

EN307 Cruise Report

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This report was prepared by Charles Greene, Peter Wiebe, Heidi Sosik, Mark Benfield, and Ann Bucklin with assistance from others in the Scientific Party. This cruise was sponsored by the National Science Foundation and the National Oceanographic and Atmospheric Administration.

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INTRODUCTION

R/V ENDEAVOR Cruise 307 was conducted as a U.S. GLOBEC process cruise to examine autumn conditions in the Gulf of Maine relevant to ecosystem processes on Georges Bank. The major scientific objectives of the cruise included:

1. Conducting broad-scale surveys to map the spatial distribution of *Calanus finmarchicus* and its major invertebrate predators in the deep basins of the Gulf of Maine,

2. Collecting MOCNESS samples of *Calanus finmarchicus* for molecular studies of its diapause physiology and population genetics,

3. Conducting broad-scale surveys to map the spatial distribution of bio-optical properties in the Gulf of Maine,

The cruise was laid out as a series of tracklines traversing the major basins in the Gulf of Maine with turning points marking a change in the direction of ship as data were being collected (Figure 1). The original turning points were modified during the cruise in response to sea and work related conditions. The trackline had us leaving Woods Hole (turning point #1), working first in Georges Basin (turning points 4-7), then moving into Jordan Basin (turning points 8,9), and after a short stop in Portland ME to allow some participants to leave the vessel, moving into Wilkinson Basin (turning points 10-21). In addition to the along-track data collection, time was allotted each day for a CTD cast between 1000 and 1400 hours to accommodate the needs of the Bio-optical Group lead by Heidi Sosik and one or two MOCNESS tows.

Summaries of the projects supported by this cruise are presented in the sections following the cruise narrative.

NARRATIVE

The R/V ENDEAVOR departed Woods Hole on cruise EN-307 at 19:00 on 8 October 1997 (Figure 2). The sky was clear and the winds were light during departure. All scientific events conducted during the cruise, beginning with the ship's departure, can be found in the cruise report event log (see Appendix 1).

The early part of the first evening was spent in Vineyard Sound practicing deployment of the BIOMAPER II (BIO-optical Multiple-frequency Acoustic and Physical Environmental Recorder), a large tow body carrying a variety of bio-optical, acoustical, and physical remote-sensing instruments. After we were satisfied with the BIOMAPER II's performance, we changed course and headed for our first station at the western end of Franklin Basin, a southwest to northeast-oriented extension of Georges Basin.

We arrived at station 1 during the late morning of 9 October. Activities at this station included two unsuccessful CTD casts (CTD 1,2) because the rosette water bottle release mechanism was not working properly, a successful CTD cast (CTD 3), and deployment of a tethered, free-fall vertically-profiling spectral radiometer. When these activities were completed, BIOMAPER II was deployed and systems were checked. After several deployments and recoveries, all systems were operational and we began collecting BIOMAPER II data along a survey trackline to the second station at the southwestern edge of the main portion of Georges Basin.

We arrived at station 2 during the early morning of 10 October. BIOMAPER II continued to collect data at the surface while an oblique MOCNESS tow (M-01-001) was conducted. After the MOCNESS tow was completed, we continued along our trackline toward the third station with BIOMAPER II continuing to collect data. Our first towyos with BIOMAPER II were conducted at this time.

We arrived at station 3 during the late morning of 10 October. BIOMAPER II was recovered and then typical mid-day station activities were conducted. These activities included a CTD cast (CTD 4), deployment of the tethered free-fall spectral radiometer, and an oblique MOCNESS tow (M-01-002). After completion of station 3, we continued northward along our survey trackline. Barometric pressure dropped during the day, the wind steadily increased and the skies were cloudy (Figure 3). As the trackline turned from northward to westward, we deployed BIOMAPER II and collected data as we steamed towards station 4 (Figure 2). While the seas did not reach heights that interfered with the data acquisition, our course deviated from the planned survey trackline due to 30 knot winds from the south blowing the ship towards the wire from which BIOMAPER II was being towed. The course change allowed us to continue towyoging BIOMAPER II until station 4. At station 4, BIOMAPER II continued to collect data at the surface while an oblique MOCNESS tow (M-01-003) was conducted. After the MOCNESS tow was completed, we continued towyoging BIOMAPER II on our survey trackline towards station 5.

