GLOBEC SJ9506 Cruise Report

Acknowledgements

We gratefully acknowledge the assistance provided by the officers and crew of the R/V Seward Johnson and the Marine Technical Group of the University of Miami, Florida.

This report was prepared by Neil Oakey, Dave Hebert, Bob Beardsley, Jim Irish, and Sandy Williams. This cruise was sponsored by the National Science Foundation and the National Oceanic and Atmospheric Administration.

Cruise Objectives

The overall objectives of the cruise were focussed around obtaining turbulence intensities and mixing rates at two sites on the southern flank of Georges Bank as part of the program to study the development of stratification. During the current cruise two sites were studied extensively, one on the bank in about 44 meters of water where the water was very unstratified and a second site near the main stratification mooring (Beardsley) where stratification was just starting to develop. This cruise early in the year is considered to be a time when there is little stratification and the results will be used to compare to the situation a month later when stratification has developed. CTD data were obtained as part of this cruise both in support of the mixing studies and to establish the large scale features in the temperature, salinity and density field. Other operations were done to some extent from the vessel as a ship of opportunity. In particular the following specific objectives defined the cruise operation.

1. Conduct EPSONDE anchor stations at a shallow mixed site and the main stratification mooring, ST1.
2. Recover and reset BASS tripod at ST1.
3. Deploy the SF long-term mooring.
4. Replace ST1 IMET long-wave sensor.
5. Make CTD sections as time and weather permit.

Cruise Narrative

The Seward Johnson left Woods Hole about 1025 EDT April 25, 1995 (Tuesday) and started steaming towards the first CTD site on the southern flank. We arrived on station for CTD1 at about 2255 and started a cross-shelf CTD transect which runs parallel to and was about 2 km west of the ST1-ST2 mooring line (line A'). This continued until 0600 on April 26 (Wednesday), at which time we proceeded to the long-term SF mooring site where Jim Irish and his staff deployed their mooring without incident. We then proceeded to the main stratification mooring to try to recover the BASS tower (Williams). This operation proved to be unsuccessful. The CTD line A' was started from its most southern station and continued northward to complete CTD 22 at 0016, April 27 (Thursday).

We then anchored ship at the "shallow EPSONDE" site, and began the microstructure profiling at about 0120. The procedure was to make a CTD cast every hour on the half-hour, with EPSONDE profiling (typically about 10 profiles) between CTD casts. Both the 150 kHz and 600 kHz broad-band ADCPs were run. Water depth at this site was about 44m, and the tidal currents were of order 1 m/s. The EPSONDE crew had no difficulty making 10 casts within 50 min, leaving ample time for the deck crew to do the CTD launch and recovery operations. Weather during Thursday was sunny, little wind, some swell from east, glassy sea in afternoon. CTD casts in afternoon show some surface warming to about 15 m, presumably due to insolation penetration. The vertical profile of PAR in the afternoon show a similar vertical scale of light extinction. The EPSONDE anchor station continued for approximately 35 hours until about 1240 April 28 (Saturday).

We then steamed to ST1 and found the BASS pickup buoy on the surface. Recovery was attempted but the line parted, presumably cut on the adjacent guard buoy mooring line. After the BASS recovery attempt, repairs were made to the IMET buoy. A further attempt was made to release the BASS mooring and we set up to do an EPSONDE anchor station about 1km ENE of the discus mooring. This anchor station continued from about 2130 until 1330 on April 29 (Sunday) when poor weather forced us to stop profiling.

Two standard CTD sections were done next. The standard long-term CTD section was done starting from off-bank (April 29 at 1645) and continued to the shallow on-bank station completed at about 0500 on April 30 (Monday). We proceeded to CTD section A, started at the on-bank site, A1, near mid-day. Some problems were encountered with the CTD system but repairs were implemented by the U of Miami technical staff. The section was completed on April 30 about 2100 at the off-bank site, A1.

A second EPSONDE anchor station was then started at ST1 about midnight and continued until about 1400 on May 1 (Tuesday) when the weather forced us to terminate profiling. All operations were suspended until about 0900 on May 2 (Tuesday) because of weather. Another attempt was made to release Bass and a final CTD section A8 to A1 was completed from 1300 to 1730 May 2 . Forecasted storms and the fact that this would not permit us to anchor again to do any further EPSONDE stations caused us to cease operations and return to port. We arrived at WHOI at 0800 on Wednesday to terminate the cruise.

