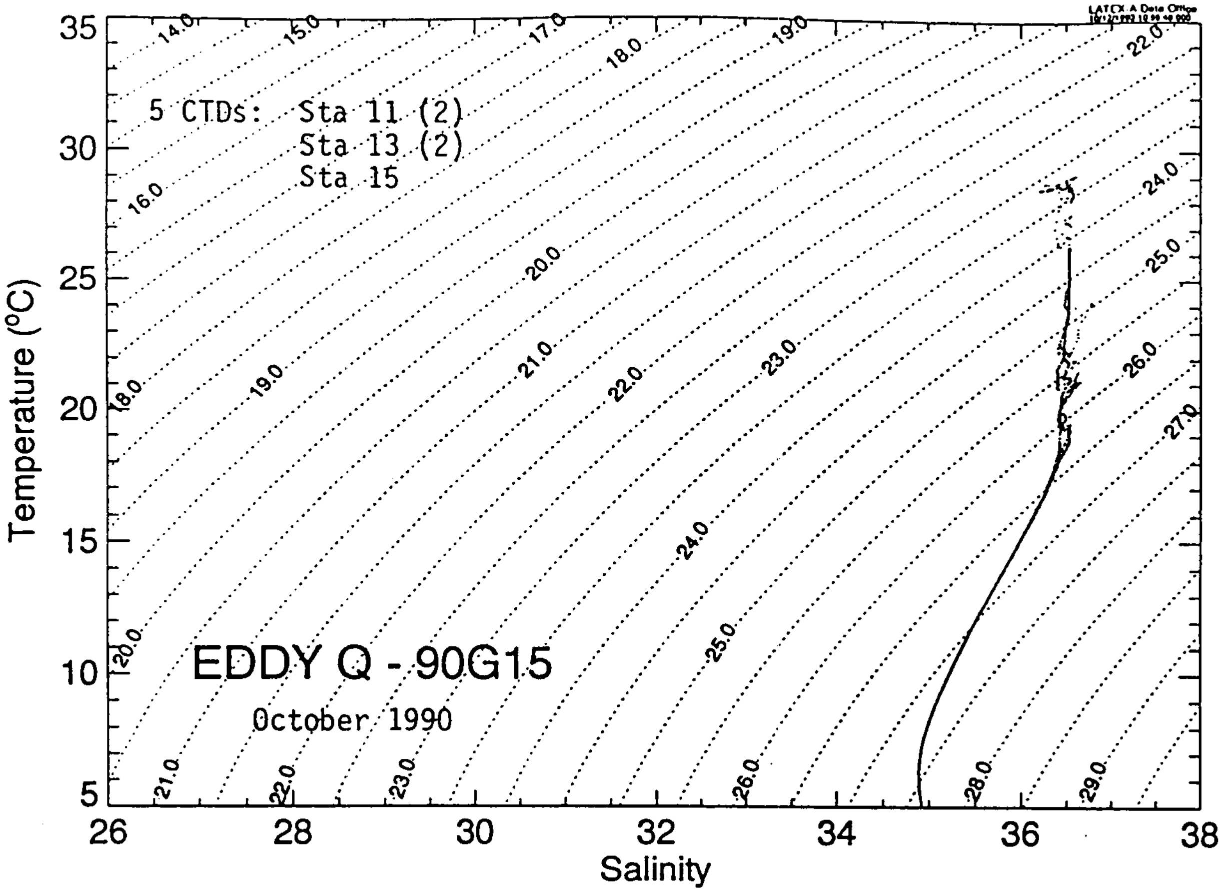

SOOP CTD and XBT Station Locations Sept, Oct and Nov.
-100° -95° -90° -85° -80°
30° 25° 20°
103 o CTD Stations
126 + XBT Stations

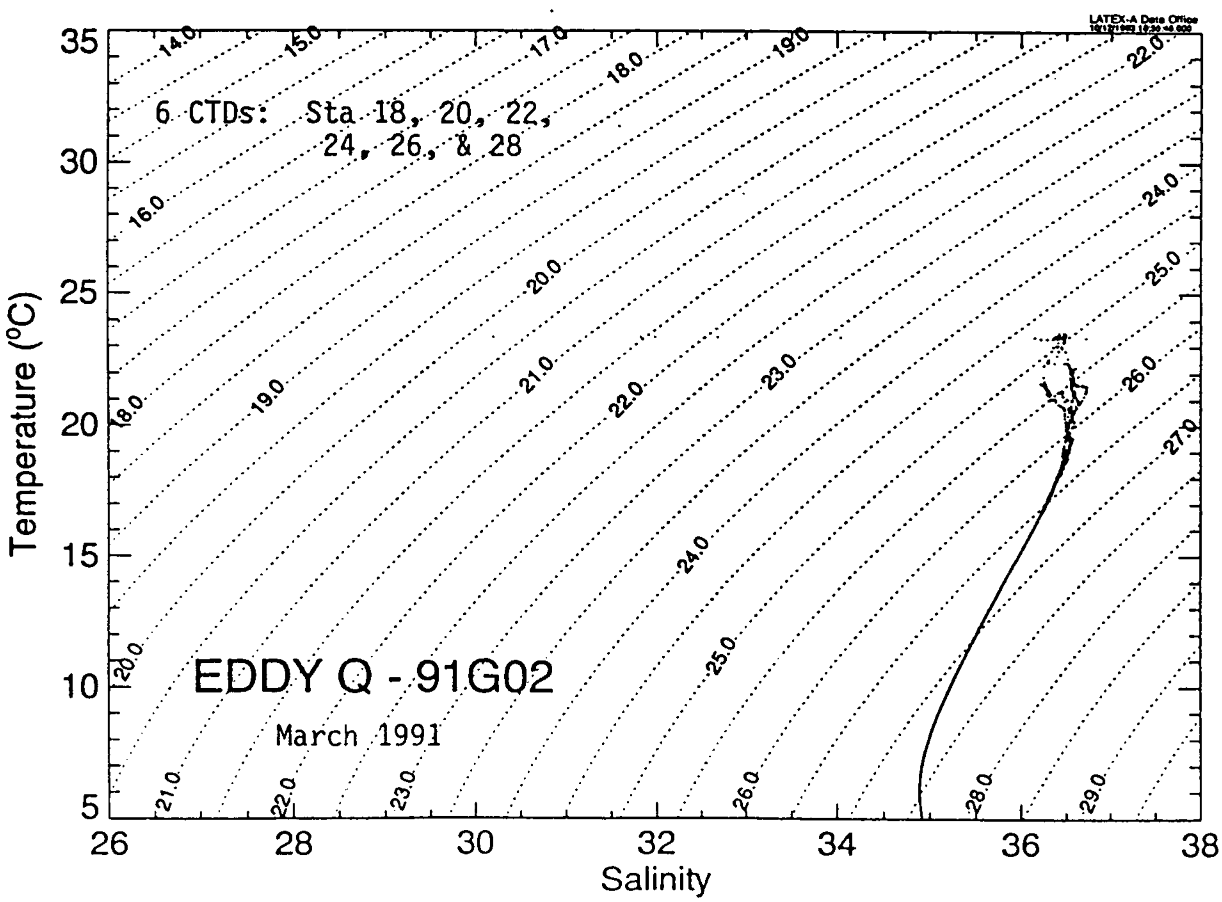

Cruise 89G-15: 23 CTDs
90G-14: 15 CTDs
90G-15: 9 CTDs
92G-09: 8 CTDs
92G-10: 26 CTDs
92G-13: 10 CTDs
93G-10: 5 CTDs
93G-11: 7 CTDs
AUTUMN
SEP-OCT-NOV
Temperature (°C)
Salinity