During the late morning of 11 October, we arrived at station 5. Barometric pressure rose during the day and the winds became light (Figure 3). BIOMAPER II remained in the water collecting data while the typical mid-day station activities were conducted. These activities again included a CTD cast (CTD 5) and deployment of the tethered free-fall spectral radiometer. After completion of station 5 activities, we changed course and steamed northward towards Jordan Basin. Initially, we collected data with BIOMAPER II towed at the surface. At 15:00, we began towyoging BIOMAPER II along our survey trackline for Jordan Basin. Towyoging continued until we reached station 6.

We arrived at station 6 in Jordan Basin shortly after mid-night on 12 October. At this station, BIOMAPER II remained at the surface collecting data while an oblique MOCNESS tow (M-01-004) was conducted. After the MOCNESS tow, towyoging of BIOMAPER II resumed until shortly after sunrise (07:44) when the system was recovered to work on its bio-optical instruments.

At 08:55, we arrived at station 7 and conducted an oblique MOCNESS tow (M-01-005). This was followed by a CTD cast (CTD 6) and deployment of the tethered free-fall spectral radiometer. After the mid-day station activities, BIOMAPER II was redeployed. We resumed towyoging BIOMAPER II for the remainder of the day as we surveyed Jordan Basin. As we headed west from Jordan Basin just after midnight on October 13, we conducted a procedure to calibrate BIOMAPER II's compass and made measurements of background acoustic noise. This involved steaming the ship in three consecutive tight circles. At 02:45, we recovered BIOMAPER II and steamed to Portland to drop off four members of the scientific party. At mid-day on a mild fall day with a shoreline lined with trees showing their fall colors, we arrived in Portland harbor where a chartered boat met the R/V ENDEAVOR and ferried the departing party to shore.

After departing Portland, we steamed toward Wilkinson Basin. During the early afternoon of 13 October at station 8, a CTD cast (CTD 7) and the tethered free-fall spectral radiometer were deployed. When these station activities were completed, we resumed steaming towards Wilkinson Basin. At 17:05, BIOMAPER II was redeployed, and we began our survey of Wilkinson Basin at turning point 11 (Figure 1). BIOMAPER II was towed along the survey trackline as we steamed towards station 9 (Figure 2).

At midnight, we arrived at station 9 where MOCNESS tow (M-01-006) was conducted while BIOMAPER II continued to collect data at the surface. After the MOCNESS tow was completed at 02:20, we resumed towyoging BIOMAPER II along the survey trackline until mid-morning. We arrived at station 10 during the late morning of 14 October and conducted a CTD cast (CTD 8) and deployed the tethered free-fall spectral radiometer. Once completed, we resumed towyoging BIOMAPER II along the survey trackline. During mid-afternoon, we arrived at station 11. BIOMAPER II continued to collect data at the surface while an oblique MOCNESS tow (M-01-007) was conducted. After the MOCNESS tow was completed at 16:28, we resumed towyoging BIOMAPER II along the survey trackline until mid-morning of the next day.

We arrived at station 12 at 11:15 on October 15. BIOMAPER II was recovered to allow calibration of its bio-optical sensors. We then deployed the tethered free-fall spectral radiometer and conducted a CTD cast (CTD 9). BIOMAPER II was redeployed at 14:15, and we resumed towyoing along our survey trackline.

Right after midnight (00:30) on October 16, we arrived at station 13 and while BIOMAPER II collected data at the surface, an oblique MOCNESS tow (M-01-008) was conducted. After the MOCNESS tow was completed, we resumed towyoing BIOMAPER II along the survey trackline until early morning of the next day (05:45) when the broad-scale survey of the Gulf of Maine deep basins was completed.

Other than the moderate, 6 - 9' seas associated with the brief windy period on October 10, we experienced exceptionally good weather, with light winds and 2 -4' seas throughout the broad-scale survey portion of the cruise. This allowed us to complete the survey with about 12 hours to spare. We used this extra time to conduct a series of observations on soliton propagation in the region. These solitons are probably generated in the vicinity of Georges Bank when standing lee waves, formed at the edge of the Bank during the off-Bank tidal flow, are released during the changing tide.