A chronology of the experimental activities is given in the event log in Appendix 4 and a track chart of the cruise is given in Figure 1. All Tables are in Appendix 2 and Figures are in Appendix 3.

Microstructure Measurements. Neil Oakey

Microstructure measurements were made during the experiment using the tethered free-fall profiler, EPSONDE. The instrument was deployed from the stern of the Seward Johnson while the ship was at anchor. The instrument is tethered to the ship with a kevlar multi-conductor cable which is fed out very loosely using a capstan at the rail so that the instrument has essentially the characteristics of a free-fall vehicle. Because the ship was at anchor, the tidal current carried the instrument astern out of the way of obstructions on the vessel. Sufficient cable was deployed to allow the instrument to hit the bottom. Data were recorded on a shipboard PC in real time.

During descent, the instrument measures temperature, conductivity and depth with a basic CTD. Two sensors measure the turbulent mixing rate to scales as small as 1 cm and a fast thermistor and a thin-film thermometer measure the temperature microstructure to scales of less than 1 cm. From these signals we are able to estimate the turbulent mixing rate and the vertical diffusivity plus several other microstructure quantities. The sensors come within about 5 cm of the bottom in the center of a circular 30 cm diameter bottom lander. So it is relatively easy for sensors to be broken and that was our experience on other experiments. On this cruise we were fortunate and no sensors got broken although the bottom lander was quit bent after a few hours profiling.

The measurements focussed on two sites, one on the bank in about 44 meters of water where the water was very unstratified and a second site near the main stratification mooring in a depth of about 75 meters where stratification was just starting to develop. Three anchor stations were done. At 41o08'N, 67o44.8'W in 43 meters of water a series of about 35 hours of profiling was done from just after midnight April 27 until about noon on April 28. This series consisted of about 10 EPSONDE profiles every hour with a CTD centered on the half hour. This operation was done with little wind and the vessel tracked the current well so that the instrument always tracked astern. Two shorter 12 hour series were done near the main stratification mooring (ST1) from about 2300, April 28 until about 1200 on April 29 when the operation was terminated because of poor weather. The Seward Johnson under windier conditions tends to go beam to the wind and doesn't track the tidal current well which meant that there were times when the EPSONDE cable tended to track hard to starboard or hard to port creating a situation that was dangerous for the instrument. It was this operational constraint that required the first anchor station at ST1 to be terminated. A third anchor station at ST1 was done, starting just after midnight on May 1 and continuing until about noon on the same day. This operation also had to be terminated as wind strength increased.

Although we were disappointed that we didn't obtain more data because of weather constraints the data that we obtained were generally good. Enough of the data were analyzed in a preliminary way aboard the vessel to assure that the instrument was performing well and to give us a preliminary picture of the mixing rates at the two sites.

A preliminary look a subset of the data was done on-board both to quality check the data and to determine any instrument problems. Typically the data were analyzed from one hourly burst before the next burst was completed. This allowed one to evaluate any sensor damage that might have occurred when the instrument hit bottom and make any repairs. As an illustration of the data from the two sites representative profiles from the shallow unstratified site and the stratified site are shown in Figures 2 and 3 respectively. At the unstratified site (Fig. 2) the water has nearly constant temperature and salinity from top to bottom and the turbulence is strongest at the bottom (just less than 10^-6 W/kg), decreasing with height above the bottom by about a factor of 5. It must be remembered that from drop to drop and between stations there is a large variability. At the deeper stratified site the temperature and salinity show a mixed layer overlying a well mixed layer from about 20 m deep to the bottom. Levels of dissipation are similar to the shallow site at the bottom but decrease about two orders of magnitude from the bottom to the base of the mixed layer. Vertical diffusivities at both sites are of order 10^-2 at the bottom and decrease with height above the bottom, about a factor of two at the shallow site and about two orders of magnitude at the ST1 site.

