HYDROGRAPHIC SURVEY REPORT
Technical Report UNH-OPAL-1998-003

Convective Overturn Experiment (CONVEX) CRUISE # 4

ENDEAVOR (EN-306) (Between 01 and 05 October 1997)

F.L. Bub, W.S. Brown, and P. Mupparapu

Ocean Process Analysis Laboratory (OPAL)

Institute for the Study of Earth, Ocean and Space
Department of Earth Sciences
University of New Hampshire
Durham, NH 03824

Research Sponsored by the National Science Foundation

This report is maintained as the web page
http://ekman.sr.unh.edu/OPAL/CONVEX/EN306/en306_report.html
(Filed 13 February 1998, Last update 01 July 1999)

no longer on-line

Report Contents.

Tables.

Figures.

Abstract.

This report describes the hydrographic measurements obtained 01 - 05 October 1997 as part of the NSF-supported "Observational / Modeling Study of Wintertime Convection and Water Mass Formation" in the western Gulf of Maine (GOM). Herein we document the fourth of seven planned University of New Hampshire (UNH) cruises aboard the R/Vs ENDEAVOR and OCEANUS as part of this "Convective Overturn Experiment" (CONVEX). This report and these data can be accessed through the RMRP Research Environmental Data and Information Management System (REDIMS) via the WWW address:

http://ekman.sr.unh.edu/OPAL/CONVEX/

---

1. Introduction.

Click here to read an introduction to the CONVEX program.

2. Cruise Narrative.

The R/V Endeavor departed the University of Rhode Island Graduate School of Oceanography pier, Narragansett, RI at 0940L (1340Z) on 1 October 1997. After passing through the Cape Cod Canal, she headed for the first CTD station (Figure 1.a) off Cape Anne at 2030L (0030Z). The Endeavor SeaBird SBE-911+ instrument package measured pressure, temperature, conductivity, dissolved oxygen, fluorescense, PAR and light transmission.

After the first hydrographic leg, the ship was diverted to Portsmouth, NH for transfer of sick personnel ashore via a U. S. Coast Guard boat. The CTD survey was then continued to the mooring site in central Wilkinson Basin (Figure 2). After a bottom survey, the Guard Buoy "E" mooring was launched at 1726L (2126Z) 2 October near 42° 42.20N 69° 38.20W. A SeaBird MicroCat was placed on the wire at 97 m depth to record temperature and salinity. The subsurface flotation immediately returned to the surface, and was hauled onboard. After determining that the bottom steel flotation sphere had broken apart, it was replaced and Guard Buoy "E" was redeployed at 2005 (2126Z) near 42° 42.14N 69° 38.07W.

The CTD survey continued through the night and Endeavor returned to the WB-98 site the next morning. Guard Buoy "D" (Figure 2) was placed approximately 150 m southeast of "E" at 0922L (1322Z) 3 October near 42° 42.09N 69° 38.09W. SeaBird MicroCats at 22 and 216 m depths were added to record temperature and salinity. At 1318L (1718Z), Thermister Chain "B" (11 thermistors at 15 m intervals between 20 and 170 m, with a pressure sensor at the top) was deployed between "D" and "E" near 42° 42.12N 69° 38.11W (Figure 2).

The cruise continued with a total of 38 CTD stations arranged in nine spokes centered on the WB-98 mooring site (Figure 1.a). An acoustic survey to exactly locate each of the deployed moorings was conducted between 0910L and 1102L 4 October.

While underway, ship instruments routinely recorded near-surface temperature / salinity and a weather package (IMET) provided a continuous records of air pressure, temperature, relative humidity, wind speed / direction, short / long wave radiation, along with ship's position and movement. A RDI 150 KHz Acoustic Doppler Current Profiler (ADCP) recorded ocean current structure along the ship's path.

The final CTD profile was completed at 0245L (0645Z) 5 October and the ship headed for port in Woods Hole, MA. RV Endeavor tied up at 1320L (1720Z) at the WHOI pier.