To observe the solitons, we returned to the region of Wilkinson Basin near station 10 where such solitons had been observed previously. The winds increased during the day to 15 to 25 kts and the seas reached 6 - 9'. Windrows of macroalgae, associated with Langmuir circulation, were observed throughout the day. BIOMAPER II was towed at the surface towards station 13. We arrived at station 13 at approximately noon on 16 October and conducted a CTD cast (CTD 10) and deployed the tethered free-fall spectral radiometer. We then resumed towing BIOMAPER II in search of solitons. A soliton, consisting of a packet of about eight internal waves, was detected in the late afternoon while steaming back towards Georges Bank. The surface manifestation of this soliton could be seen on the ships' radar, and thus the ship's watch could track the soliton's location from the bridge. A description of the work that ensued is provided in the acoustic results section below. After a series of passes over the soliton, a final MOCNESS tow (M-01-009) was taken which cut across the soliton. After this pass was completed, we recovered the MOCNESS and BIOMAPER II and steamed for Woods Hole.

The cruise ended when the ship tied up to the Woods Hole dock about noon on 17 October.

INDIVIDUAL REPORTS

1.0 Processes Regulating the Recruitment of *Calanus finmarchicus* from the Gulf of Maine to Georges Bank (Principal Project).

(C.H. Greene, M.C. Benfield, and P.H. Wiebe)

1.1 Introduction

Calanus finmarchicus dominates zooplankton secondary production on Georges Bank during spring. The Georges Bank *Calanus* population is derived from diapausing populations in the deep basins of the Gulf of Maine and the Scotian Shelf east of the Bank. It is hypothesized that processes which regulate the survivorship and supply of *Calanus* from diapausing populations in the deep basins of the Gulf of Maine determine this copepod species' annual production on Georges Bank. To test this hypothesis, research is being conducted 1.) to determine what processes regulate the abundance and survivorship of the diapausing *Calanus* populations in these deep basins, and 2.) to determine how physical and biological processes interact to seed Georges Bank with recruits from these basins each year.

Acoustic and video remote-sensing methods are used to survey diapausing populations of *Calanus* in Georges, Jordan, and Wilkinson Basins of the Gulf of Maine. Broad-scale survey cruises conducted in early and late autumn during 1998 and 1999 will be used to estimate survivorship of the diapausing *Calanus* and the scale-dependent spatial coupling of *Calanus* and its principal invertebrate predators - the euphausiid, *Meganyctiphanes norvegica*, and the siphonophore, *Nanomia cara*.

Results from field studies and feeding experiments will focus on quantifying the relative contribution of predation to the overall mortality of the diapausing *Calanus* population. The results from field studies also will be used as input to coupled physical-biological models to examine how physical transport processes in the Gulf of Maine interact with *Calanus*'s seasonal and diel vertical migration behaviors to seed Georges Bank with new recruits during winter.

1.2 Methods

1.2.1 Broad-scale survey

A broad-scale survey of the Gulf of Maine deep basins was conducted from October 8 - 17, 1997. The survey track included multiple transect lines in Georges, Jordan, and Wilkinson Basins (Figure 2). This initial survey was designed as a pilot study to test our methods prior to the first full field season in 1998.

The survey was conducted using a high-speed, deep-towed system, BIOMAPER II (BIOlogical Multiple-frequency Acoustic Platform and Physical Environmental Remote-sensing system - Figure 4), configured with multiple-frequency (43 kHz, 120 kHz, 200 kHz, 420 kHz, and 1000 kHz) acoustics, a video plankton recorder (VPR), an environmental sensing package (pressure, temperature, conductivity, fluorescence, transmissometry), and several bio-optical sensors (down- and upwelling spectral radiometers, spectrally matched attenuation and absorption meters). The acoustic frequencies were chosen to bracket the transition from the Rayleigh to geometric scattering regions for the target species under investigation. A down- and up-looking transducer operated at each frequency to provide more complete coverage of the water column when the instrument was towed. Echo integration was conducted at 30-second intervals to provide volume-backscattering data at all five frequencies. Split-beam data were collected at the four lower frequencies. All raw acoustic data were recorded on digital audio tape (DAT), while the processing for echo integration was carried out in real time.

The VPR mounted on BIOMAPPER sampled a volume of 2.43 liters min⁻¹. It had an imaging volume with a height of 6.5 mm, a width of 8.0 mm, and a depth of field of 13.0 mm. All video images were recorded on SVHS tape for post-cruise processing at WHOI. GPS data were synchronized with the VPR signal and stamped on the video time code.