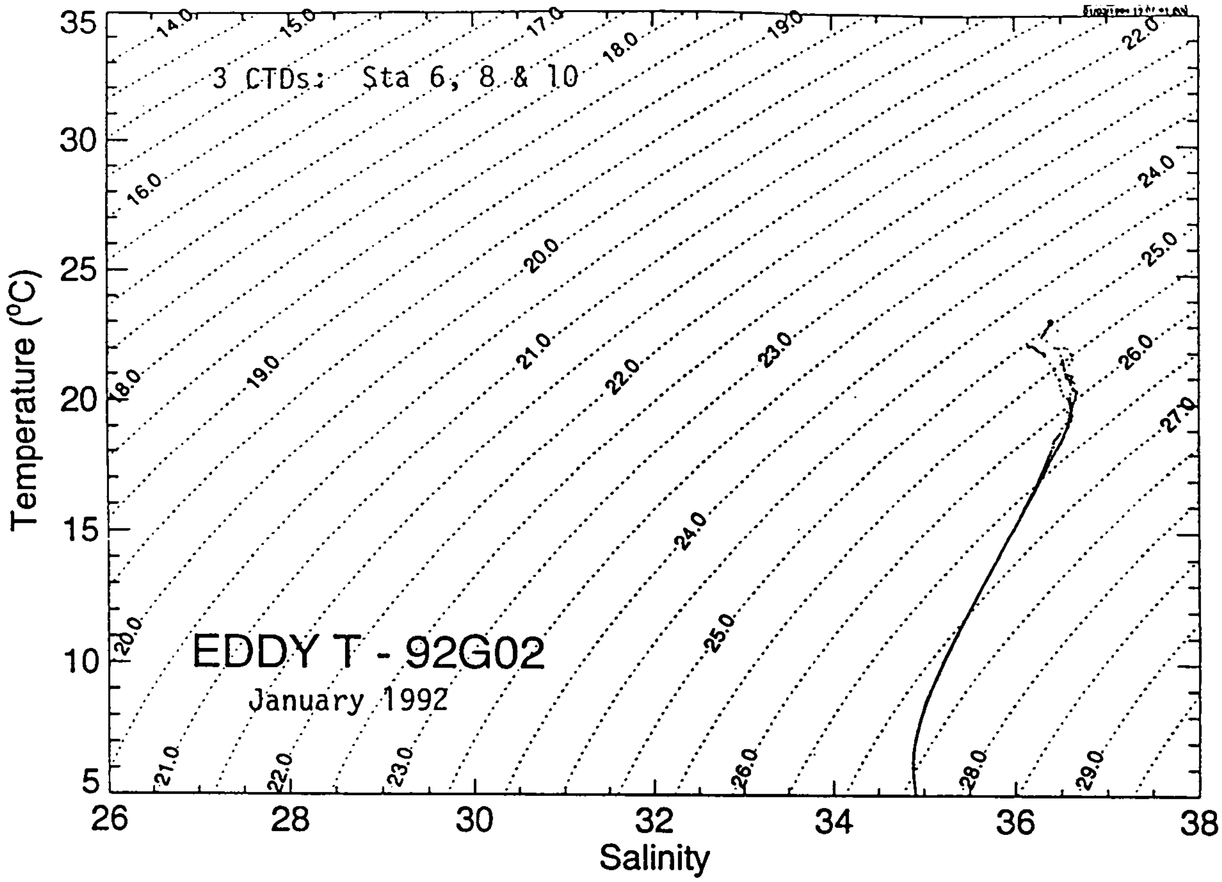
Section 2

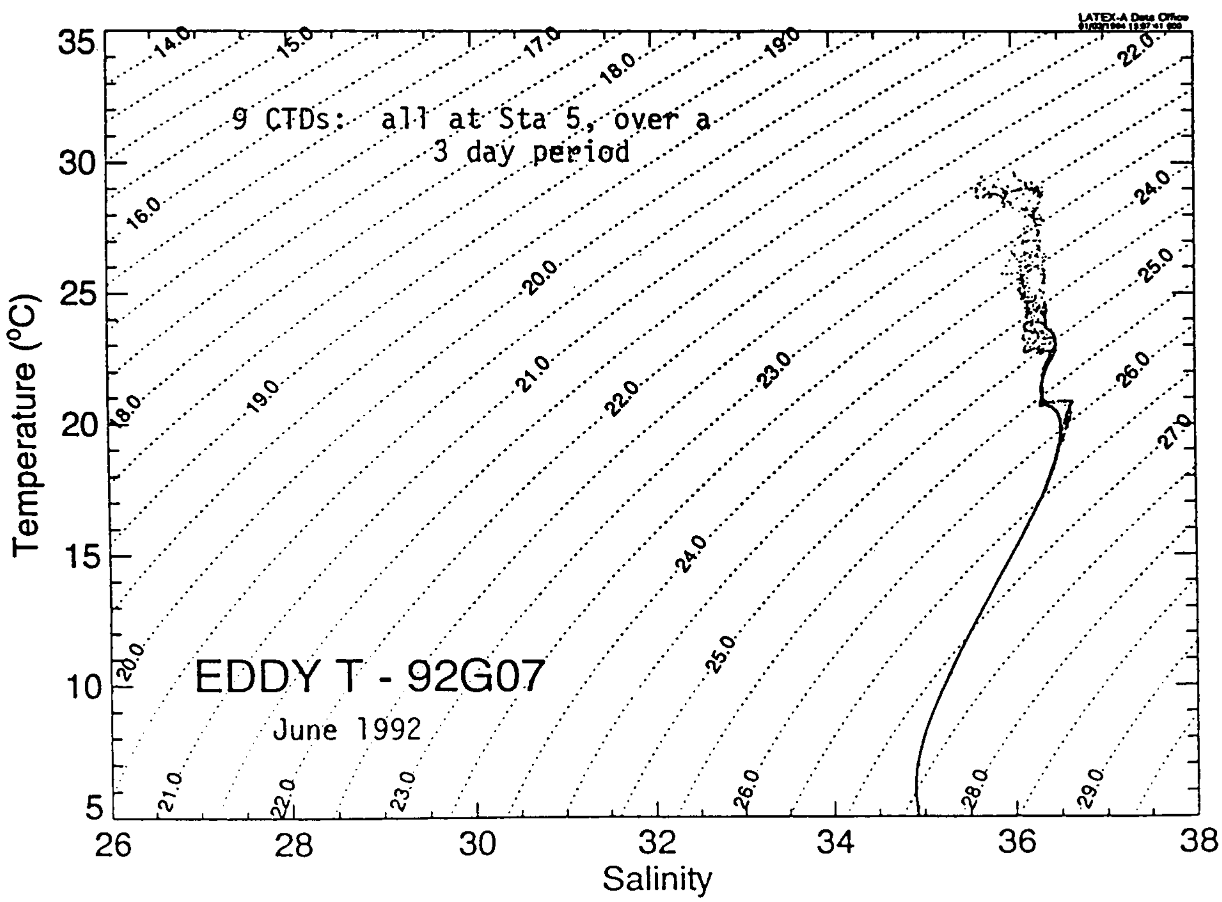
T/S RELATIONSHIPS FOR LOOP CURRENT EDDIES

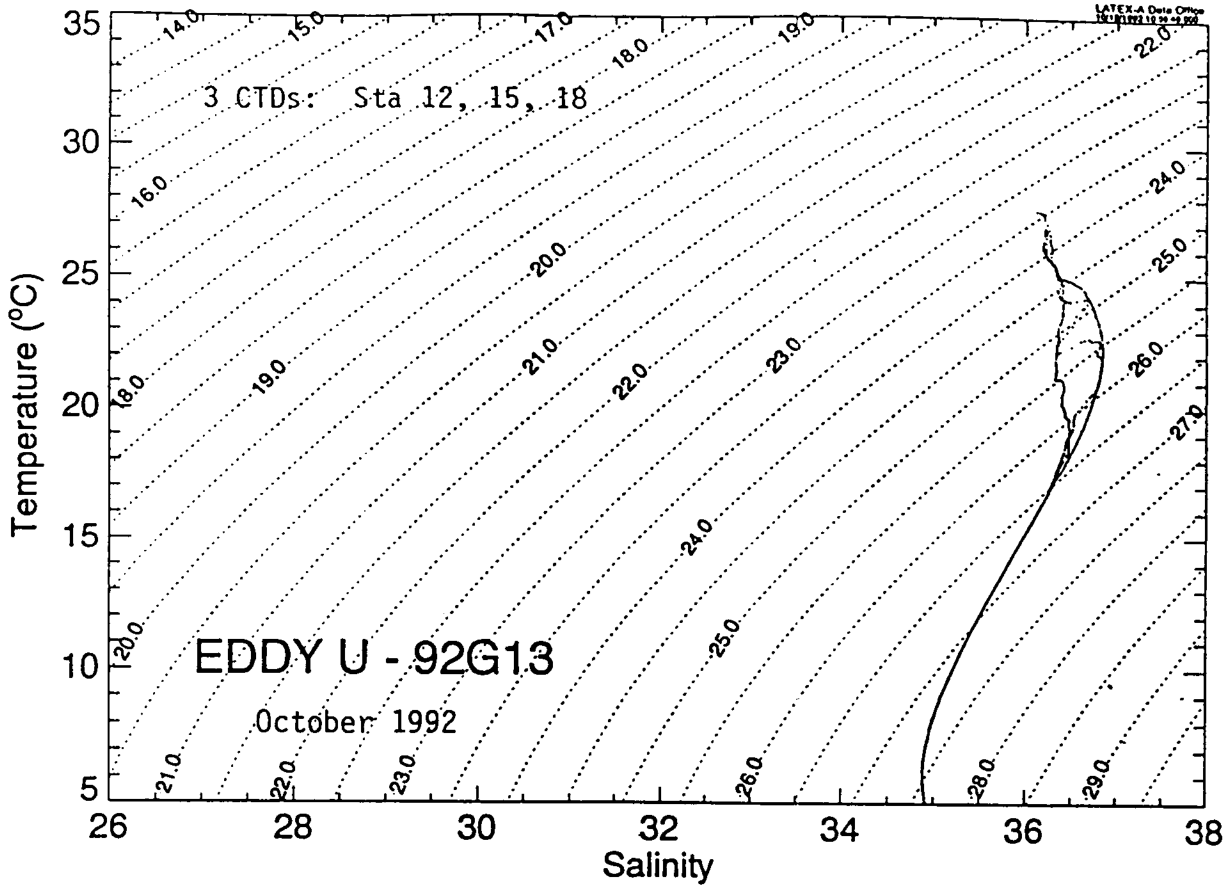
CRUISE	Month-Year	EDDY SAMPLED (and ring "age" since it was shed)	
90G-15	Oct 90	Quiet Eddy	(4 months)
91G-02	Mar 91	" "	(9 months)
92G-02	Jan 92	Eddy Triton	(7 months)
92G-06	May 92	" "	(10 months)
92G-07	Jun 92	" "	(11 months)
92G-13	Oct 92	Eddies U/V	(3 months/1 month)
93G-01	Jan 93	Eddy V	(4 months)
93G-12	Oct 93	Eddy V	(15 months)
93G-07	Jun 93	Eddy Whopper (transected as it was separating)	

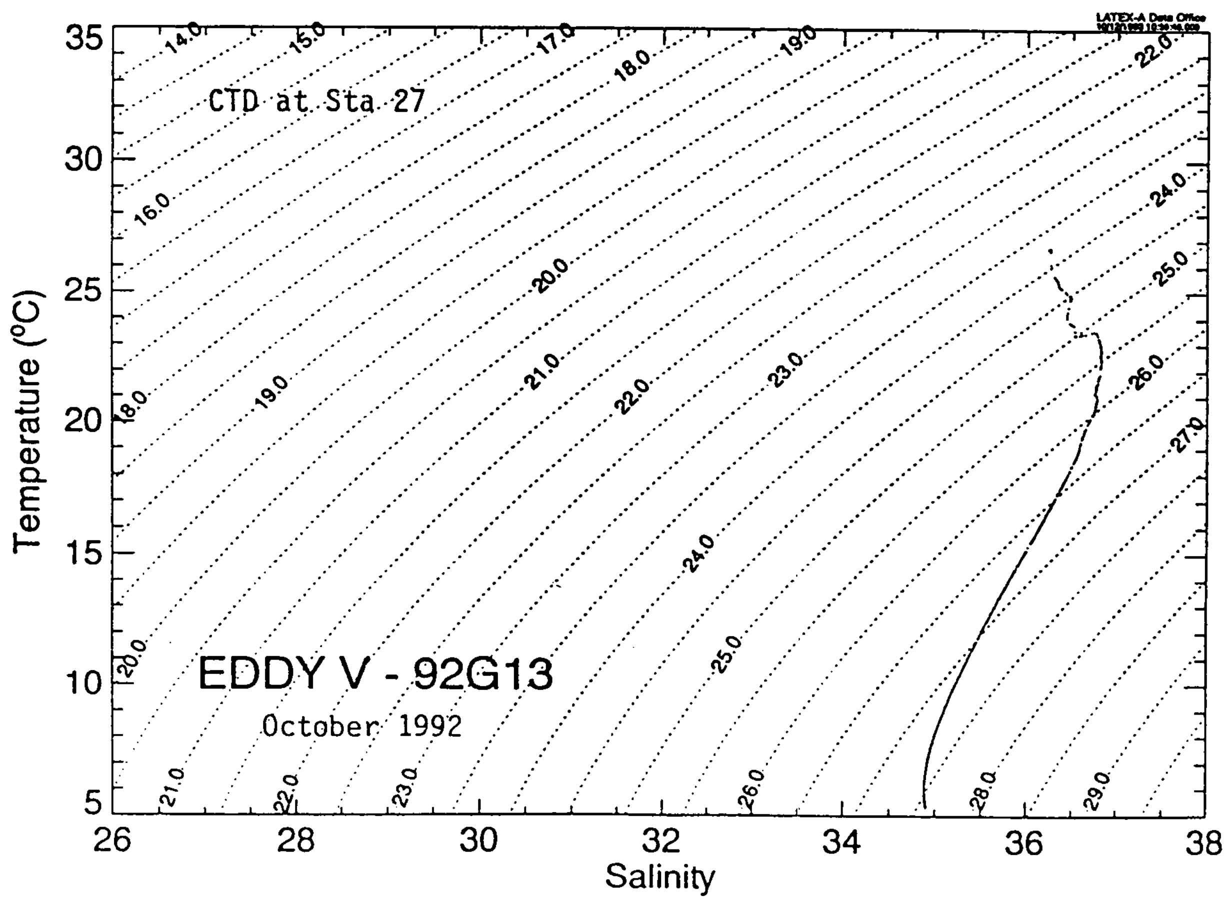

5 CTDs: Sta 11 (2)
Sta 13 (2)
Sta 15
EDDY Q - 90G15
October 1990
Temperature (°C)
Salinity
LATEX-A Data Office

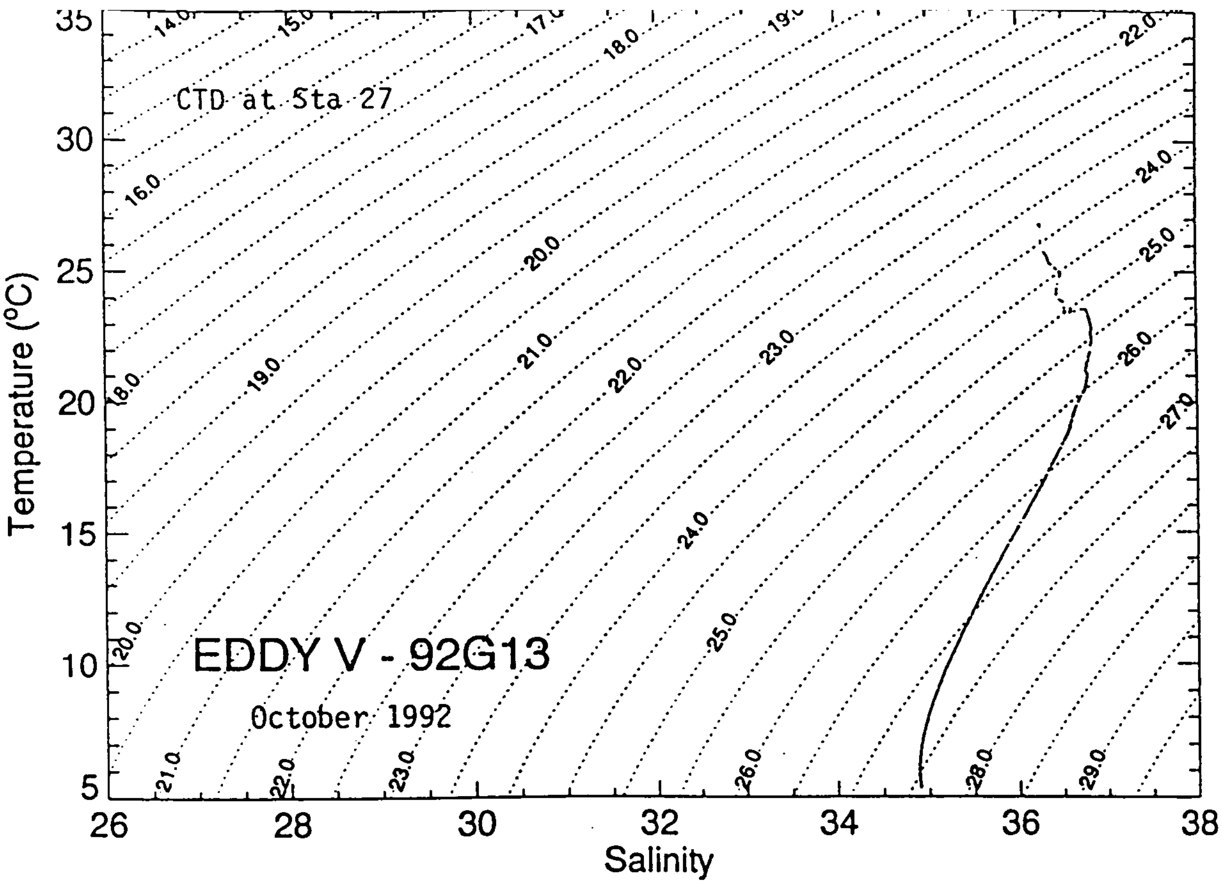

6 CTDs: Sta 18, 20, 22,
24, 26, & 28
EDDY Q - 91G02
March 1991
Temperature (°C)
Salinity
LATEX-A Data Office

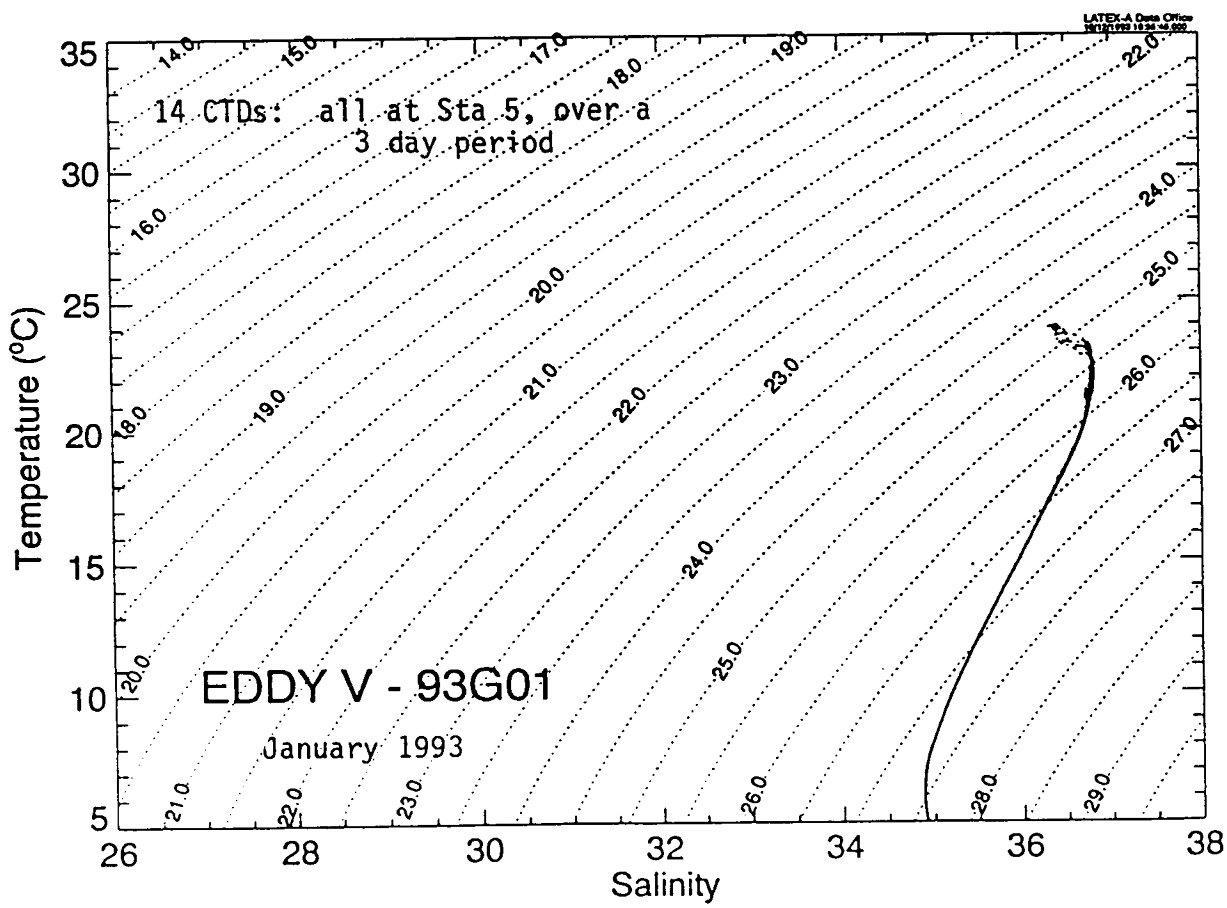

3 CTDs: Sta 6, 8 & 10
EDDY T - 92G02
January 1992
Temperature (°C)
Salinity
35
30
25
20
15
10
5
26
28
30
32
34
36
38


LATEX-A Data Office
9 CTDs: all at Sta 5, over a
3 day period
EDDY T - 92G07
June 1992
Temperature (°C)
Salinity
35
30
25
20
15
10
5
26
28
30
32
34
36
38


LATEX-A Data Office
3 CTDs: Sta 12, 15, 18
EDDY U - 92G13
October 1992
Temperature (°C)
Salinity


LATEX-A Data Office
CTD at Sta 27
EDDY V - 92G13
October 1992
Temperature (°C)
Salinity


CTD at Sta 27
EDDY V - 92G13
October 1992
Temperature (°C)
Salinity
5
10
15
20
25
30
35
26
28
30
32
34
36
38