Postlog: On 9 December 1997, we visited the WB-98 mooring site on the UNH RV Gulf Challenger to replace GPS/ARGOS locators which had run down their batteries due to improper programming by the manufacturer. Upon arrival, we found guard buoy "D" was missing (the transmitter on "E" was replaced). With help from ARGOS, we found an approximate location for buoy "D" and returned to the area on December 12. After about 6 hours of searching and a timely position update, we found and recovered the buoy, two Microcat instrument packages (with good temperature and salinity records), and mooring cable. It appeared the shackle had been carefully detached just above the tethers. The acoustic release and tethers were recovered and redeployed on Guard Buoy "G" on 9 January 1998 (RV Oceanus cruise OC315).

2.a. Scientific Party:

F. Bub (Chief Scientist), W. Brown, K. Morey, K. Garrison, L. Connors, Y. Fan, A. Harmon, M. Loomis, S. Miller, P. Mupparapu. G. Rice, and J. Salisbury.

2.b. Cruise Photos

Click here to see EN-306 Cruise photos. GIF photos of the EN-306 scientific party and cruise work are included.

3. Data.

3.a. Hydrographic Data Acquisition.

The R/V ENVEAVOR'S SeaBird SBE 911 Plus CTD Profiler was used to measure vertical profiles of electrical conductivity and temperature versus pressure at 38 hydrographic stations during 01 - 05 October 1997 (Figure 1.a).

Sensors on the CTD were factory calibrated on 9 October 1996. This CTD sampled at a rate of 24 scans per second. Salinity profiles were computed from these data. Additional sensors on the SBE-911 also recorded data for the measurement of dissolved oxygen, water transmissivity, fluorescence (Chl-a), and irradiance (PAR). See Figure 3.a. for a composite of profiles. CTD data acquisition, display and storage were managed by an on-board computer using the SeaBird software package SEASOFT.

At each station, the CTD was lowered at a rate of approximately 30 meters per minute to depths within 5-10 meters of the bottom. Three to eight water samples were collected with a rossette of 5-liter Niskin bottles, and specimens for nutrient and oxygen isotope analyses were gathered. At selected stations, the condutivity of one water sample was determined using the ship's Guildline 8400A Autosal and the corresponding salinities were used to correct salinity values derived from the raw CTD measurements.

3.b. Data Processing.

The CTD data were processed using a series of SeaBird SEASOFT programs (listed in parentheses) in which:

a. Raw hexidecimal CTD output is converted into engineering units (DATCNV). Only downcast data were used to produce station profiles. Bottles samples were taken during upcasts and average CTD data at each bottle depth were stored (ROSSUM).

b. Noise contamination greater than 2 standard deviations from 50 point sections was removed (WILDEDIT). In addition, CTD downcast data associated with downward velocities of less than 25 cm/s (due to looping) were discarded (LOOPEDIT).

c. Data were filtered to ensure consistent response times using a low pass filter with time constant 0.15 sec (FILTER).

d. Data were averaged into 1 decibar (dbar) bins (BINAVG) to produce profiles of temperature, salinity, etc., versus pressure from the unequally-spaced cast data from each station.

e. These profile data were stored as ASCII files on floppy disks for post-processing and plotting.

3.c. Data Descriptions, Corrections and Estimated Accuracy / Precision.

Click here for a summary of data descriptions, corrections and estimated accuracy / precision.

3.d. Data Presentations.

The corrected hydrographic data are presented as:

1. Station profile plots and property-property diagrams,
2. Vertical section contour plots, and
3. Horizontal pressure and desnity surface contour plots.

3.d.1. Vertical CTD Profile Plots.