1.2.2 MOCNESS stations

During the broad-scale survey cruise of the Gulf of Maine deep basins, 1-m² MOCNESS tows were conducted at three stations in Georges Basin, two stations in Jordan Basin, and four stations in Wilkinson Basin (Figure 2, Appendix II). The MOCNESS was equipped with nine nets made of 335 μ m nylon nitex mesh. Splits from the MOCNESS samples were preserved in formalin for ground-truthing and inter-comparisons with the BIOMAPER II acoustics and VPR data, and preserved in alcohol or frozen in liquid nitrogen for molecular studies of copepod population genetics by Ann Bucklin (University of New Hampshire), and diapause physiology, by Patrick Hassett (University of Ohio). Additional detail about the latter work is given below.

1.3 Results

1.3.1 Broad-scale survey

1.3.1.1 Multi-frequency acoustics

The multi-frequency acoustics, bio-optical (including VPR), and physical oceanographic data were collected during nine deployments of BIOMAPER II throughout the Gulf of Maine. Two major acoustic sections were obtained in Georges Basin, one line extended from Georges Basin to Jordan Basin, two lines were taken in Jordan Basin, and four lines were taken in Wilkinson Basin (Figure 5). The last line involved a special study of a soliton (See section below). The total trackline distance along which data were collected was 1017 km (549 nm - Table 1). During the deployments, data were collected in a down-looking mode with BIOMAPER II towed just below the surface, in a down and up-looking mode while towed horizontally at some sub-surface depth, or towed from the surface to within 10 to 30 m of the ocean bottom. As described above, during some periods of BIOMAPER II data acquisition, MOCNESS tows were taken to collect planktonic animals (Figure 2). Aliquots of these samples will be analyzed to produce numbers and size data of the major taxa making up the samples and these data will be used in combination with theoretical models to develop predicted volume backscattering values for comparison with those values observed with BIOMAPER II.

Table 1. Distance of BIOMAPER II Trackline Sections on R/V ENDEAVOR Cruise 307 (7-17 October 1997).

| Section | Year-day Start Time | Year-day End Time | km | nm |
|---------|------------------------|----------------------|-------|--------|
| 1 | 282.885 | 283.440 | 126.5 | 68.3 |
| 2 | 283.848 | 284.478 | 82.3 | 44.5 |
| 3 | 284.628 | 285.004 | 85.4 | 46.1 |
| 4 | 285.092 | 285.322 | 42.6 | 23.0 |
| 5 | 285.531 | 286.010 | 96.6 | 52.2 |
| 6 | 286.728 | 288.154 | 280.6 | 151.5 |
| 7 | 288.237 | 288.477 | 55.6 | 30.0 |
| 8 | 288.631 | 289.239 | 126.6 | 68.4 |
| 9 | 289.296 | 289.951 | 120.9 | 65.3 |
| Total | | | 549.2 | 1017.1 |

The instrument systems on BIOMAPER II worked very well with the exception of one of the 43 kHz transducers which suffered an, as yet undefined, electronic hardware failure during the first trackline section and the Environmental Sensing System's (ESS) pressure transducer which gave poor pressure readings until it was repaired during the transit from Jordan Basin to Portland, ME. The software to acquire the data, which was provided by HTI, enabled the simultaneous acquisition of data on five frequencies each with two transducers (one up-looking and one down-looking). Each transducer was allocated 200 1-m depth strata and data were collected in 30 second intervals (averages). A ping cycle for all frequencies and transducers took about 2.5 seconds with a firing sequence of down-looking 43, 120, 200, 420, 1000 kHz and then up-looking 43, 120, 200, 420, 1000 kHz. In addition, the raw data for each ping were recorded on DAT tape for postprocessing of either target strengths or echo-integrations on a different time averaging basis. Each tape recorded two gigabytes of data and a total of 62 tapes were recorded during the cruise.

Post-processing software, which was still under development on the cruise, was used to combine the up-looking and down-looking data for a given frequency and then display the data as color enhanced echogram. During the cruise significant progress was made by Erhan Mutlu in making improvements in the MATLAB code used in the post-processing and it is now possible to create plots of the volume backscattering in the water column shortly after a BIOMAPER II section has been completed.