LATEX-A Data Office
14 CTDs: all at Sta 5, over a
3 day period
EDDY V - 93G01
January 1993
Temperature (°C)
Salinity
5
10
15
20
25
30
35
26
28
30
32
34
36
38

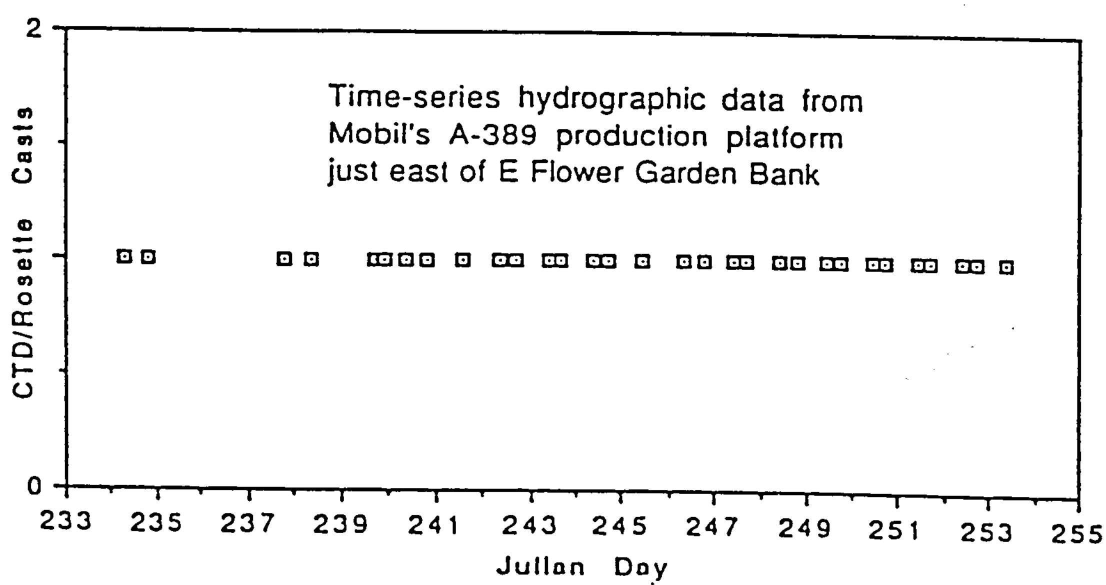
Section 3

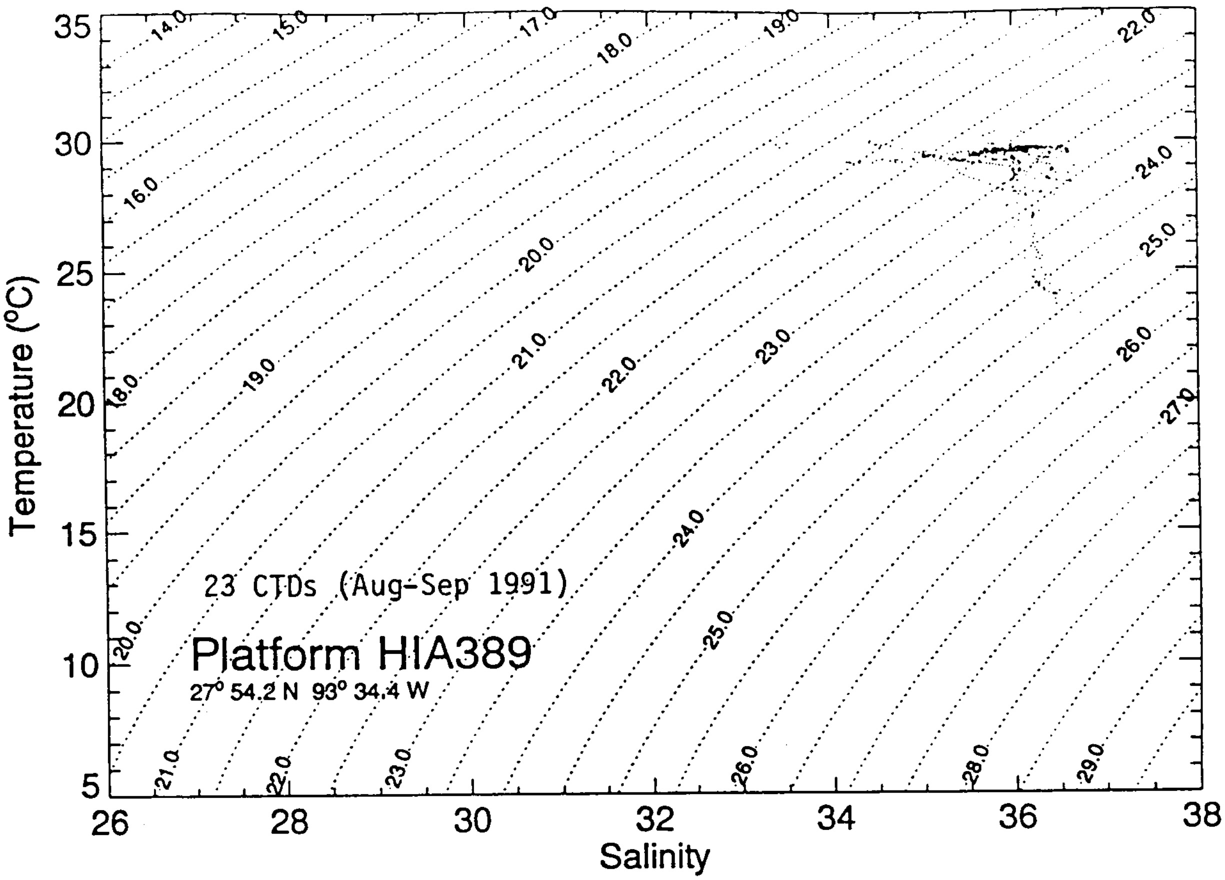
HYDROGRAPHIC DATA FROM AN OFFSHORE PRODUCTION PLATFORM AT THE EAST FLOWER GARDEN BANK

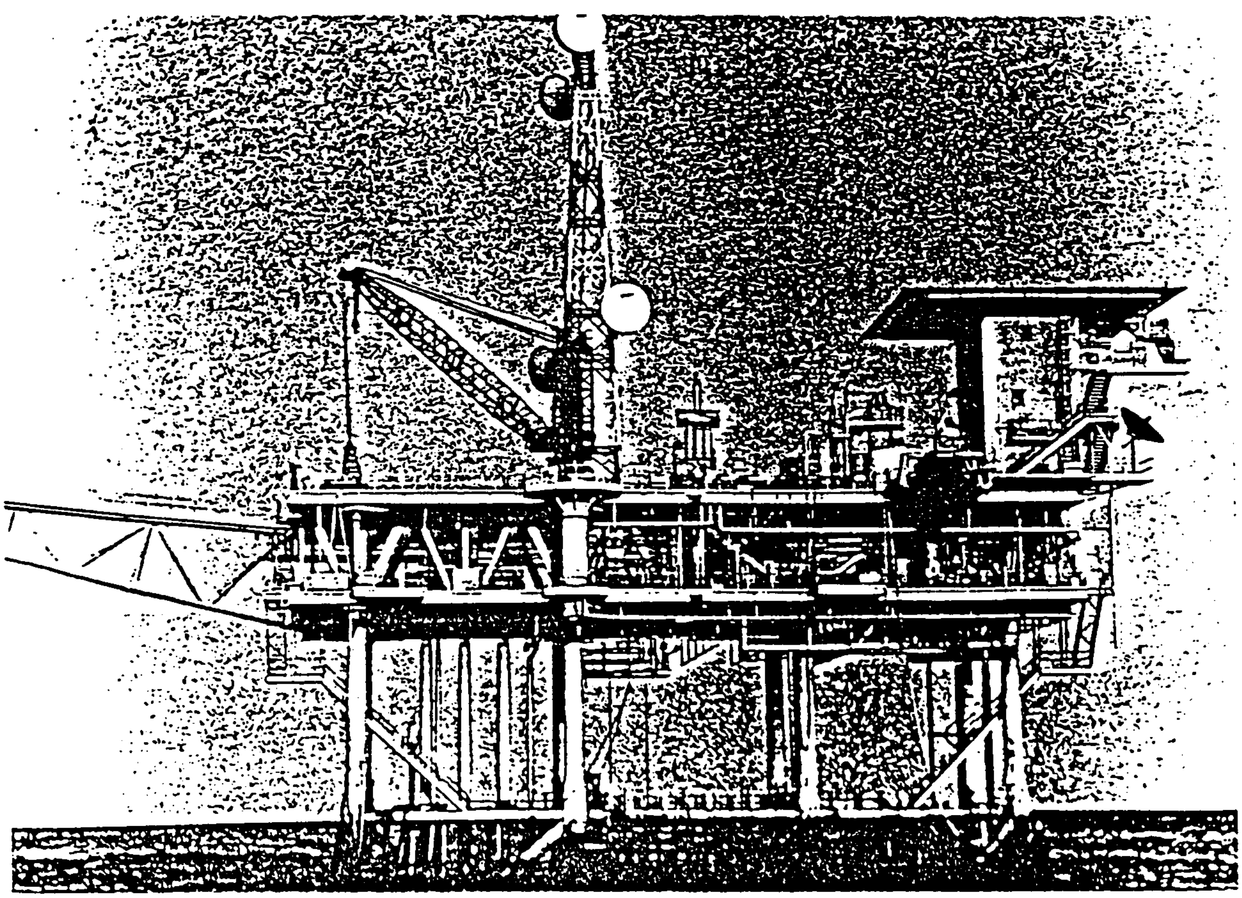
During summer 1991, TAMU personnel carried out 3 weeks of CTD-rosette hydrocasts from a gas production platform that is located in lease block High Island Addition 389. This platform, operated by Mobil Exploration and Production US (MEPUS), is located at 27° 54.2' N and 93° 34.4' W, in a water depth of 135 m about one mile to the east of the East Flower Garden Bank.

From 19 August to 10 September 1991, TAMU technicians were on platform to demonstrate the feasibility of using it as a base to carry out hydrographic monitoring work with a CTD + 6 bottle rosette-multisampler instrument package.

This work afforded a better basic-science understanding of late summer hydrographic conditions near the shelf-slope break in the NW Gulf of Mexico, and in particular of the amount of day-to-day variability in the hydrographic regime of the upper ocean at this outer shelf site. The hydrographic measurements were also coordinated with the applied-science monitoring of the coral reef communities at the Flower Gardens that is being coordinated by Dr. Steve Gittings, who directs the NOAA's national marine sanctuary program there.







Gas Production Platform HI-A389 (Texas Sea Grant Program photo)

Section 4

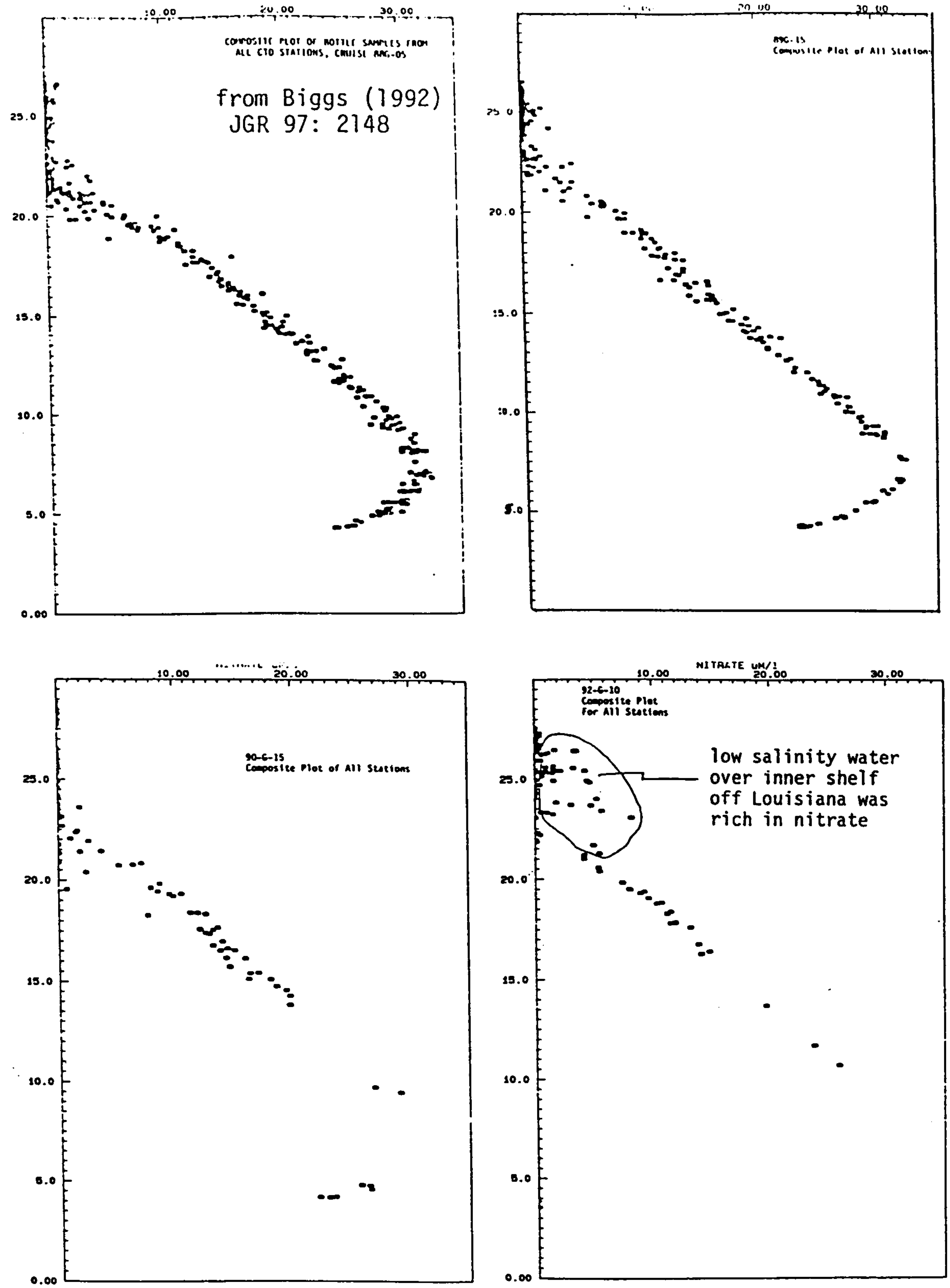
BOTTLE SAMPLING

At most CTD stations, Niskin bottles mounted on a 12-place or 24-place rosette multisampler were tripped on the upcast for at sea analyses of bottle salinity, nutrients, dissolved oxygen, and for chlorophyll + acid degradation products.