Individual profiles may be viewed via Table 2. A composite of all CTD profiles is shown as Figure 3.a and an expanded T-S diagram as Figure 3.b. Data are presented on two pages per station:

- **Page A** - Station profiles of temperature, salinity, sigma-theta density, stability (N-squared) and a temperature-salinity diagram. The upper three plots (surface to 100 m deep) represent zoomed details of water property structure in the main thermocline (halocline, pycnocline) zone (horizontal scales vary). The middle plots present these water property structures for the entire water column. These plots are all on the same depth / property scale for intercomparison. A Brunt-Vaisaila frequency (N-squared) plot indicates water column stability.

- **Page B** - When data are available, this page shows station profiles of measured dissolved oxygen, transmissivity, fluorescence (Chl-a), solar irradiance (PAR), as well as computed sound velocity, temperature - dissolved oxygen, and salinity - dissolved oxygen diagrams.

3.d.2. Vertical Hydrographic Sections.

Potential temperature, salinity, and sigma-theta sections for the following transects are presented. Each plot spans 200 km and horizontal scales are preserved. Contour intervals are indicated on plots. The CTD station numbers are shown along the top horizontal axis and the ocean bottom (based on depths at CTD stations) is shaded.

- Point A to F, tracking southeastward through Jeffreys and Wilkinson Basins (Figure 4.a),

- Point B to G, tracking eastward through Massachusetts Bay and Wilkinson Basin (Figure 4.b),

- Point J to E, tracking southward across Wilkinson Basin (Figure 4.c),

- Point C to F,G, tracking eastward across the southern Wilkinson Basin (Figure 4.d), and

- Point D to F,G, tracking eastward across the southern Wilkinson Basin (Figure 4.e).

3.d.3. Horizontal Pressure and Density Surfaces.

Contoured surfaces may be accessed via Table 1. Contours of temperature, salinity and density fields on the 5, 25, 50, 100, 150 and 200 dbar pressure surfaces (equivalent to depth in m) and the sigma theta 26.00 density surface (mid water column) are presented for information. The 5 m field is the mean of the 0-10 m layer. Dynamic height fields indicate geostrophic shear. Cyan regions show where the ocean bottom is shallower than the plotted surface. CTD profiles at the red dots (x indicates no data). Wilkinson Basin mooring marked by the wheel. Red lines bound region of the CONVEX water mass analyses. Plotted contour intervals, along with data extrema and search epsilon, are indicated in captions.

3.d.4. Data Files.

Profiles can be made available as (a) **ASCII files** upon request to frank.bub@unh.edu. Upon final quality control, we will provide (b) **JGOFS** default files through a ftp site.

Other EN-306 Cruise data including enroute ADCP, TSAL, navigation, bathymetry and observed weather records will also be made available upon further processing.

4. Acknowledgements.

The valuable work of Ken Morey, Dan Howard and Karen Garrison resulted in the successful deployment of the Wilkinson Basin Bouy and hydrographic survey. We appreciate the efforts of the captain and crew of R/V ENDEAVOR as they helped us conduct this field program. We are grateful for the help provided by T. Loder and A. Wang / V. Pilon in processing the bottle salinities.

F. Bub, W. Brown, and P. Mupparapu are supported by NSF Grant OCE-9530249.

5. References.

Fofonoff, N. P. and R. C. Millard Jr., 1983. Algorithms for compilation of fundamental properties of seawater, UNESCO Technical Papers in Marine Science, no. 44. UNESCO, Paris, France, 53 pages.

Garrison, K. M. and W. S. Brown, 1989. Hydrographic survey in the Gulf of Maine July-August 1987, UNH Tech. Rpt. No. UNHMP-T/DR-SG-89-5, Univ. of NH, Durham, NH.

Morgan, P. P., 1994, SEAWATER Software Version 1.2b, CSIRO Division of Oceanography, Hobart, AUS.

Table 1. Surface Contours of Water Properties.

These fields are briefly described in section 3.d.3. Pressure (P), Temperature (T), Salinity (S), Density (D), and Dynamic Height (DH) are contoured at the specfied pressure or density levels.