There are several general observations that result from an initial look at the post-processed acoustic data. Diel vertical migration is evident in the echograms from all three basins with somewhat lower volume backscattering in the surface waters during the day and higher levels in this depth interval at night (Figure 6). During the same period, increased scattering occurred at mid-depth levels i.e. 50 to 150 meters during the day which became much weaker or disappeared at night.

There were basin to basin differences in the acoustic structure as well. A distinct layer was present near the bottom in Georges Basin which does not show up in the echograms from Jordan Basin. Such a layer did exist in Wilkinson Basin, but it was not as well formed nor as strong. On the other hand, in Jordan Basin there were many isolated but quite strong targets (perhaps small fish schools) which occurred from just above the bottom (around 240 to 250 m) up to 100 meters depth which were not nearly as evident in the other two basins. Interpretation of these trends in terms of the biological entities present must await the analysis of the VPR video tapes and the MOCNESS samples.

Soliton Experiment: After completing the survey of Wilkinson Basin at Turning Point 21 on 16 October (Figure 1), we began a short study of internal wave packets or solitons which were observed during work in the vicinity of Turning Points 13 and 14. The vessel steamed back towards Turning Point 13 at about 6 kts with BIOMAPER II deployed at about 5 m and operating in the down-looking mode. We arrived at this location about noon and commenced a light profile cast and a CTD cast. During the period of this work, no

substantial internal wave activity was observed. Once the station work was completed, we began to steam towards Georges Bank at about 4 kts., because it was a likely source of internal wave activity.

At 1513, the bridge called down to say that they could see strong banding on the radar was which reflected the presence of internal waves. There were about 8 wave crests in the soliton visible on the radar screen. A few minutes later, the acoustic records clearly showed the first crest of the internal wave packet (Figure 7). The radar image of the sea surface manifestation of the soliton together with the acoustic echogram of its internal structure enabled determination of the direction of packet propagation which was approximately 310 degrees. Within 45 minutes, the ENDEAVOR had passed the soliton. The ship's course was reversed and BIOMAPER II was lowered to 50 m depth. This was done to enable the up-looking transducers to provide acoustic measurements right to the sea surface. It took much longer (more than 100 minutes) to return to the front of the soliton because we were steaming in the direction of its propagation which was estimated to be 1 to 1.5 kts. Once past the soliton, BIOMAPER II was lowered to within 30 m of the bottom to get a profile of environmental properties and then brought to the surface before again reversing the ship's course.

The third pass through the internal wave packet was made at 25 to 30 m depth which was where volume backscattering appeared to be most intense in the wave crests on previous tows. About 2009 (42 28.43 N; 68 45.24 W), the radar on the bridge showed that we were again in the soliton and about to enter the second wave trough. On this occasion, the estimate was that the waves were heading on a course of 330 degrees.

Once through the packet, we again returned on a reciprocal course (339 deg true). A fourth pass across a portion of the internal wave packet was done at 6 kts with BIOMAPER II at the surface. About halfway into the wave packet, the ship was slowed to about 2 kts and the 1-m² MOCNESS was deployed. The net system was shot to 175 m and then nets were opened and closed at 175, 150, 125, 100, 80, 60, 40, 20 and 0 m. With the closing of the last net, the data acquisition of this special experiment was ended, the gear brought onboard, and the ENDEAVOR began its steam back to the port of Woods Hole.

Initial results from the first pass over the soliton provided a very interesting picture of the frequency dependence of the volume backscattering from the wave packet (Figure 7). In the 43 kHz record, most of the energy echoed back to BIOMAPER II came from wave crests and trough close to the surface. At 120 kHz, a deeper structure became evident as proportionately more energy was received. This trend continued with the 200 kHz record where about equal amounts of energy came from the near surface and deeper wave forms, and then with the 420 kHz record where the dominant source of energy came from the deeper wave form. At 1000 kHz, the soliton was also visible, but only near the surface due to the short range of that frequency. Additional work is required to explain this frequency dependence.