ADCP Measurements.Dave Hebert

On SJ9506, three RDI ADCPs (two broad-band ADCPs, 150 and 600 kHz, and one narrow-band 150 kHz ADCP) were used at different times (see Table 1). The broad-band 150 kHz ADCP was located in the Straza tower and could be only operated at ship speeds less than 6 kts. Therefore, we used the narrow-band 150 kHz ADCP while steaming and the broad-band 150 kHz while on long-term stations. The 600 kHz ADCP was operated during the period we were on Georges Bank. The data were logged using the TRANSECT program for all ADCPs. Initially we tried to program the ADCPs to average pings over a one-minute period but the ADCPs would not operate with these parameters (i.e., conversion of beam velocities to earth coordinates within the ADCP). Thus, we decided to use the settings, with some changes, from the previous cruise. The ensembles in the raw data consists of averages of 4 water pings and 4 bottom pings in beam coordinates. [After the cruise, discussions with Julio Candela informed me that the UMiami's ADCPs cannot do the earth coordinate transformation in the ADCP head. Thus, the maximum number of pings allowed in each raw ensemble is 4 pings.] These short raw ensembles (approximately 10 s averages) have large error velocities. Post-processing will produce velocities in earth coordinates. Overall, the three ADCPs worked well. There were two minor problems with the logging of the data. Occasionally, the broad-band ADCPs would lose the navigation data. The acquisition of data had to be stopped and re-started. This only happened to one of the broad-band ADCPs at any time. The other problem was with the narrow-band ADCP. Sometimes, the transect program would display an error message stating that an ensemble was lost. Finally, it was noticed that the time to start the acquisition of data increased with time -the PC spent a large time accessing the hard disk; the problem might be related to the number of files in the data directory.

CTD Measurements, Mooring Placement, Mooring Maintenance. Bob Beardsley

The ship is equipped with an NBIS Mark III CTD profiling system (IM962813) on loan from the University of Miami. In addition to the standard temperature, conductivity and pressure sensors, the fish also supports sensors for fast temperature, light transmission, fluorescence, PAR, height from bottom, and DO. UMiami EG&G software is used for data acquisition, processing and archiving.

To get a first look at the regional stratification, we did a cross-shelf CTD transect which runs roughly parallel to and a km or so west of to the ST1-ST2 mooring line. We arrived on station for CTD1 at about 2255 and began to learn how to use ship's system. The University of Miami technicians prefer to take three bottles per cast, so we agreed to take two at bottom and one at the top of the cast. Station procedure included starting station log sheet on the DEC computer, getting position and depth for use in the CTD station setup. The depth was from a chirp sonar. This depth minus 5 m was given to the winch operator as the target depth. Then counting down the real-time screen readout of the CTD altimeter to the winch operator allowed him to stop the CTD fish about 5 m above the bottom. After the cast was completed, the station log sheet was completed. A separate log is kept for salinity bottle samples, which were run during the cruise in the 01-deck hydro van.

Several of the first CTD T and S profiles looked too well mixed to be believed (and also were too cold in comparison to the ship's surface temperature, which was at least a deg C warmer), so after CTD5, we checked with a bucket temperature (which agreed) and then put warm water in the sensor cap with the CTD on deck. This indicated that the CTD temperature channel was working.
We finished CTD8 on section A' about 0555, and left for SF mooring site to deploy Jim Irish's mooring. The SF mooring deployment went smoothly. Afterwards, we did three CTD casts (CTD9-11) within an hour to provide some inter-comparison with the SF mooring. We finished at the SF site about 1040, and left for the ST1 site, where Sandy Williams and team attempted unsuccessfully to recover BASS. We then proceeded to the southernmost station on section A', and started CTD12 station about 1525. We did rest of section and finished CTD22 at about 0016 Thursday.

We then anchored ship at the "shallow EPSONDE" site, and began the microstructure profiling at about 0120. The procedure was to make a CTD cast every hour on the half-hour, with EPSONDE profiling (typically about 10 profiles) between CTD casts. Both broad-band ADCPs were run. Water depth at this site was about 44m, and the tidal currents were of order 1 m/s. The EPSONDE crew made10 casts within 50 min, leaving ample time for the deck crew to do the CTD launch and recovery operations. Weather during Thursday was sunny, little wind, some swell from east, glassy sea in afternoon. CTD casts in afternoon show some surface warming to about 15 m, presumably due to insolation penetration. The vertical profile of PAR in afternoon shown similar vertical scale of light extinction.