PRESSURE SURFACE	POTENTIAL TEMPERATURE (deg C)	SALINITY (psu)	DENSITY: SIGMA-THETA (kg/m^3)	DYNAMIC HEIGHT (cm, ref surface)
05 dbar	T05	S05	D05	X X X
25 dbar	T25	S25	D25	X X X
50 dbar	T50	S50	D50	X X X
100 dbar	T100	S100	D100	DH100
150 dbar	T150	S150	D150	DH150
200 dbar	T200	S200	D200	X X X

DENSITY SURFACE (kg/m^3)	PRESSURE (dbar)	POTENTIAL TEMPERATURE (deg C)	SALINITY (psu)
26.00 sigma theta	P26.00	T26.00	S26.00

Table 2. CTD Profile Plots.

Hydrographic station information for the **R/V ENDEAVOR Cruise EN-306 (1-5 October 1997).** Position, depth, date, and time are for the bottom of the cast. Profiles, which are described in section 3.d.1, may be viewed by clicking on ##A or ##B. See Figure 1.a for station locations.

CTD station number		Latitude (deg min N)	Longitude (deg min W)	Water Depth (meters)	Time (Z)	Date (DD/MM/YY)
02A	02B	42.5655	70.2932	115	01:57	02/10/1997
03A	03B	42.5812	70.1460	77	03:01	02/10/1997
04A	04B	42.5947	69.9987	138	04:05	02/10/1997
05A	05B	42.6130	69.8533	235	05:21	02/10/1997
06A	06B	42.7010	69.6357	274	07:12	02/10/1997
07A	07B	43.0075	70.2095	165	15:10	02/10/1997
08A	08B	42.8187	69.9502	240	17:37	02/10/1997
09A	09B	42.7070	69.6348	270	01:31	03/10/1997
10A	10B	42.8370	69.6985	215	04:06	03/10/1997
11A	11B	42.9715	69.7598	170	05:24	03/10/1997
12A	12B	42.8973	69.5912	175	06:47	03/10/1997
13A	13B	42.8235	69.4245	160	08:01	03/10/1997
14A	14B	42.7267	69.4363	210	09:16	03/10/1997
15A	15B	42.7007	69.6292	270	19:00	03/10/1997
16A	16B	42.5262	69.6083	265	20:37	03/10/1997
17A	17B	42.3508	69.5877	240	22:02	03/10/1997
18A	18B	42.1780	69.5603	230	23:32	03/10/1997
19A	19B	42.0000	69.5397	218	01:03	04/10/1997
20A	20B	42.0503	69.7153	200	02:15	04/10/1997
21A	21B	42.1000	69.8905	115	03:22	04/10/1997
22A	22B	42.2508	69.8193	233	04:35	04/10/1997
23A	23B	42.4000	69.7593	265	05:54	04/10/1997

24A	24B	42.5510	69.6933	254	07:12	04/10/1997
25A	25B	42.6965	69.6305	275	10:10	04/10/1997
26A	26B	42.5593	69.4627	250	11:36	04/10/1997
27A	27B	42.4205	69.2793	255	13:26	04/10/1997
28A	28B	42.2800	69.1033	205	15:10	04/10/1997
29A	29B	42.1423	68.9330	154	17:11	04/10/1997
30A	30B	42.0027	68.7483	145	18:43	04/10/1997
31A	31B	42.1683	68.7485	202	19:55	04/10/1997
32A	32B	42.3337	68.7482	180	21:07	04/10/1997
33A	33B	42.5007	68.7495	185	22:23	04/10/1997
34A	34B	42.5673	69.0440	175	00:01	05/10/1997
35A	35B	42.6357	69.3460	218	01:49	05/10/1997
36A	36B	42.7023	69.6330	265	03:32	05/10/1997
37A	37B	42.5100	69.8503	220	05:26	05/10/1997
38A	38B	42.3993	69.9988	190	06:36	05/10/1997