Instrumentation improvements: As with any new instrument system, this first scientific cruise of BIOMAPER II was not without some difficulties. Some problems were identified which have relatively easy solutions. These include:

- 1) Extending the VPR camera and strobe to position further in front of the BIOMAPER II nose to get around probable avoidance problems. As described in the section on the VPR by M. Benfield, there did seem to be evidence that some of the animals were making move to avoid the region where their picture was taken.
- 2) There was also some indication in the pitch data displayed on the Bio-engineering computer that pitch values started to be large when vertical velocities exceed 10 m/min. For this and other reasons, the vertical descent and ascent rates should be kept around 5 m/min. Perhaps more importantly, the pitch and roll data need to be logged to a computer file so that these parameters can be examined after a tow has been completed.
- 3) For a number of situations, it is desirable to collect echo integration data at intervals smaller than 30 seconds. When starting the internal wave study described below, there was an attempt made to average over 10 second intervals. The HTI software, however, developed severe timing problems and eventually the acquisition program failed and the computer system had to be re-booted. HTI is aware of the need to fix this problem. In addition, while the acoustic processing software generally worked well, it was still subject to failures of undetermined origin which may be solved by using a more powerful computer.
- 4) Some of the difficulties with the HTI data acquisition system may also be related to the Lantastic LAN system used to connect all the computers that are involved in data handling in BIOMAPER II. There is a need to improve the LAN system so that data can be more easily passed from one to the other. There is also a need to put SCSI interfaces in strategic computers so that JAZ drives can be used to move data to computers not on the Network.
- 5) During the operation of BIOMAPER II, there were times when the oil temperature got close to the perceived upper limit on the hydraulic system for the winch and power pack. The extent to which this is a problem needs to be examined. At the least the winch/power pack should have the vital instrument readouts wired so that the readings can be displayed and recorded by the BIO_Engineering computer.
- 6) There is also a need for a count-down timer for alerting watch-standers of DAT and video recording tapes that are about to run out. Data were lost because tapes were not exchanged on a timely basis.
- 7) There is a need for red lights inside the BIOMAPER II van which would allow people to work and read while enabling them to watch the external and VPR monitors with much less glare. Better lighting outside the van is also needed.

A problem of concern, but of uncertain origin, has to do with the volume backscattering anomalies that are evident in the echograms within 10 to 15 meters above and below BIOMAPER II when the system is being towed (Figure 8). In regions of the water column where volume backscattering is high, the values within 10 to 15 m of the towed body are enhanced and where volume backscattering is low, the values are depressed. The effect is not apparent when BIOMAPER II is held at a constant depth either near the surface or at some depth below the surface. The effect may have something to do with the towing wire and tow-bar assembly, but it is not clear at this writing how these structures could have an effect on both the up-looking and the down-looking transducers.

1.3.1.2 Video plankton recorder (VPR)

The VPR on BIOMAPER remained operational throughout the entire cruise. It was not possible to view still images from the VPR in real time because the camera was not connected to a region of interest (ROI) extraction system. However, the presence of a video

monitor afforded us brief glimpses of abundant taxa as they flashed by at 60 fps. Subsequent examination of an extremely limited subset of the video data was undertaken using a field by field SVHS editing deck. The results indicated that the quality of individual images was superb. The oil sacs, antennular and urosome segments, and prosome details were all clearly visible on *Calanus finmarchicus*.

The orientations of *Calanus* suggested that this species may have detected that presence of BIOMAPER II. Some individual copepods had their antennae folded against their sides and occasionally had their urosome folded anteriorly. Examination of four 2.5-5.0-min sections of tape 49 revealed that the frequency of *Calanus* in alarm postures was higher than normal postures (Figure 9); however, this difference was not statistically significant ($p=0.26$, one-tailed t-test). In light of the relatively high incidence of animals in alarm postures, we suggest that the camera and strobe be moved further forward so that they can collect images from an undisturbed volume of water.

The concentrations of *C. finmarchicus* estimated from these tape sections ranged from 493-1150 copepods m^{-3} . Concentrations were not estimated for other taxa, however, siphonophores, ctenophores, salps, chaetognaths, amphipods, small copepods, and diatom chains were all frequently observed on the video monitor. It is important to emphasize that these results are based on an extremely small sub-sample of the total VPR data set and that we cannot associate these video fields with specific locations and depths until their time codes have been referenced to the other BIOMAPER II data sets.