During this first anchor station, we experimented with the EG&G editing software, and eventually settled on a first difference filter (SJ9506C: delP=5 m, delT=0.50 degC, delC=0.10, del Transmission=1.0). The down and up-casts for all stations were then processed using the EG&G first difference filter, smart editor, and pressure averaging to 1m bins. The resulting **.prs** files were then transferred to a PC computer disk into both the SJ9506\Hydro\ctdsave directory for backup and the SJ9506\Hydro for further processing. The .prs files were then edited using the Norton editor '**edt**' to remove blank lines in the header and any initial lines of data which did not appear to be good (i.e., with either negative pressure, or small pressure (less than 1m) or with a low number of observations). Then a program 'sortctd' was used to convert the final edited .prsfile into a ASCII **.dat** file with no header or commas. These .dat files were then plotted using MATLAB. After this first anchor station was completed, final processing of CTD01-57 was completed.

At CTD30, we decided to take bottle samples only every other cast. The general impression of CTD data during the anchor station was that except during the afternoon, the T and S profiles were generally well-mixed. Some casts showed less than 0.01 degC variation. Some casts also showed deviations to less salinity which may be due to biological fouling of the cell (e.g., CTD50). The most obvious of these deviations were corrected in the editing process. Starting with CTD52, first the salinity (conductivty) and then the temperature traces showed noise, of order +-0.005 C. After CTD54 it was determined with a deck cast that the ground wire was not making a good connection on the cable termination shackle. This was cleaned, and a new bolt was used to attach the ground cable. The traces for the remaining stations at this anchor station did not exhibit this noise.

About 1240 on Friday, the last CTD of the first anchor station was completed, and the ship raised anchor and steamed to ST1. After an unsuccessful attempt to recover BASS, the Zodiac was launched and personnel went over to the discus buoy to change the IMET long-wave sensor. The new sensor was dropped in the water, but recovered, connector wiped dry and mounted on the discus. Visual inspection of the other sensors suggested all were ok except the IMET Young wind monitor, which was missing one of its four blades, and as a result was shaking itself to destruction. Visual inspection of the IMET and VAWR wind record on ship shows a decrease in the IMET wind relative to the VAWR starting about April 5. In hindsight, we should have monitored this better and attempted to fix it on this cruise if possible. We will suggest it be considered for the next Seward Johnson cruise.

We decided to anchor about 1 km ENE of the discus in preparation for the second EPSONDE anchor station. We started the ADCP and the CTD profiling about 2130. Continued CTD and ADCP sampling until about 1330 Saturday, when the ship left this site and looked again for the BASS float at ST1. During the night and morning, the wind became strong enough to push the ship out of alignment with the current, so both EPSONDE and the CTD wire trailed to port. This prevented continuous EPSONDE profiling, although about one complete M2 cycle was obtained. CTD stations 58-74 were done during this anchor station. Around 1300, the EPSONDE developed some wire handling problem, so the anchor station was terminated after CTD74.

The ship then headed southeast to the start of the standard long-term CTD section, to work north on this section, then south on the standard Section A line while the weather was rough. We started the long-term section at LT13 (CTD75) at about 1645 Friday, and completed the last station LT2 (CTD86) at about 0500 Saturday morning. Then we steamed to the start of the standard stratification mooring line Section A at A1 to conduct CTD87 at about 0730. At start of cast with fish in water at 3m, the fish started giving very high random pressure readings (above 3000 db), and the acquisition program would not start. We brought the fish back on deck. We did a deck cast and found the same problem so decided to switch to backup fish. We got fish 2 out of the backup rosette and mounted it in frame 1. A deck test showed that the fish worked ok but the rosette would not fire or home on command from the deck unit. After additional tests, including talking via RS232 with each rosette, we decided to switch to rosette 2. Then we did deck cast with no change, so substituted an independent rosette battery which allowed the rosette to work. This system, consisting of fish 2, rosette 2, separate battery with all other sensors as original on frame 1, was used successfully for the rest of the cruise. (Later a test was done with the sea cable and fish 1 in the lab, which confirmed that the pressure signal from fish 1 was not working correctly.)

Once the CTD was functioning, we started Section A and did most of it, skipping every other station to make up for lost time. We returned to ST1 and anchored and started hourly CTD casts with EPSONDE profiling between. The first CTD in this series was CTD93 taken about 2111. We did CTD and EPSONDE profiling until weather (both wind and seas) got too rough for safe operations. The last CTD cast was CTD107, made at 1331 on Monday. The wind and seas got worse, the ship dragged anchor until much later in evening when it was brought up to allow ship more maneuverability. Winds were about 45 knots at peak of storm. Peak waves perhaps 6-7 m. The ship took several severe rolls.