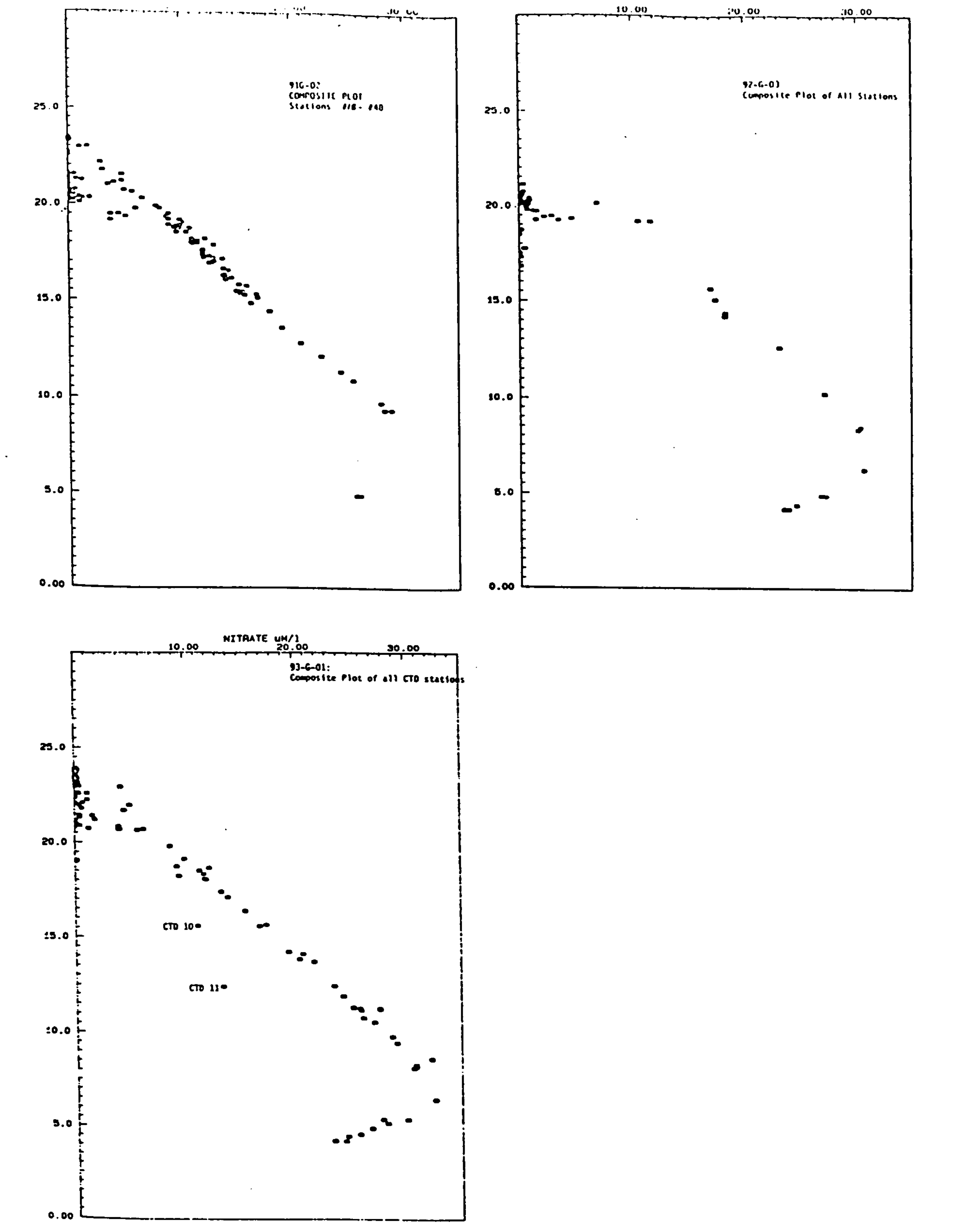
Chlorophyll vs phaeopigment composition was estimated by the "Turner" fluorometric method, following the protocols of Parsons et al. (1985).

Dissolved oxygen was determined by modified Carpenter titration, carried out manually using a Manostat ultramicropipetter. Salinity was analyzed with Guildline Autosal model 8400 conductive salinometer, and a 6-channel Technicon AA-II autoanalyzer was used to determine: 1) nitrite, 2) nitrate, 3) ammonium, 4) urea, 5) phosophate, and 6) silicate.

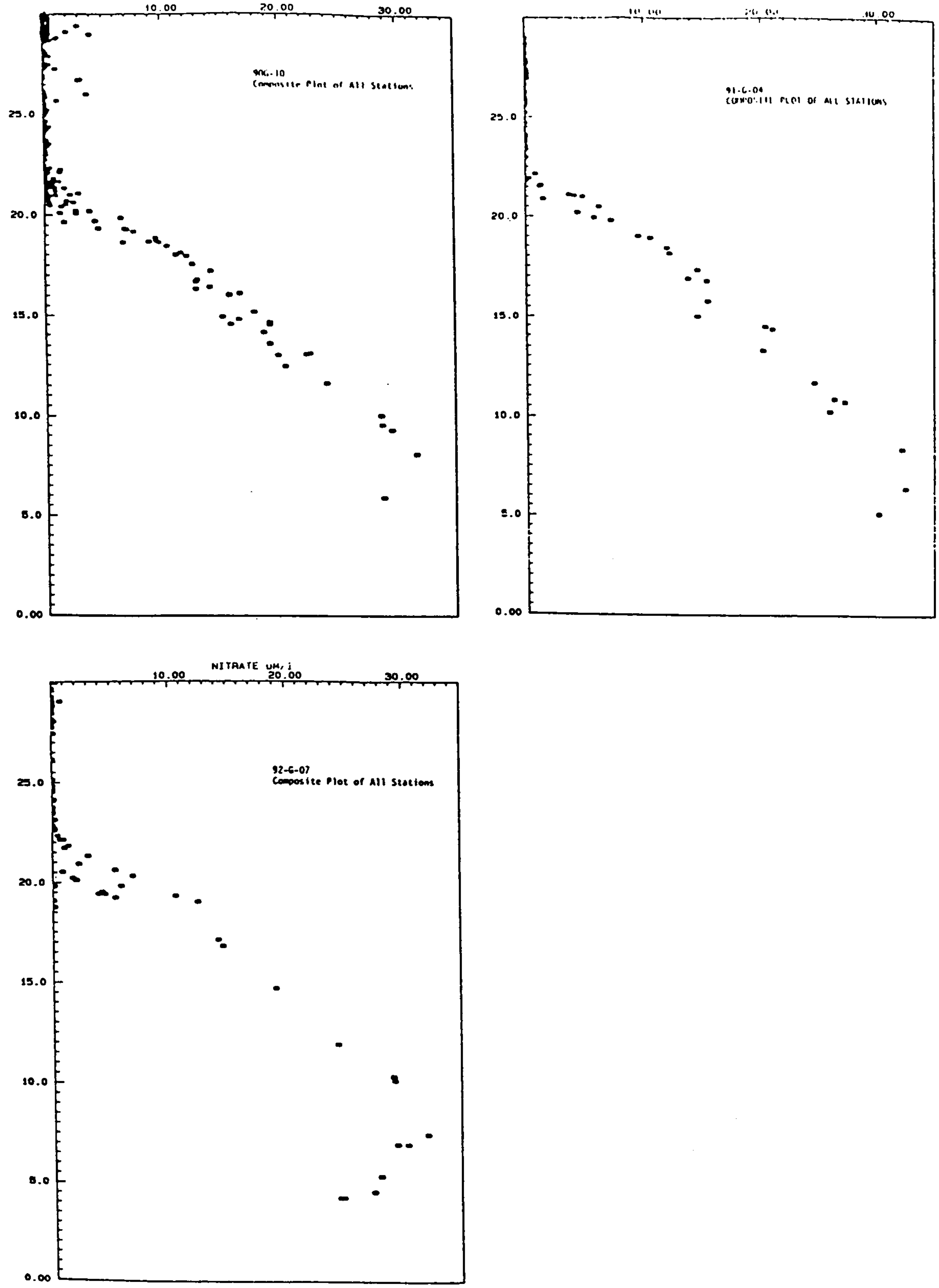
Property-property plots of deep chemical measurements are in excellent agreement with those reported by *Morrison et al.* (JGR 88: 2601-2608, 1983) as characteristic of gulf water, tropical Atlantic central water, Antarctic intermediate water, and Caribbean midwater. Our data, like that of *Morrison et al.*, demonstrate that property distributions are closely related to the mesoscale eddy regime.