By Tuesday around 0800, wind and seas were both down, and the ship returned to ST1 and a tried once again to release the second BASS float. This try was also unsuccessful. Following this, the ship circled around the ST1 discus for photos, saw that both starboard and port solar panels were now moved, and the propeller sensor had lost its steering tail. At least one of the high flyer buoys was also there.

Then ship steamed to do CTD108 at A8. CTD traces show a 2-layer structure near the surface, with a shallower mixed layer over riding a deep layer. The fluorometer signal showed a strong increase in amplitude with depth until the top of the mixed layer. This tendency also showed at next CTD station. If this water is local water mixed deep during storm, how could fluorescence increase so much? Completed CTD115 at A1 about 1730 and started steaming for Woods Hole, arriving at about 0800 May 3, 1995. A summary of CTD sampling is given in Table 2 CTD station positions are listed in Table 3.

The positions of the CTD stations in the survey lines are plotted in Figures 4 and 5 which show the relationship of the lines to the rest of the experimental area. Along these lines the section plots of Figure 6, 7, 8, 9 and 10 give contoured salinity, temperature and density.

Long -Term Mooring Placement. Jim Irish

We were able to get a few hours time on Neil Oakey's Turbulence Cruise to deploy the Southern Flank Scientific mooring which broke loose early March 1995 and was recovered by the R/V Seward Johnson, but not in time for deployment on our turnaround cruise SJ9504. The first day out was spent working to finish securing antenna wires and solar panel wires on the Southern Flank buoy and to set up the subsurface buoy and chain at anchor. We monitored the ARGOS telemetry from the buoy on deck with our TELONICS up-link receiver. The system diagnostics indicated all systems were working fine with buoy batteries fully charged.

The buoy was deployed on Wednesday, 26 April 1995. The seas were calm, the winds were under 10 kts, and the weather was sunny. The backup TDS2020 PCMCIA recorder was checked and working fine. Battery voltages via ARGOS were fine. The Electro-Mechanical cable was lead around the A-frame to the anchor. The two bio-optical packages were placed in line and cabling secured. The fluorometers were flashing at the same time indicating that they are on time and working properly. Poison tubes were placed on all conductivity sensors, and two tubes were placed in the bio-optical sensor cleaning pumps. Also poison rings were placed around the transmissometer and fluorometer windows to reduce bio-fouling. When we arrived at South Flank site (0800 EDT) both surface guard buoys were there. Ship's drift was about 0.8 kts to the NE with the currents and wind in about same direction. Thus the buoy was launched to the SW on the bow thruster only at about 0.5 kts speed. The Buoy was picked up and set into water with the 10 m bio-optical package at 0845 EDT. The bio-optical package at 40 m was in the water at 0847 EDT. By 0853 the mooring was all strung out and tension was taken on the anchor ready to steam into position. The 0.5 kt launch speed was good, and buoy drifted astern rapidly and tension on cable was not too great for hand payout of cable. Towing at 2 kts appears OK, but at 3 kts, the wake and splash around the buoy indicated that it was too fast. The anchor was released at 0915 EDT in good alignment with other buoys. DGPS position of ship whenanchor was dropped was 40 58.149' N , 67 19.178' W. The acoustic release was commanded and replied that it was vertical and unreleased.

Three CTDS (SJ06D009, SJ06D010, and SJ06D011) were taken near the Southern Flank Mooring deployment site for an initial in-situ calibration point. Some stratification was seen in the upper 20 meters, with a weak thermocline at about 15 m depth. After the CTD was secured on deck, the ship steamed by Southern Flank buoys for visual inspection and pictures. Data from the ARGOS uplink receiver check of the system at this time showed that all sensors were working properly.