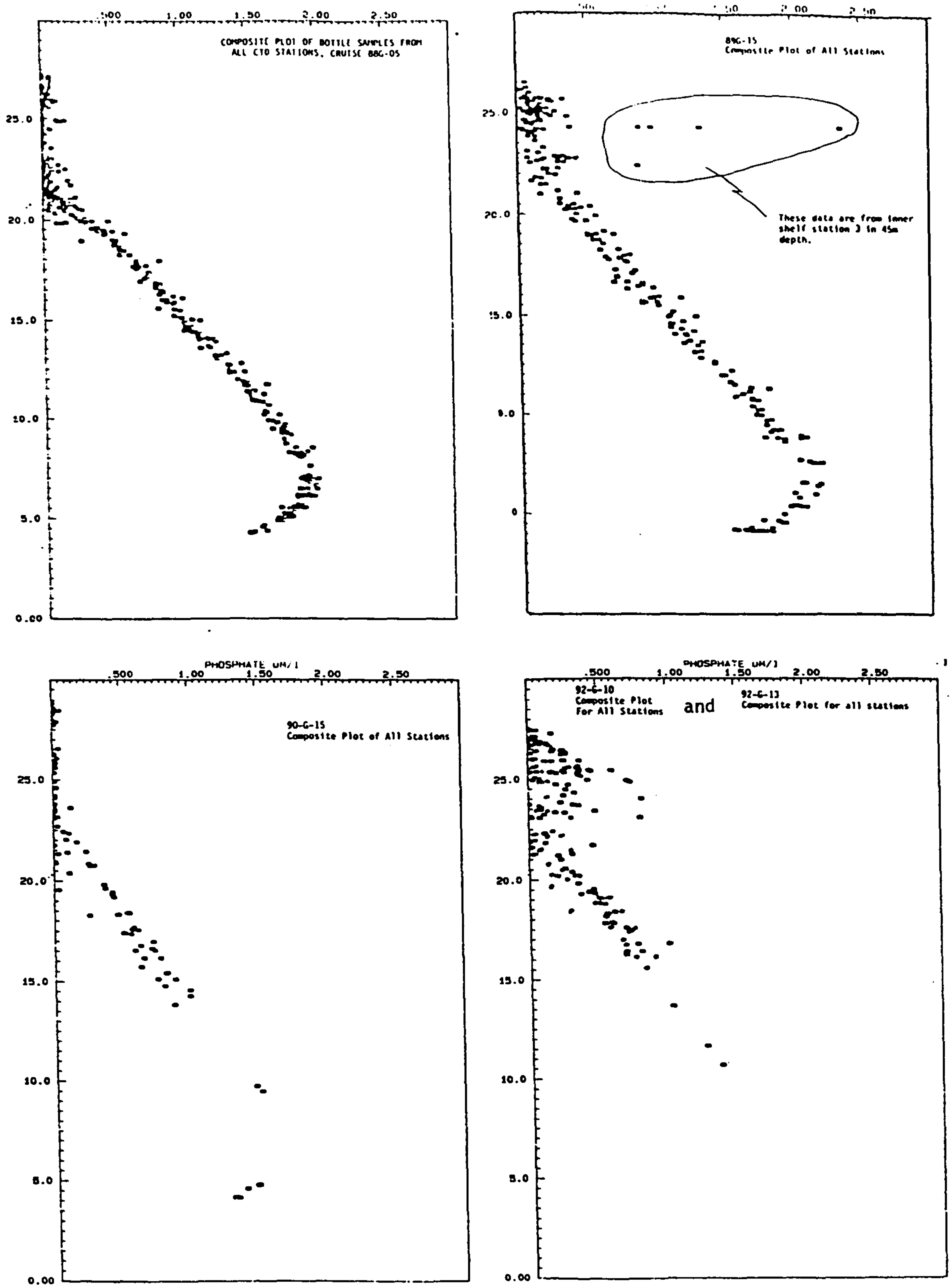
NITRATE: AUTUMN



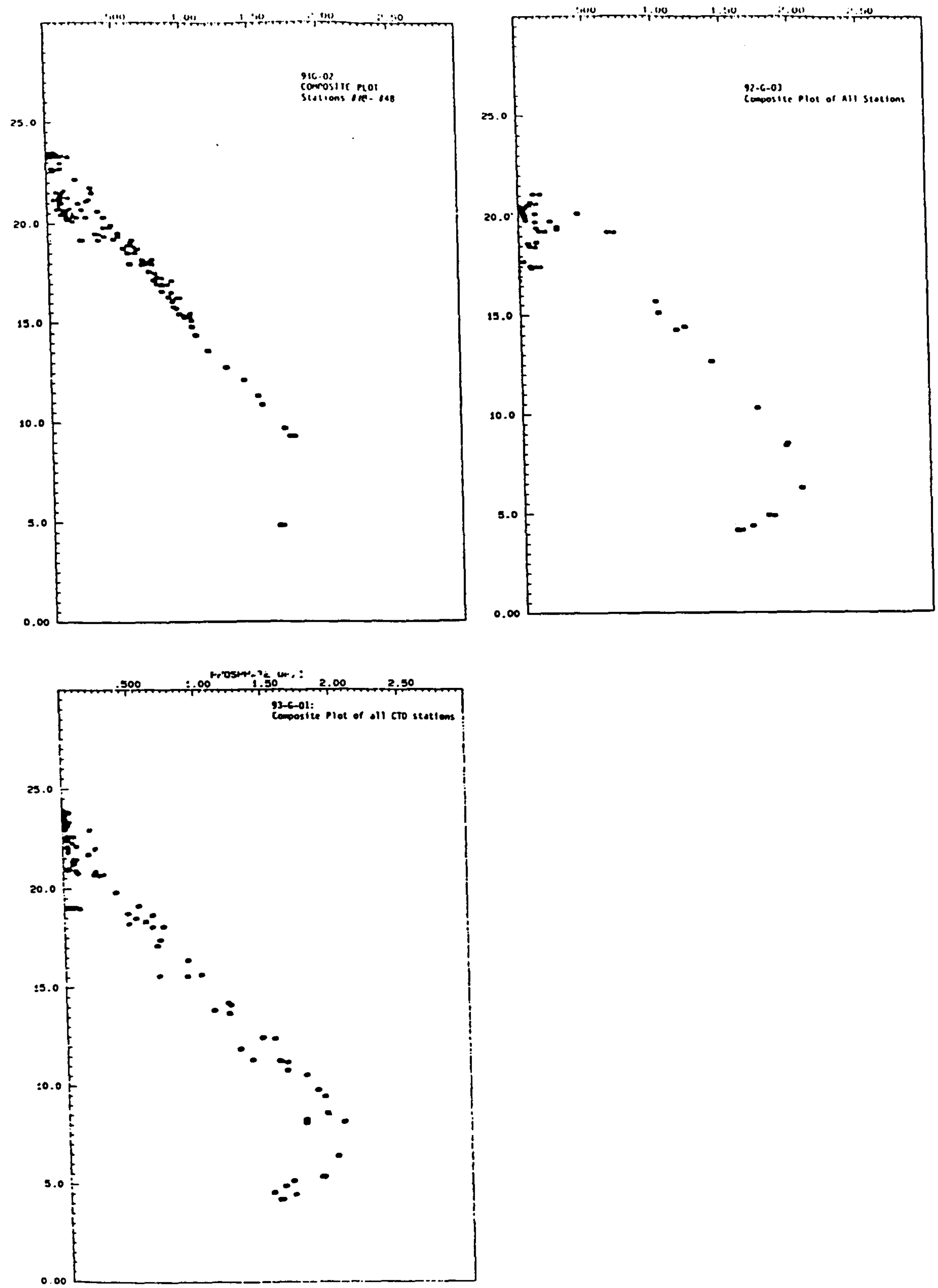
NITRATE: WINTER-SPRING



NITRATE: SUMMER



PHOSPHATE: AUTUMN



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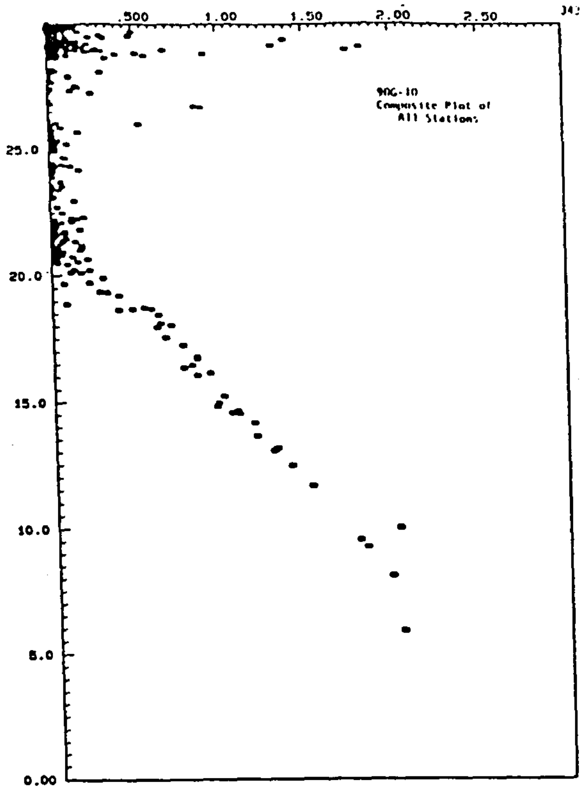
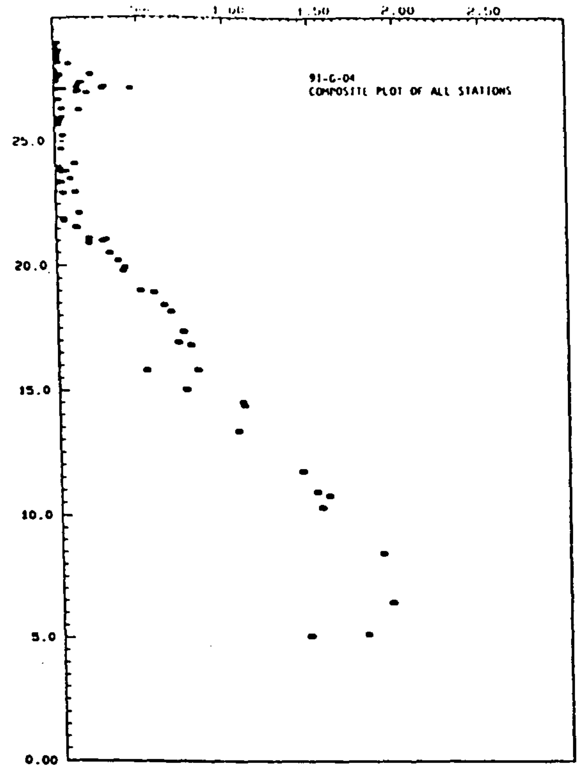
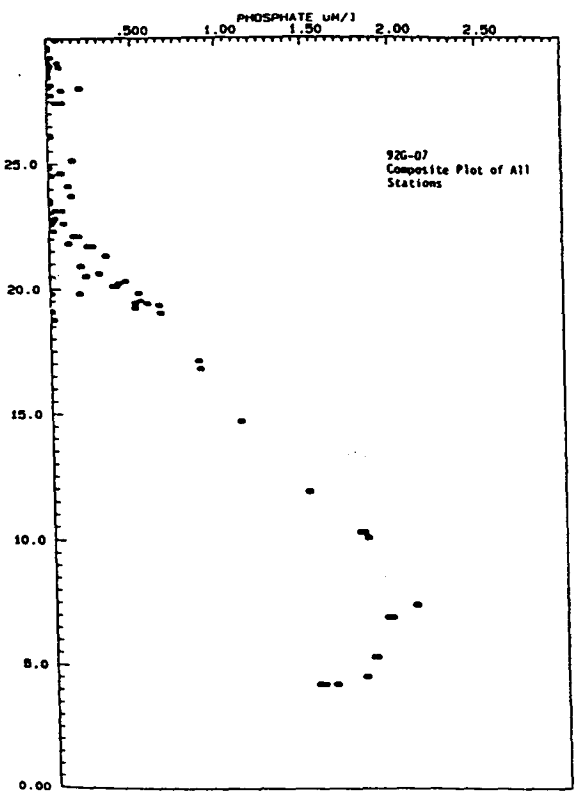
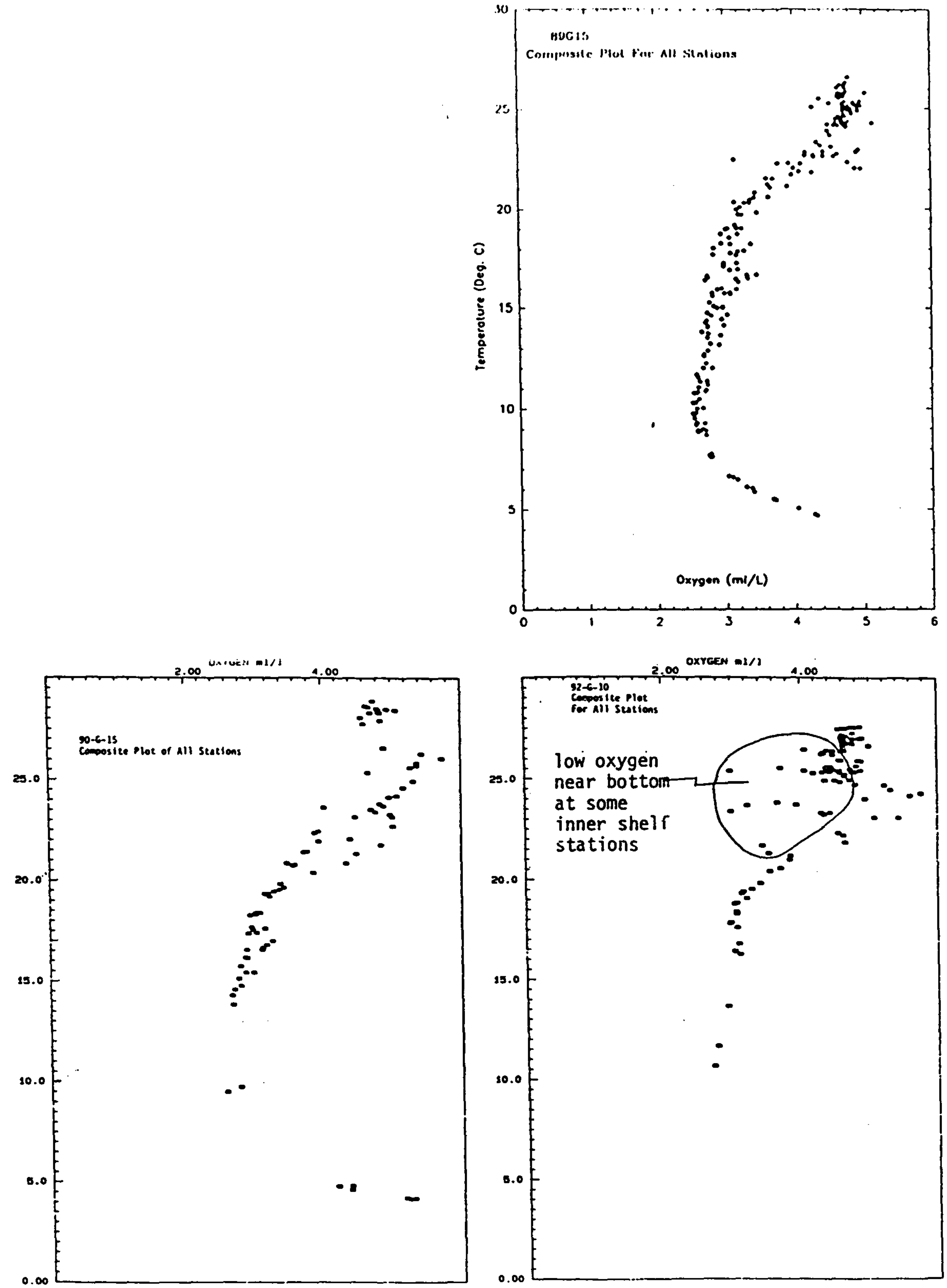


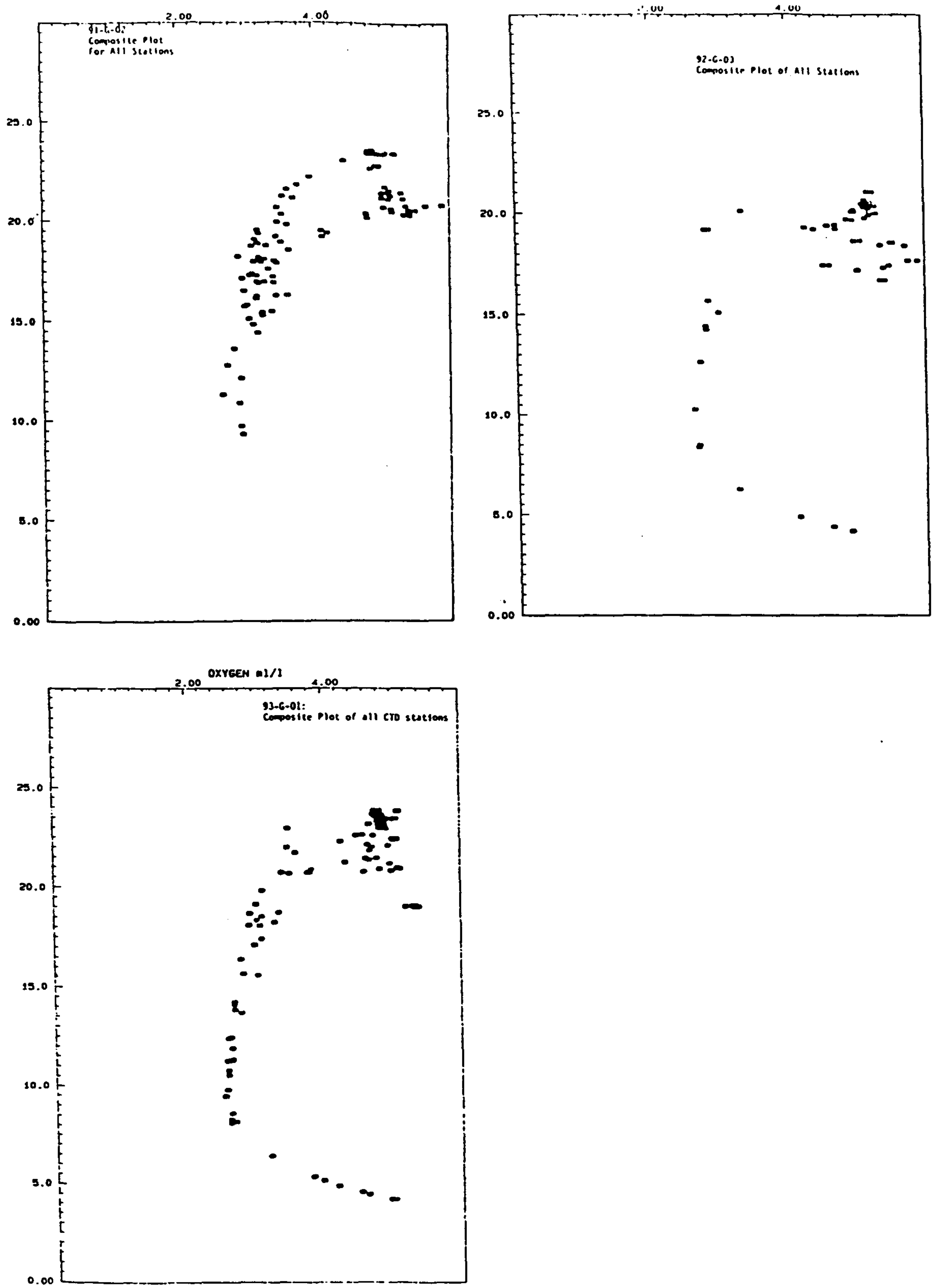




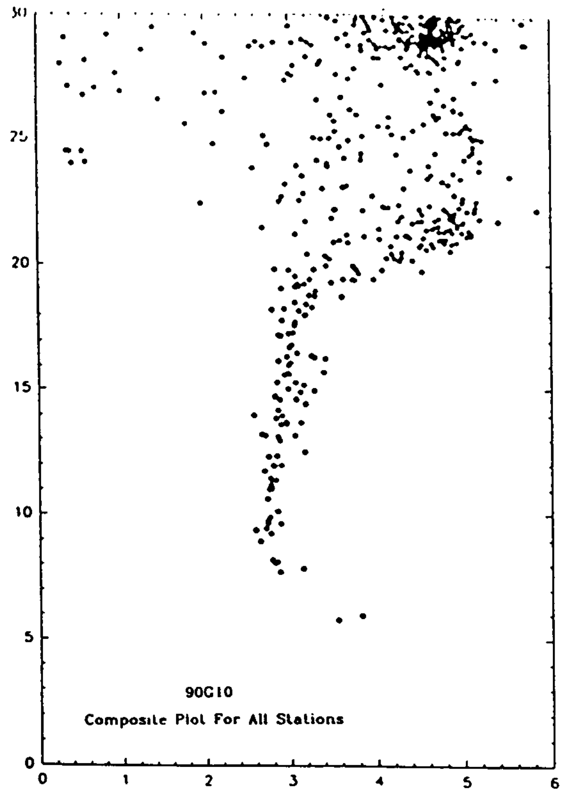
PHOSPHATE: SUMMER

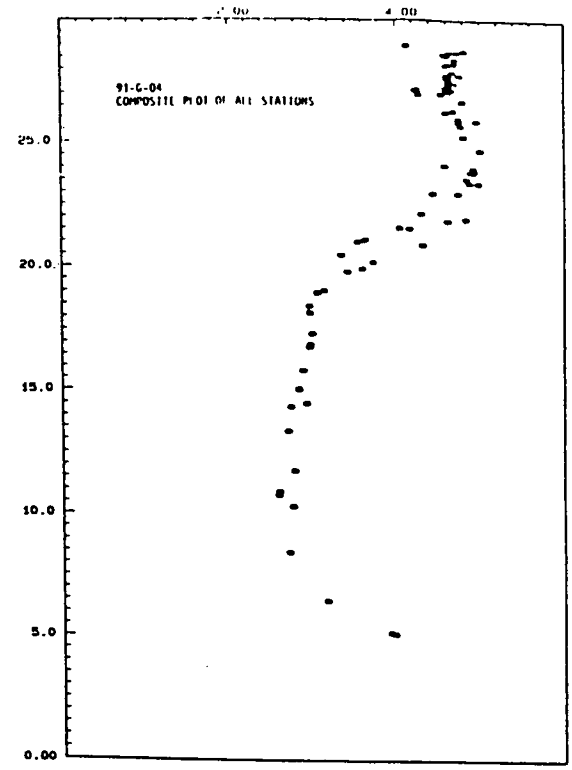


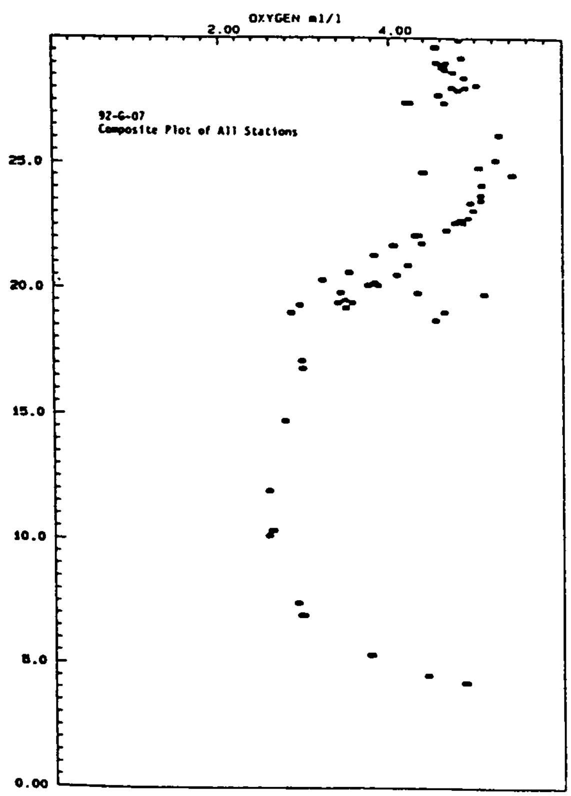
OXYGEN: AUTUMN



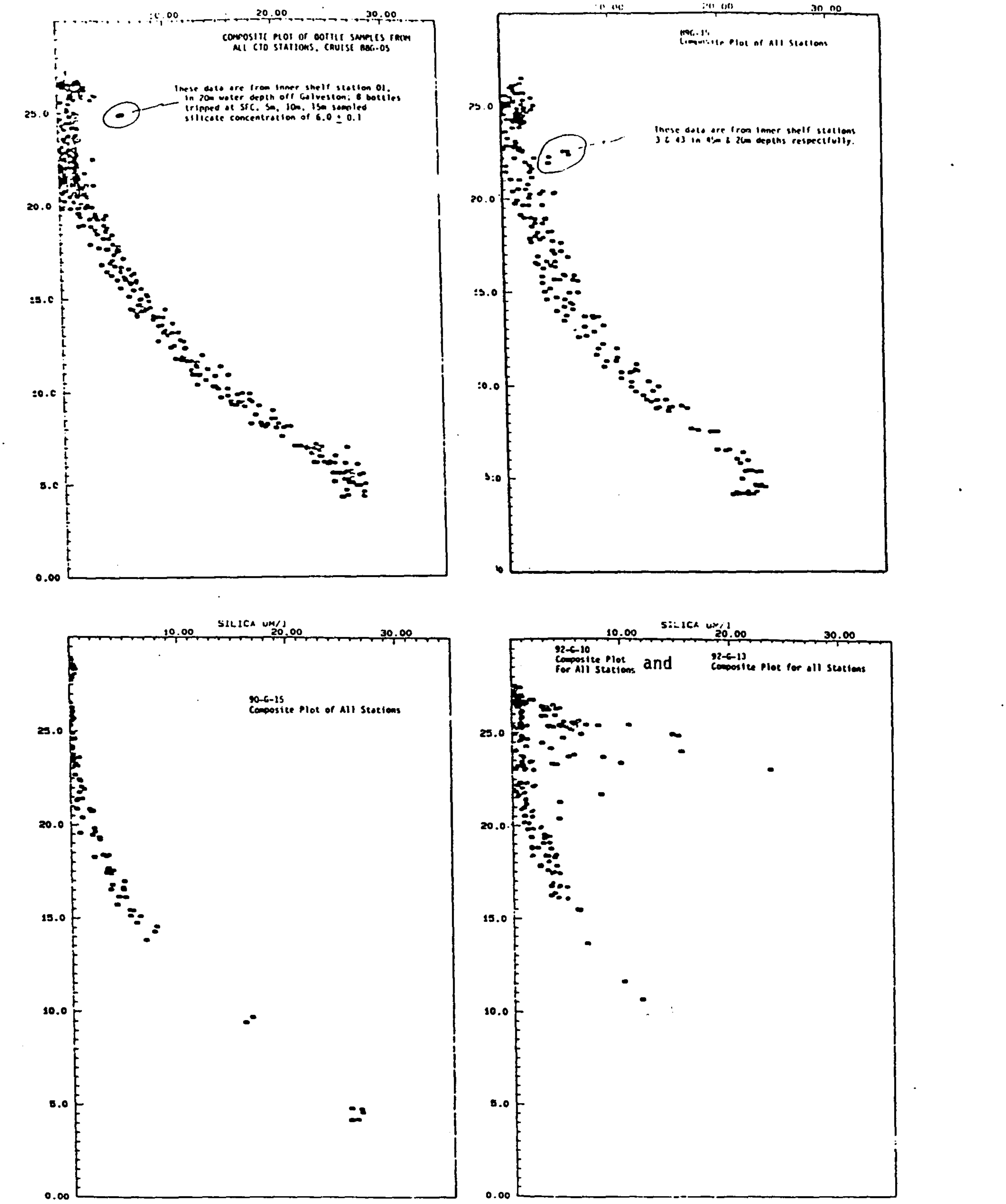
OXYGEN: WINTER-SPRING



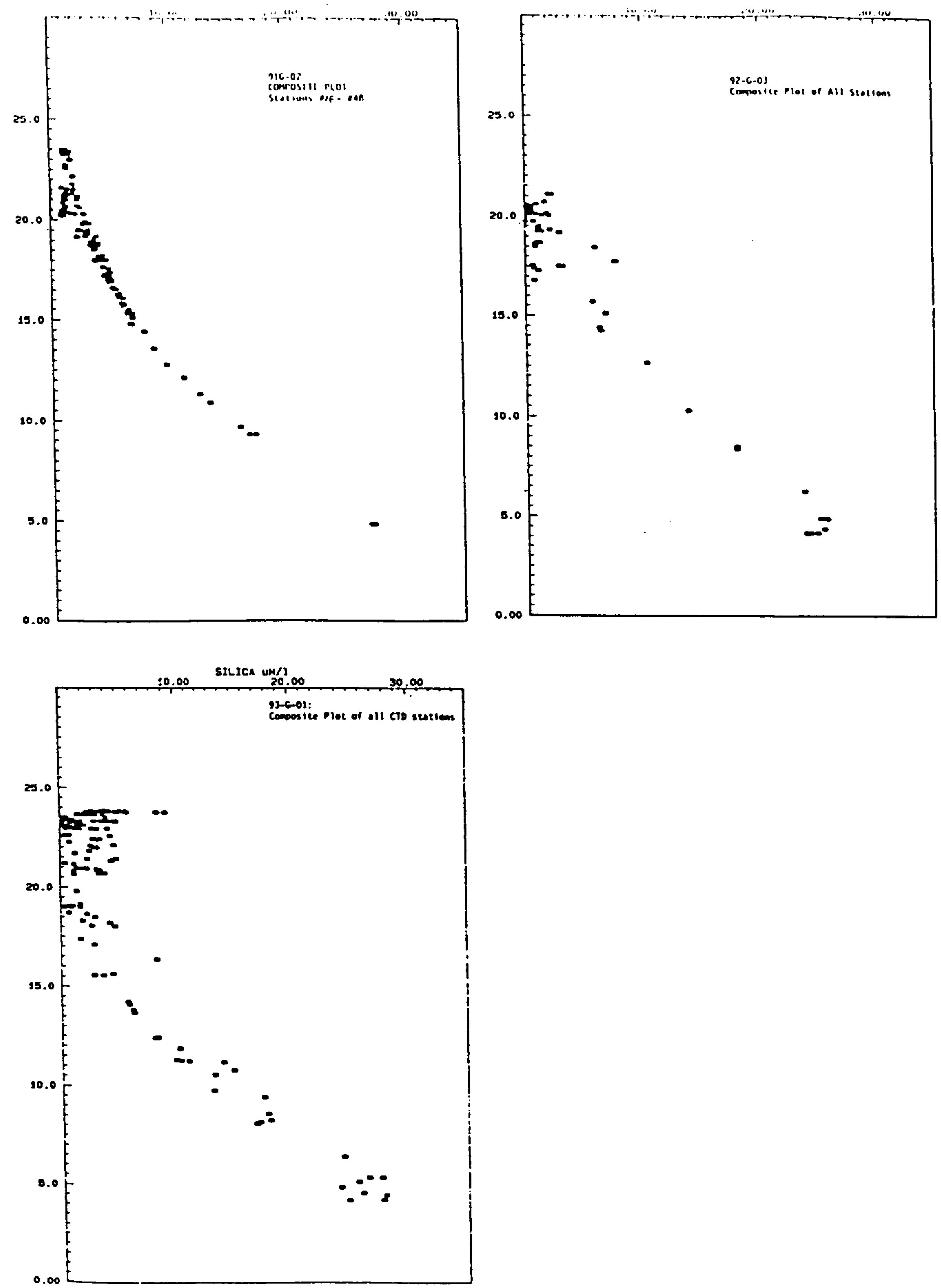




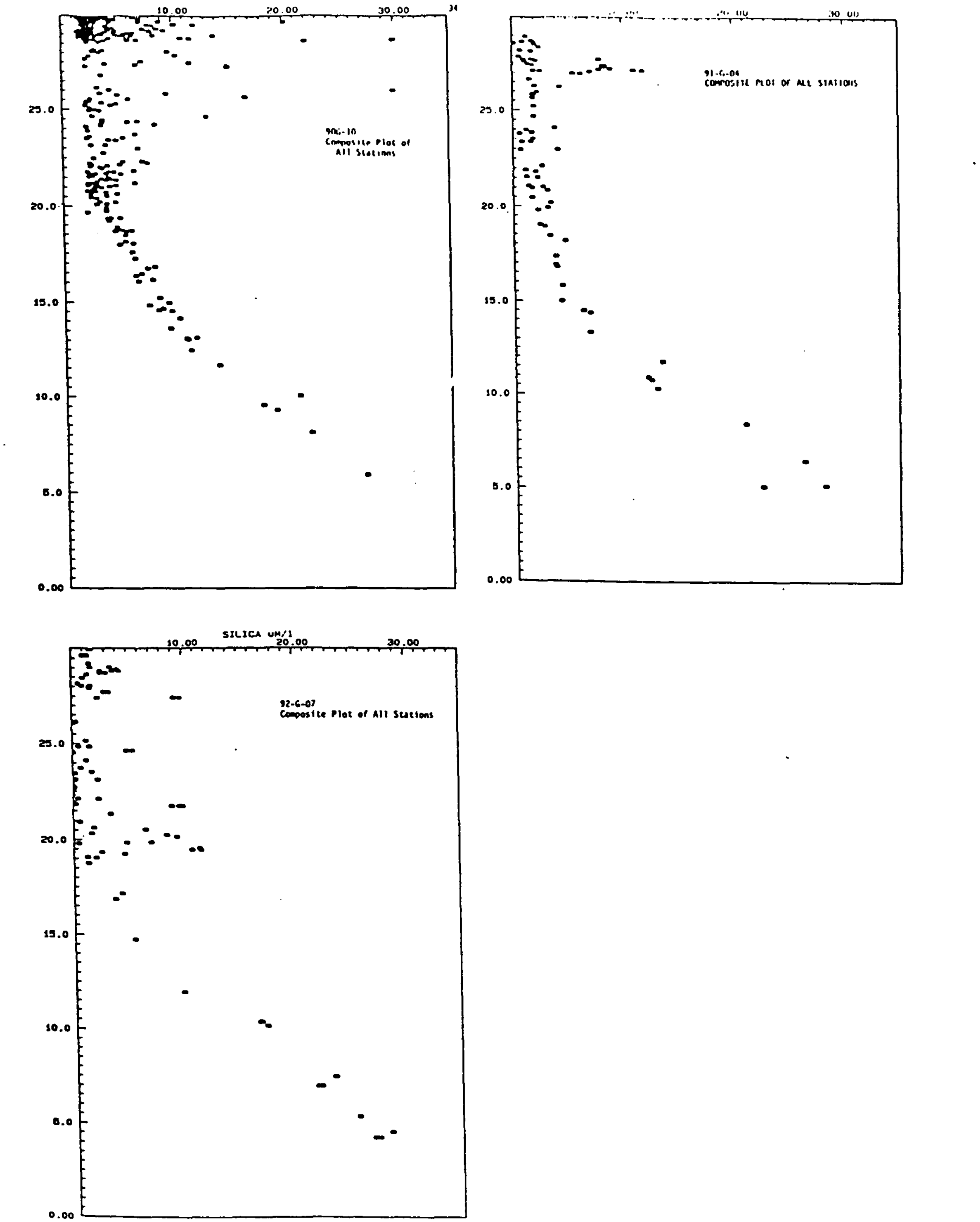
OXYGEN: SUMMER



SILICATE: AUTUMN



SILICATE: WINTER-SPRING



SILICATE: SUMMER

Section 5

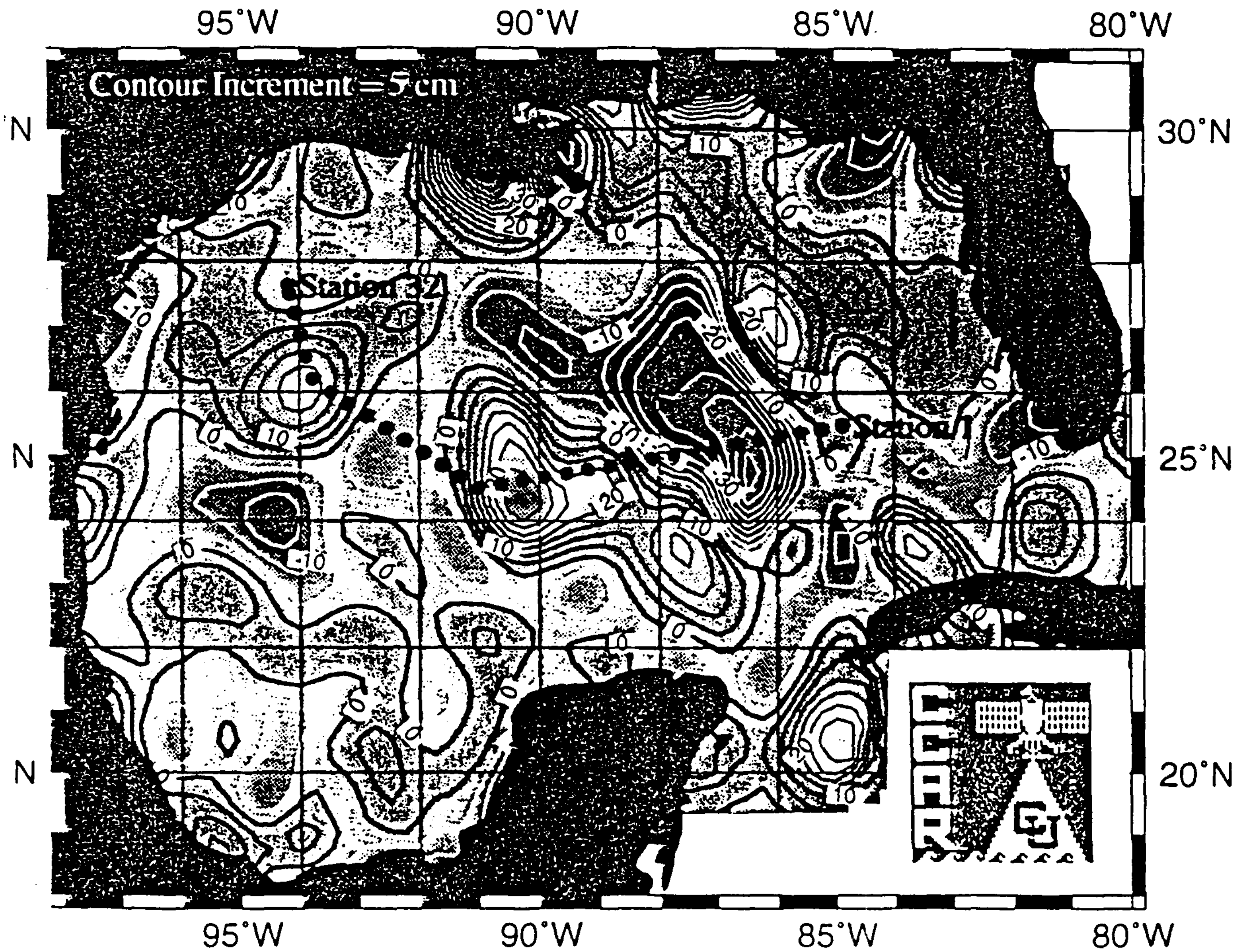
"SEA TRUTH" FOR REMOTE SENSING: SST AND SSH