BASS Recovery Operations. Albert J. Williams 3rd

The Globec BASS tripod was deployed on the south flank of Georges Bank February 3, 1995 at L 4051.665'N, 6733.593'W in 77 m. It had two acoustic command releases with independent latches, floats, and lift lines. These were both tested January 24, 1995 in Vineyard Sound where the first line got cut by the recovery barge and the second line was released later and the tripod recovered. The releases use 12.0 kHz transmissions coded into a 16 bit sequence. When they are enabled, they become transponders answering the 12.0 Khz interrogate pulse with a 12.5 Khz reply. If enabled, they can be set to release by sending a different command to the same address. A release command is answered (since the transpond function must be enabled to release) and at the end of the command, 12 volts is impressed on the burnwire pin with respect to the instrument case. This electrochemically corrodes the piece of nichrome wire connected to the burnwire pin and releases the latch holding the floats. The voltage remains on the pin for 2.5 hours and cannot be turned off. The deployment of Globec BASS was normal, being placed in the water from the crane of R/V Endeavor and released to free fall to the bottom very near a surface guard buoy. This buoy was one of four surface buoys; two more guard buoys and a meteorological discus buoy.

The weather was clear with southerly wind about 12 knots on April 26, 1995. R/V Seward Johnson approached the cluster of surface buoys at L 4051.665'N, 6733.593'W at 1208 EDT close to the time of maximum southeasterly tidal flow. This is the flow most likely to sweep the recovery float away from the guard buoy closest to the tripod. We hove to and drifted southerly while release, enable, release, enable, and release commands were sent to address 0100 from a Commander hung over the side at a depth of 12 ft. We were on the side of the ship away from the buoys so the ship might have cast an acoustic shadow in the direction of the tripod and the tripod might not have heard the commands. The ship's 12 Khz echo sounder had been turned off to avoid its interference with the commands being sent. We then moved into the cluster of surface buoys and re-sent release, enable, release, enable, and release commands with the Commander lowered to 24 feet below the hull. The last two of these were monitored with a EG&G acoustic navigation unit set to listen for 12.5 Khz. All of the pulses sent to the release were replied to. This confirms that the release on BASS received the release command.

Twenty minutes later a sequence of commands was sent to the second acoustic release, address 1011. The sequence was started at 1258 EDT. The sequence release, enable, release, enable, release was completed at 1308. We left the area without seeing any floats on the surface at 1337, viewing the region between buoys with binoculars as we left to see any late arriving floats at the surface. This is apparently a failure of the recovery system. Globec BASS is now lost in the sense that normal recovery attempts have failed.

The tripod is there because the transponder address 0100 replied to the interrogate pulse. At least one release command was received. The failure of either float to appear at the surface may be explained by the failure of both releases to actually burn the release wires. Or the floats may have released prematurely in the 2.5 months of deployment. Finally, the corrosion of the nichrome burnwires may be much slower than our experience would lead us to believe. If the last, the floats may have come to the surface after we left and may be there now. Or they may require a second 2.5 hour burn time to complete the burn, or even a third. These possibilities can be tested by revisiting the site and sending more commands.

If the BASS tripod cannot be recovered on this cruise, a fall back position would be to attempt recovery with ROV or submarine. A final attempt could be made with sidescan sonar emplaced moorings and dragging through the space between the moorings. Failure to recover the BASS tripod on this cruise will limit our ability to observe the spring stratification because the recording capacity will expire May 2, 1995. Peter Wiebe is attempting recovery of the BioMapper in the next month with the SeaLink and might permit an attempt to recover BASS on his cruise. I have R/V Endeavor July 10 - 15, 1995 and can use that time to search for and recover BASS. I could use the sidescan sonar technique of placing floats with acoustic reflecting anchors close to the tripod and towing between them with a grapnel. This is problematic in the high tidal current environment of Georges Bank. An ROV would be better or a submersible. Thus the BioMapper rescue cruise is preferred.

Further Events - April 28, 1995

At 1430 EDT April 28, R/V Seward Johnson returned to the BASS site and one of the BASS recovery floats was on the surface. This was the yellow float, the float released second. However it had ten small floats rather than 3 large floats. It was explained to me that the string had been changed after the Vineyard Sound recovery but the colors were the same. The floats were somewhat nearer to one of the guard buoys than if the line had lead directly from the tripod. However we picked up the line, got the float on board, tied a butterfly knot in the line, attached the line to a lifting line led through a fisherman's block on the crane, another fisherman's block on the deck, and to a line winch, and removed the float. The line lead down and away from the ship, not directly to the guard buoy, so we hauled on it. The line came taut and parted subsurface. After retrieval, it was found to be cut about 90 meters down, a plausible distance to the guard buoy's mooring chain. Apparently, the float came up sometime within the 2.5 hour burn time but after we left the area, and then wrapped itself up to three times around the guard buoy over the next 36 hours. The tidal ellipse is nearly circular at one to two knots.