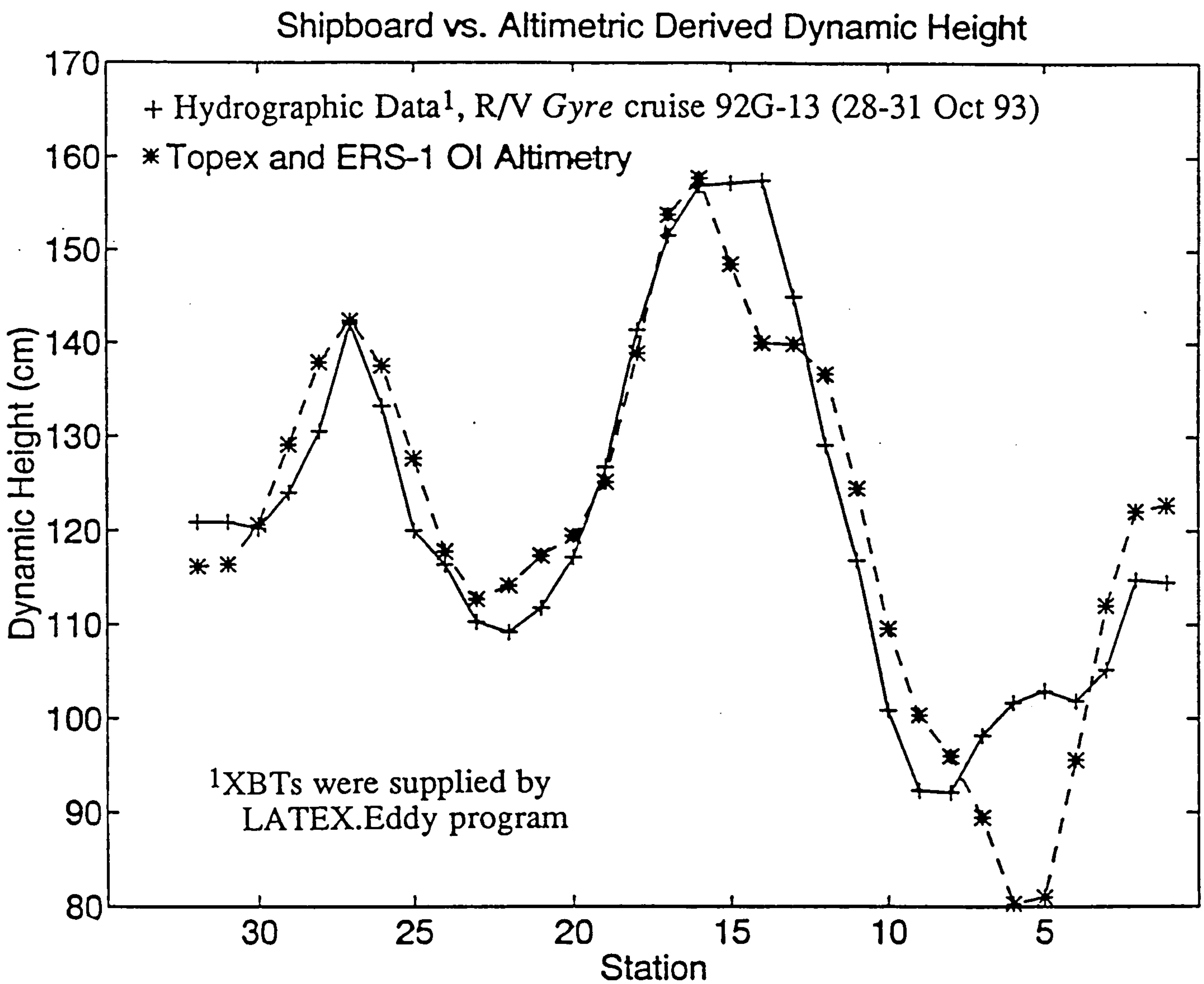
Through collaboration with a) Dr. Nan Walker and Dr. Larry Rouse of the Coastal Studies Institute of Louisiana State University, b) Dr. Melba Crawford of the Center for Space Research of the University of Texas, and c) Dr. Jeff Hawkins and Dr. Doug May of the Naval Oceanographic Laboratory at Stennis Space Center, SST fields that were determined from AVHRR data were used to optimize cruise tracks and station spacing for cruises of opportunity that were expected to pass close to, or through, warm- and cold-core eddies. Particularly on transits to/from Galveston to the Straits of Florida and Strait of Yucatan, we collaborated with LSU, UT, and NRL researchers to modify rhumbline courses so that these passed through recently shed Loop Current eddy(s). Accordingly, Quiet Eddy was transected on cruise 90G-15, and eddies Triton, Unchained, Vazquez, and Whopper were crossed on cruises 92G-02, 92G-13, 93G-07. Eight GIF files have been produced at LSU that show SOOP "rings" cruise stations overlain on gulfwide SST fields for 1) Nov 1989; 2) Oct 1990; 3) Mar 1991; 4) Jan 1992; 5) May 1992; 6) Oct 1992; 7) Mar 1993; 8) Jun 1993.

Through collaboration with Dr. Bob Leben and Dr. George Born of the Colorado Center for Astrodynamics Research and with Dr. Don Johnson of the Naval Oceanographic Laboratory, TAMU-SOOP geopotential anomaly calculations from CTD and XBT data were used to verify TOPEX-Poseidon and ERS-1 altimetry in the Gulf of Mexico. For SOOP cruises in Oct 1992 and Mar 1993, differences of the altimeter derived dynamic heights with respect to a corrected Rapp mean sea surface based on GEOS-3, Seasat, and GEOSAT altimeter data and dynamic heights determined from the hydrographic data show a rms difference of 2-4 cm. The method has been summarized in *TOPEX/Poseidon Research News* (1: 3-6; 1993) and detailed by Leben et al. for the Topex Verification special issue of *Journal of Geophysical Research* (in press for 1994).

Using the corrected Rapp mean, TOPEX IGDR data from the "quick look bulletin board" is currently being posted to the Gulf.Mex bulletin board to allow monitoring of the Gulf of Mexico in near real time.

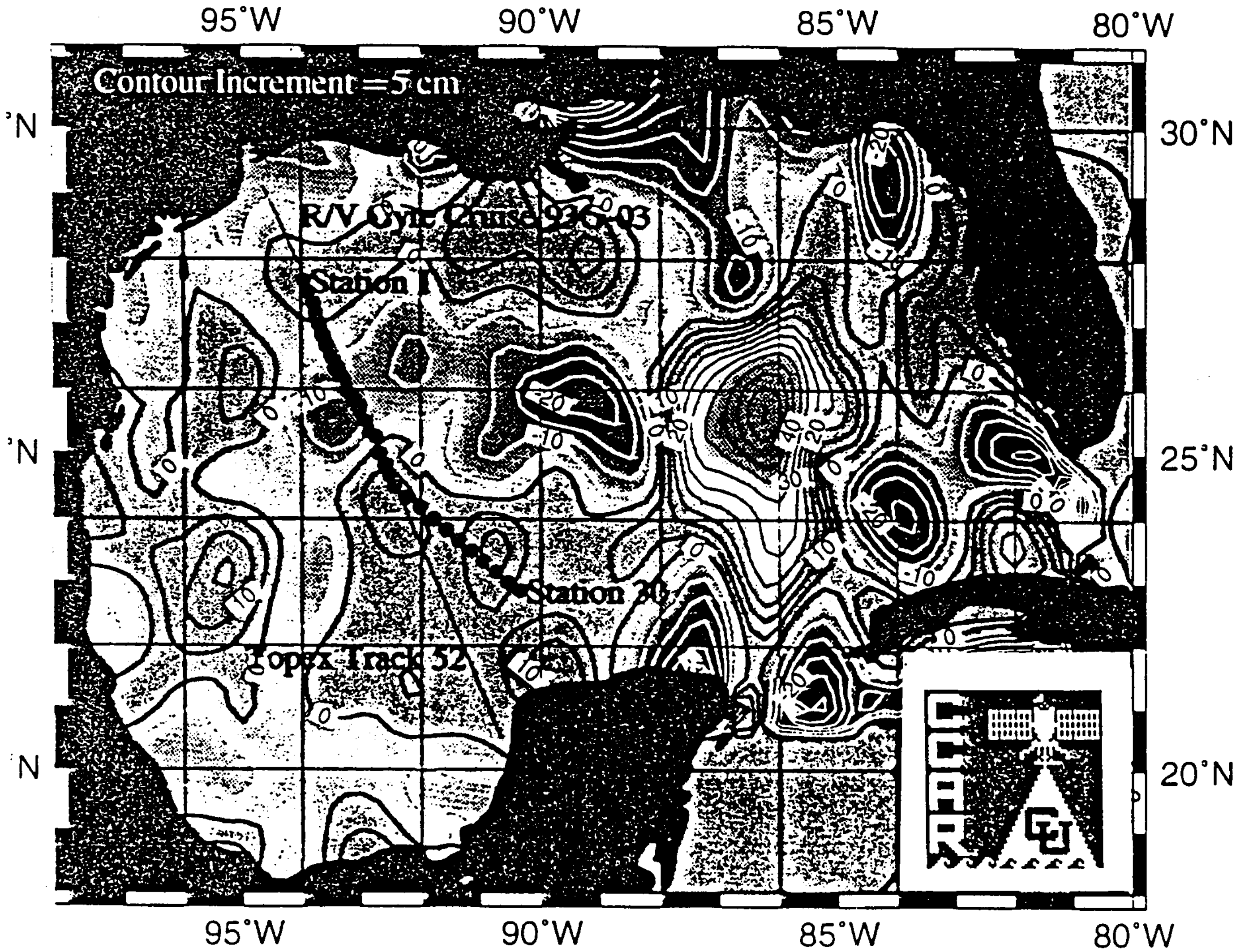
Gulf of Mexico Dynamic Height Anomaly
w.r.t Corrected Rapp Mean
TOPEX Cycle 4.5 to 5.5 - Oct 27 to Nov. 6, 1992
Including Coincident 35 days of ERS-1 Data

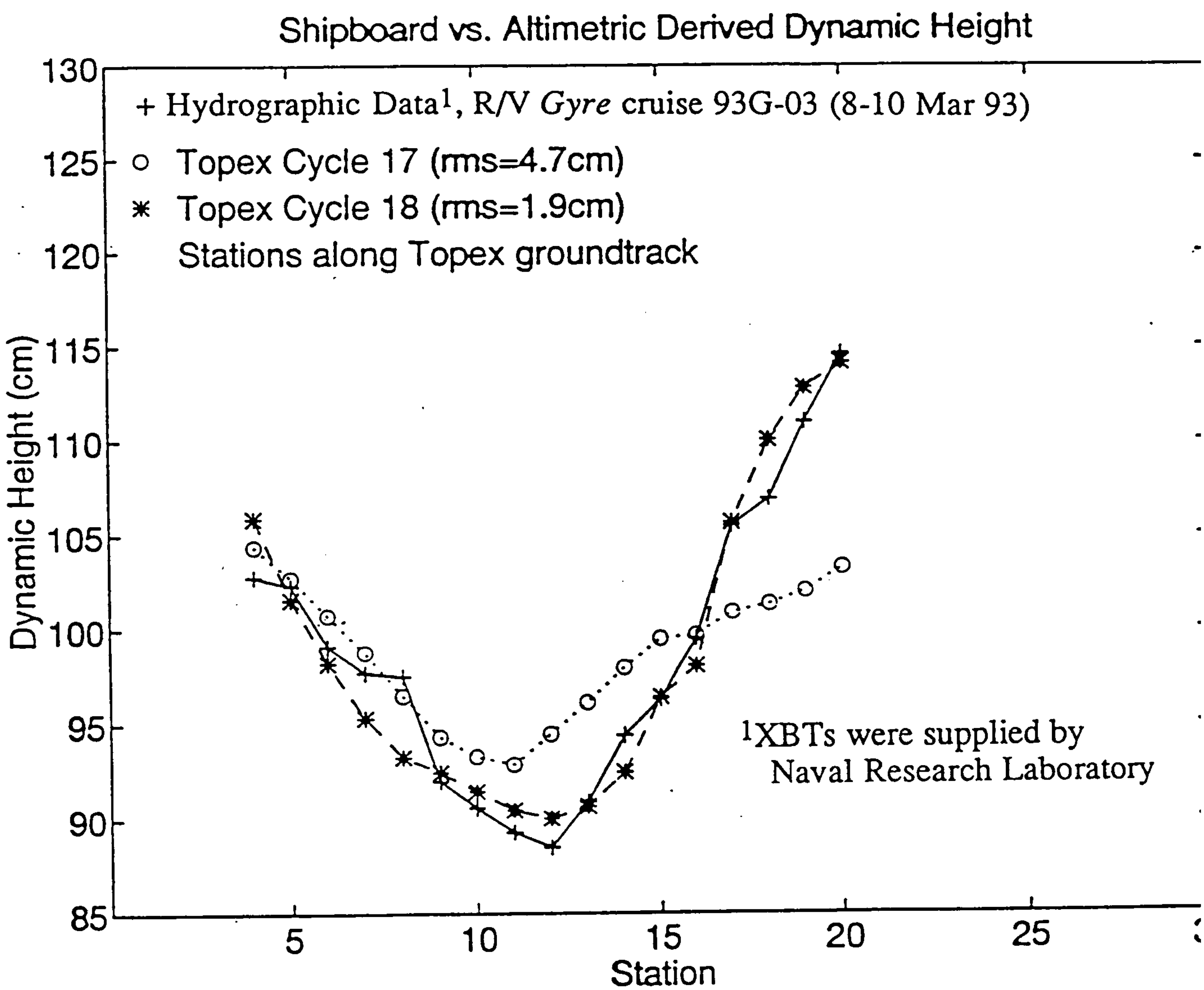



Shipboard vs. Altimetric Derived Dynamic Height
170
160
150
140
130
120
110
100
90
80
Dynamic Height (cm)
+ Hydrographic Data1, R/V Gyre cruise 92G-13 (28-31 Oct 93)
* Topex and ERS-1 OI Altimetry
1XBTs were supplied by LATEX.Eddy program
30
25
20
15
10
5
Station