A release command was sent to address 0100, the orange float release that had been turned on and confirmed April 26. Of course the burn had stopped 2.5 hours after it was received and it is to be hoped that whatever makes it burn slowly will have prevented it from burning in 2.5 hours but will permit it to burn in 5 hours. Using Jim Irish's EG&G Navigation unit, we confirmed that the transponder was not answering until enabled, then answered and received every release pulse. Finally it was sent a disable command (three pulses in a pattern 1001 0100 0000) to which it replied perfectly but then remained in transpond mode. This inability to be disabled results from a latched release command. We remain watchful from 1550 EDT until 1820 to observe a buoy during the 2.5 hour burn time of the 0100 release.

Observations Through April 30, 1995

The float did not surface by 1830 April 28 and we went to the Mooring EPS station about 1 km away. We could see the moorings by daylight. The weather worsened and by morning, it was too windy to carry on with the EPSONDE work. At 1300 April 29, we passed through the mooring array looking for a surface float from BASS and at 1600 April 30 we passed back through the array with calm conditions and saw no BASS floats.

Observations Through May 2, 1995

A storm May 1, 1995 prevented us from trying to release BASS again until May 2. We sent release commands to address 0100 which were confirmed by EG&G receiver from 0900 to 0920 EDT and then sent a release sequence to 1011 in case the was a mistake in the assignment of the yellow floats to 1011. We waited at the mooring array until 1145. Then we sent the same sequence again, again confirming the release command was received by 0100 at 1200 EDT.

After doing two CTD stations, we returned to the mooring array at 1405 and scanned the array for a float that might have been released by a slow burn at 1200. No float by 1430 when the CTD was finished.

BASS Scientific Party

Globec BASS was supported by Albert J. Williams 3rd, A. Todd Morrison, and Donald Peters of WHOI. Equipment was loaded on R/V Seward Johnson by Todd and Don April 24 and we all stood CTD and Epsonde watches. Pat O'Malley, Jim Irish, and Craig Marquette helped us rig recovery equipment and Pat directed deck operations during our float recovery. Jim helped us to listen to replies from the commands we sent our release

Appendix 1. Personnel List

Cruise Personnel

- Bedford Institute - EPSONDE profiling

    - Neil Oakey Chief Scientist
    - Liam Petrie Technician
    - Bob Ryan Technician
    - Ed Verge Technician
    - Dan Clark Student
- University of Rhode Island - EPSONDE profiling
    - Dave Hebert Scientist
    - Russ Burgett Student
    - Andy Mack Student
- Woods Hole - CTD, Mooring, BASS
    - Bob Beardsley Scientist
    - Sandy Williams Scientist
    - Jim Irish Scientist
    - Todd Morrison Student
    - Donald Peters Engineer
    - Pat O'Malley Technician
    - Craig Marquette Engineer
    - Kent Bradshaw Technician
- R/V SEWARD JOHNSON
    - Dan Schwartz Captain
    - John Etter Chief Mate
    - Gray Hendrikson Second Mate
    - George Fisher Chief Engineer
    - John Terry Assistant Engineer
    - Whitney Staley Second Assistant Engineer
    - Merlin Martin Seaman
    - Chuck Garrett Seaman
    - Tony Monocandilos Seaman
    - Jay Grant Steward
    - Bruce Ellzey Assistant Steward
- University of Miami, Technical Support
    - Cecil Crosby
    - Don Cucchiara
    - Buddy Davidson

Appendix 2. Tables

Table 1:

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Approximate times (UTC) for the operation of the different ADCPs.


Broad-band 150 kHz

26 Apr 13:50 -26 Apr 14:35

27 Apr 04:25 -28 Apr 16:25

29 Apr 00:10 -29 Apr 17:45

1 May 03:40 - 1 May 19:15


Broad-band 600 kHz

26 Apr 02:40 - 3 May 01:25


Narrow-band 150 kHz

25 Apr 22:16 -26 Apr 13:50

26 Apr 14:40 -27 Apr 04:20

28 Apr 16:30 -29 Apr 00:10

29 Apr 17:45 - 1 May 03:40

1 May 19:25 - 3 May 04:00
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Table 2: Summary of CTD operations on SJ9506

CTD Number Dates   Measurement

1- 8   2306 April 25 Section A' (partial)

- 0533 April 26

9-11   1003 April 26 Calibration of SF LT mooring

- 1024 April 26

12-21 1529 April 26 Section A'

- 2321 April 26

22   0016 April 27 Test cast at shallow EPS site

23-57 0229 April 27   EPSONDE time series at

- 1220 April 28 shallow EPS site

58- 74 2139 April 28   EPS time series #1 at ST1

- 1334 April 29

75-86 1645 April 29 LT Section

- 0443 April 30

87-92 1149 April 30 Section A

- 2111 April 30

93-107 2349 April 30 EPSONDE time series #2 at ST1

- 1331 May 1

108-115 1251 May 2   Section A (partial)

- 1722 May 2

Table 3: CTD Station Positions

Long-Term Moored Program CTD Section Stations

LT1   41 deg 31.0' N x 67 deg 36.0' W 35 m

LT2   41 deg 24.5' N x 67 deg 32.5' W 40 m Crest Mooring Site

LT3   41 deg 17.0' N x 67 deg 28.5' W 45 m

LT4 41 deg 12.5' N x 67 deg 26.5' W 46 m

LT5 41 deg 09.5' N x 67 deg 24.5' W 56 m

LT6 41 deg 06.0' N x 67 deg 22.5' W 62 m

LT7 41 deg 02.0' N x 67 deg 20.8' W 68 m

LT8 40 deg 58.0' N x 67 deg 19.0' W 75 m Southern Flank Mooring

LT9 40 deg 54.5' N x 67 deg 17.0' W 82 m

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LT10 40 deg 50.5' N x 67 deg 15.0' W 89 m

LT11 40 deg 47.0' N x 67 deg 13.0' W 94 m

LT12 40 deg 41.5' N x 67 deg 10.5' W 108 m

LT13 40 deg 35.7' N x 67 deg 08.0' W 165 m
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Turbulence Section

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A1 41 deg 09.2' N x 67 deg 47.0' W 39 m

A2 41 deg 05.7' N x 67 deg 44.2' W 41 m

A3 41 deg 02.3' N x 67 deg 41.4' W 55 m

A4 40 deg 58.8' N x 67 deg 38.6' W 64 m

 40 deg 57.35'    67 deg 37.59'           ST2 Mooring Site

A5 40 deg 55.4' N x 67 deg 36.0' W 67 m

A6 40 deg 51.8' N x 67 deg 33.5' W 75 m  ST1 Mooring Site

A7 40 deg 48.5' N x 67 deg 30.8' W 81 m

A8 40 deg 45.0' N x 67 deg 28.0' W 89 m

A9 40 deg 41.6' N x 67 deg 25.6' W 93 m

A10 40 deg 38.1' N x 67 deg 22.5' W 91 m

A11 40 deg 34.7' N x 67 deg 20.0' W 114 m

A12 40 deg 31.2' N x 67 deg 17.2' W 147 m

A13 40 deg 27.5' N x 67 deg 14.0' W 460 m
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Appendix 3. Figures

Note: Figures are not yet available on-line.

Figure 1: The track chart of GLOBEC Seward Johnson cruise SJ9506 is shown.

Figure 2: A profile from preliminary analysis of the EPSONDE data at the shallow anchor site is shown. In the upper panels are profiles of temperature and salinity showing that the site is unstratified. (Note that there is an offset in the salinity that must be corrected by post-cruise calibrations.) In the panel to the left below are profiles of dissipation (eps) and Chi-Theta (chi) from EPSONDE and the corresponding calculated vertical diffusivities in the bottom right panel.

Figure 3: A figure similar to that in Figure 2 is shown for the anchor station at the stratified site near ST1.

Figure 4: The positions of the CTDs in the first section A and the long term LT section are shown.

Figure 5: The positions of the CTDs in the second and third occupation of the section A are shown.

Figure 6: The sections of temperature, salinity and density along section A1 for (4/25/95 - 4/26/95) are shown.

Figure 7: The sections of temperature, salinity and density along section A1 for (4/26/95) are shown.

Figure 8: The sections of temperature, salinity and density along section LT for (4/29/95 - 4/30/95) are shown.

Figure 9: The sections of temperature, salinity and density along section A for (4/30/95) are shown.

Figure 10: The sections of temperature, salinity and density along section A for (5/2/95 - 4/26/95) are shown.

Appendix 4. Eventlog

The event log is available on-line; you will find it here