Gulf of Mexico Dynamic Height Anomaly w.r.t Rapp Mean

TOPEX Cycle 17.5 to 18.5 - Mar. 5 to Mar. 15, 1993
Including ERS-1 35 Day Repeat
centered on midpoint of Topex Cycle




Shipboard vs. Altimetric Derived Dynamic Height
+ Hydrographic Data1, R/V Gyre cruise 93G-03 (8-10 Mar 93)
o Topex Cycle 17 (rms=4.7cm)
* Topex Cycle 18 (rms=1.9cm)
Stations along Topex groundtrack
1XBTs were supplied by Naval Research Laboratory
Dynamic Height (cm)
130
125
120
115
110
105
100
95
90
85
5
10
15
20
25
Station

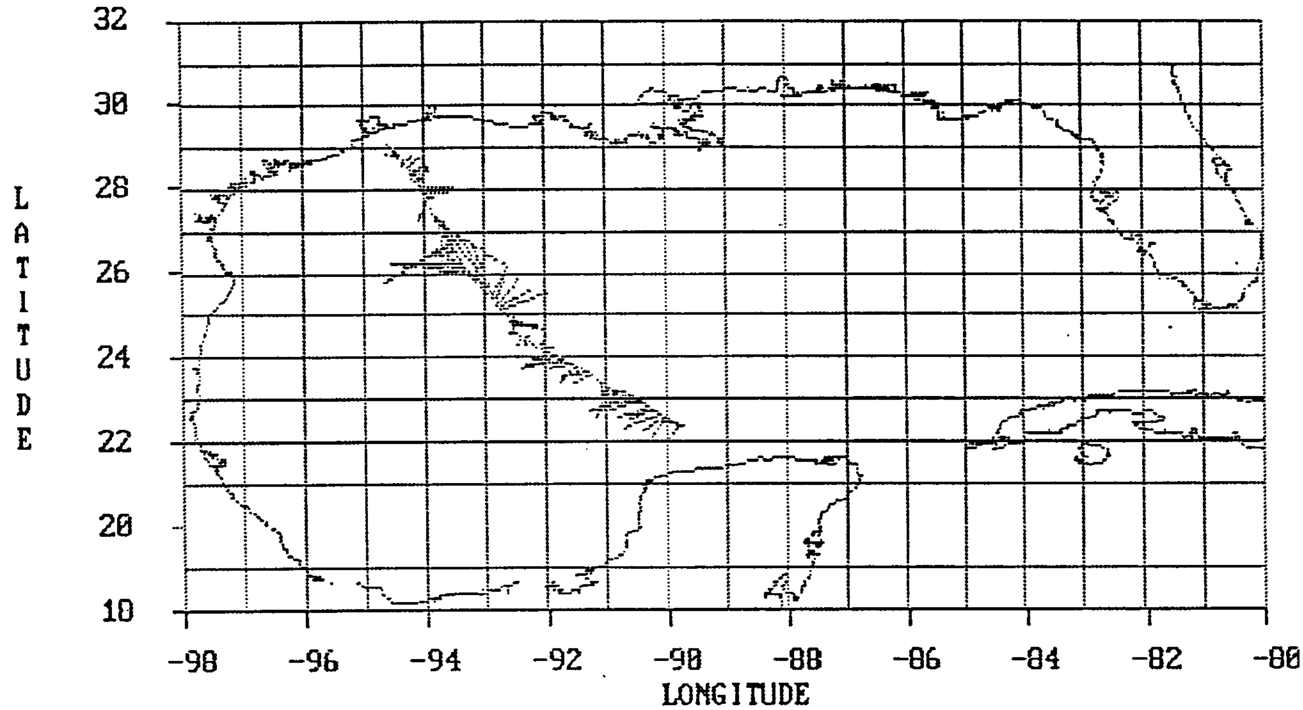
Section 6

ADCP DATA

On most of the TAMU-SOOP "rings" cruises, TAMU Technicians logged data with *Gyre*'s 150 kHz Acoustic Doppler Current Profiler (ADCP). Though such data logging/data sharing were not included in TAMU-MMS cooperative agreement for the collection of hydrographic data, we are working post-cruise to quality assure/control these ADCP data and to produce summary plots of along track near-surface currents (z = 12 m, at the center of the uppermost usable 4 m depth bin: 10-14 m). In the accompanying example, for which ADCP data were averaged in blocks of five 5-minute ensembles, the cyclonic nature of near-surface currents between 27°N and 25°N allows a summary visualization of a cold-core (cyclonic) circulation which was transected by R/V *Gyre* cruise 93G-03 in mid-March 1993 .

ADCP data are also being used to estimate along track standing stocks of zooplankton and nekton, by quantifying the intensity of the acoustic backscatter intensity. An MS thesis by Mr. Robert A. Zimmerman (TAMU Dept. Oceanography: August 1993) entitled "Bioacoustic Surveys of Planktonic Sound Scatters and of their Diel and Seasonal Variability in the Northwest Gulf of Mexico" gives details.

ADCP DATA R/V GYRE Cruise 93G03



1 degree lat = 50cm/s current

TAMU-SOOP DATA REPORTS

(D.C. Biggs, Technical Editor)

93-08-T: Ship-of-opportunity hydrographic data from R/V Gyre cruises 93G-09, 93G-10, and 93G-11 in August-September-October 1993. 87 pp. Issued 12 November 93.

93-05-T: Hydrographic data from a June 1993 transect-of-opportunity aboard R/V Gyre from Key West, Florida, to Galveston, Texas. 194 pp. Issued 6 August 93.

93-04-T: Ship-of-opportunity hydrographic data from R/V Gyre cruise 93G-03: Galveston, Texas, to Colon, Panama. 216 pp. Issued 10 May 93.

93-03-T: Hydrographic data from the continental shelf and slope of the NW Gulf of Mexico: R/V Gyre cruise 93G-01. 198 pp. Issued 29 Feb 93.

93-02-T: Ship-of-opportunity hydrographic transect of warm-core eddies 'U' and 'V': 28-31 October 1992, Texas Institutions Gulf Ecosystem Research (TIGER) cruise 92G-13. 335 pp. Issued 22 Jan 93.

93-01-T: Hydrographic data from the Louisiana-Texas continental shelf of the Gulf of Mexico: TIGER cruise 92G-10. 194 pp. Issued 15 Jan 93.

92-05-T: Hydrographic data from the continental shelf and slope of the NW Gulf of Mexico: R/V Gyre cruise 92G-07. 119 pp. Issued 11 Sep 92.

92-04-T: XBT data from the western Gulf of Mexico from R/V Gyre cruise 92G-06. 131 pp. Issued 7 Aug 92.

92-03-T: Hydrographic data from the Louisiana-Texas continental shelf of the Gulf of Mexico: TIGER cruise 92G-04 in cooperation with NOAA-NECOP. 53 pp. Issued 10 Jul 92.

92-02-T: Hydrographic data from the Texas continental shelf and the NW continental slope of the Gulf of Mexico: R/V Gyre cruise 92G-03. 91 pp. Issued 29 May 92.

92-01-T: Ship-of-opportunity hydrographic transect of warm-core Eddy Triton: 27-29 January 1992. 178 pp. Issued 29 May 92.

91-06-T: Hydrographic observations from a gas production platform: Mobil HIA-389. 61 pp. Issued 1 Apr 92.

91-05-T: Gulf of Mexico hydrographic data: CTD data and bottle data from R/V Gyre cruise 91G-04 and CTD data from R/V Powell cruise 91P-03. 88 pp. Issued 15 Oct 91.

91-02-T: Hydrographic data from the Texas continental shelf and the NW continental slope of the Gulf of Mexico: cruise 91G-02 of the Texas Institutions Gulf Ecosystem Research (TIGER) and the Analysis Multi-disciplinario de Investigaciones en Golfo Occidentale (AMIGO), a cooperative initiative between Texas A&M University and the Secretaria de Marina de Mexico. 329 pp. Issued 10 May 91.

91-01-T: Gulf of Mexico hydrographic data: XBT, CTD, and bottle data from R/V Gyre cruises 90G-14 and 90G-15. 143 pp. Issued 17 Jan 91.

90-04-T: Hydrographic data from the Texas and Louisiana continental shelf of the NW Gulf of Mexico: Texas Institutions Gulf Ecosystem Research (TIGER) cruise 90G-10. 353 pp. Issued 2 Nov 90.

90-01-T: Hydrographic data from the Texas continental shelf: Texas Institutions Gulf Ecosystem Research (TIGER) cruise 90G-04. 26 pp. Issued 19 Apr 90.

89-05-T: Hydrographic data from the Texas continental shelf and the NW continental slope of the Gulf of Mexico: Texas Institutions Gulf Ecosystem Research (TIGER) cruise 89G-15. 163 pp. Issued 19 Dec 89.

PRESENTATIONS at MMS INFORMATION TRANSFER MEETINGS:

DECEMBER 1989

Biggs, D.C.: The Texas Institutions Gulf Ecosystem Research Initiative: Multi-Year, Repeated Hydrographic Surveys in the NW Gulf of Mexico Continental Shelf and Slope. pp. 175-181 in *Proceedings, 10th Annual Gulf of Mexico Information Transfer Meeting.*

Schaudt, K.J., G.Z. Forristall, D.C. Biggs, and J.B. Bole: Nelson Eddy, 1989. pp. 182-183 in *Proceedings, 10th Annual Gulf of Mexico Information Transfer Meeting.*

NOVEMBER 1990

Biggs, D.C., M.M. Crawford, D. Salas de Leon, O. Salas Flores, and S. Escoto Hidalgo: A United States - Mexico Cooperative Study of a Cold-Core Ring in the Western Gulf of Mexico. pp. 374-380 in *Proceedings, 11th Annual Gulf of Mexico Information Transfer Meeting.*

Schaudt, K.J., J. Lamkin, G.Z. Forristall, C. Cooper, D.C. Biggs, W. Sturges, J.D. Hawkins, T.J. Berger, P. Hamilton, and J.W. Feeney: Quiet Eddy, 1990. pp. 355-356 in: *Proceedings, 11th Annual Gulf of Mexico Information Transfer Meeting.*

NOVEMBER 1991

Biggs, D.C.: A Cooperative Agreement for Ship-of-Opportunity Hydrographic Work in the NW Gulf of Mexico. pp 139-142 in *Proceedings, 12th Annual Gulf of Mexico Information Transfer Meeting.*

DECEMBER 1993

Biggs, D.C., and L.L. Lee III: Hydrographic Data from Texas A&M University Ship-of-Opportunity Program, 1989-1993.

Biggs, D.C., G.S. Fargion, R. Kozak, and P. Hamilton: Repeated Observations of an Anticyclonic Loop Current Eddy in 1992.

Hamilton, P., G.S. Fargion, and D.C. Biggs: Surveys of Eddies U, V and W with Expendable Probes and Drifters.

Fargion, G.S., P. Hamilton, and D.C. Biggs: Dynamic Topography of Eddies U, V and W in 1992-93 from Gulfcet, Aircraft, and Ship-of-Opportunity Surveys.

ACKNOWLEDGMENTS

CTD, XBT, and bottle data were collected by TAMU Electronics Technicians RV Pittman, Eddie Webb, and Mark Garner, and by Marine Techs Ken Bottom, Dennis Guffy, and Mark Spears. We gratefully acknowledge the assistance of former TAMU Techs David Murphy (now with SeaBird Elecronics Corp.), Mike Cooke (now with Dynacon), David Voegele, Glenn Casey, and Greg Warr, and of Woody Lee of the TAMU-LATEX Data Office.

Ship time for most of these SOOP cruises 1989-1993 was provided by Texas A&M University for graduate student training and research. However, data collection was piggy-backed as well on NSF-, Navy-, and DOE-sponsored cruises and during charters by GERG and SAIC.

APPENDIX

SET OF 40 SLIDES TO ACCOMPANY SYNOPSIS 1989-1993:

01) Title and Contract Information
02) Summary
03) SOOP CTD + XBT station locations Nov 1989 - Oct 1993
04) SOOP CTD + XBT station locations Dec-Jan-Feb (Winter) and Winter T/S composite
05) SOOP CTD + XBT station locations Mar-Apr-May (Spring) and Spring T/S composite
06) SOOP CTD + XBT station locations Jun-Jul-Aug (Summer) and Summer T/S composite
07) SOOP CTD + XBT station locations Sep-Oct-Nov (Autumn) and Autumn T/S composite
08) Hydrographic Data from Loop Current Eddies
09) T/S characteristics of Eddy Q: Oct 1990 v Mar 1991
10) T/S characteristics of Eddy T: Jan 1992 v Jun 1992
11) T/S characteristics of Eddies U and V: Oct 1992
12) T/S characteristics of Eddy V: Oct 1992 v Jan 1993
13) Hydrographic Data from an offshore production platform: MEPUS platform HIA-389
14) aerial photo (courtesy M. Kennicutt, GERG) of MEPUS platform HIA-389
15) Bottle Sampling
16) example of bottle sampling property-temperature plots (cruise 89G-15)
17) Remote Sensing: Sea Surface Temperature
18) SST for 10 Nov 1989 w station locations for cruise 89G-15
20) SST for 14 Oct 1990 w station locations for cruise 90G-15
21) SST for 7 Mar 1991 w station locations for cruise 91G-02
22) SST for 29 Feb 1992 w station locations for cruise 92G-02
23) SST for 24 May 1992 w station locations for cruise 92G-06
24) SST for 26 Oct 1992 w station locations for cruise 92G-13
25) SST for 9 Mar 1993 w station locations for cruise 93G-03
26) SST for 6 Jun 1993 w station locations for cruise 93G-07
27) Remote Sensing: Radar Altimetric Mapping of Sea Surface Height
28) Dynamic Height Anomaly for Oct-Nov 1992 w station locations for cruise 92G-13
29) Shipboard vs Altimetric Derived Dynamic Height for Oct-Nov 1992
30) Dynamic Height Anomaly for Mar 1993 w station locations for cruise 93G-03
31) Shipboard vs Altimetric Derived Dynamic Height for Mar 1993
32) ADCP Data
33) example of along track plot of ADCP data for cruise 93G-03
34) Presentations at MMS Information Transfer Meetings: Dec 1989
35) Presentations at MMS Information Transfer Meetings: Nov 1990 and Nov 1991
36) Presentations at MMS Information Transfer Meetings: Dec 1993
37) Hydrographic Data Reports: SOOP Year One
38) Hydrographic Data Reports: SOOP Year Two
39) Hydrographic Data Reports: SOOP Year Three
40) Hydrographic Data Reports: SOOP Year Four
40) Acknowledgments

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.