1.3.2 MOCNESS stations

MOCNESS samples revealed large, qualitative differences in zooplankton composition and distribution among the Gulf of Maine deep basins. Zooplankton composition in Georges Basin exhibited a strong influence from the Slope Water, especially from samples collected at the station nearest Northeast Channel. *Calanus* was moderately abundant in the deeper waters of the Basin, but diminished in abundance along a west to east gradient. Gelatinous zooplankton, including chaetognaths, ctenophores, scyphomedusae, and salps, were extremely abundant in the Basin. Salps dominated the zooplankton biomass in the surface waters of two of the three MOCNESS stations (stations 2 and 3).

Zooplankton biomass in Jordan Basin was strongly dominated by *Calanus*. *Calanus*

was extremely abundant in the deeper waters of the Basin and diminished rapidly at mid-water depths. Zooplankton biomass was sparse at these mid-water depths. Small copepods were abundant in the upper water column.

Zooplankton biomass in Wilkinson Basin was dominated by *Calanus*, Meganyctiphanes, decapod shrimp, and salps. *Calanus* was abundant in the deeper and middle portions of the water column and salps were very abundant in the upper water column. The Meganyctiphanes and decapod shrimp were strong migrators, occurring in the deeper waters by day and in the upper 100 m by night.

2.0 Spatio-Temporal Variability of Bio-Optical Properties in the Gulf of Maine (Ancillary Project).

(H.M. Sosik)

2.1 Introduction

Our long term objectives are to characterize spatial and temporal variability in the optical properties related to phytoplankton biomass and productivity in the Georges Bank/Gulf of Maine region. This will be accomplished by a combination of optical measurements made from vertical-profiling moorings, towed vehicles, earth-orbiting satellites, and research vessels conducting conventional station surveys. This cruise is the first field phase of the project, aimed at testing equipment and methods for optical characterization from the BIOMAPER II towed vehicle.

2.2 Methods

We successfully integrated several optical instruments on to BIOMAPER II. These included two Ac-9 dual path spectral absorption and attenuation meters (Wet Labs, Inc.) as well as a spectral downwelling irradiance sensor (OCI-200, Satlantic, Inc.) and a spectral upwelling radiance sensor (OCR-200 series, Satlantic, Inc.). One of the Ac-9's measured whole-water properties and the other was configured with an in-line 0.2 μm water filter to assess absorption by dissolved material. The instruments were configured with matching wavelength bands selected to cover the visible spectrum and to reflect those on the SeaWiFS ocean color sensor [Ac-9's: 412, 440, 488, 510, 532, 555, 650, 676, 715 nm; radiometers: 412, 443, 490, 510, 555, 665, 683 nm]. The data acquisition system (designed and assembled at WHOI) for these instruments is based on a subsurface PC-104 and includes 2 serial ports, a 16-channel/16-bit A/D converter, an 8 MB flash disk, and an ethernet adapter for communication with the BIOMAPER II Lantastic network. Through network access this system enabled storage of data files on a desktop PC aboard the ship. In addition to the measurements made from BIOMAPER II, continuous logging of surface spectral irradiance was also carried out with a spectral downwelling irradiance sensor (MVDS, Satlantic, Inc.) mounted above the deck of the ship.

Sampling conducted on the cruise also included water collection and vertical profiles of downwelling irradiance and upwelling radiance with a free-fall spectral radiometer (SPMR/SMSR system, Satlantic, Inc.) deployed away from the ship. This work was conducted at mid-day on each day of the cruise. Water samples were collected for pigment analysis and for estimation of light absorption by particulate and dissolved material. Pigment samples were concentrated on Whatman GF/F filters and extracted in 90% acetone for spectrophotometric estimation of chlorophyll a and phaeopigment concentrations. Spectrophotometric determinations of particle absorption were made on freshly filtered samples (GF/F filters) before and after extraction of phytoplankton pigments with methanol and dissolved absorption was measured on 0.2 μm filtrate in 10 cm cuvettes. These spectra were acquired with 1 nm resolution between 300 and 800 nm. The free-fall radiometer has the same spectral bands as the optical heads on BIOMAPER and profiles were conducted between 10:00 and 14:00 local time, immediately prior to or immediately after the CTD/water sampling casts.

Trial measurements with a new Fast Repetition Rate Fluorometer (FastTracka FRRF, Chelsea Instruments) also were made in flow-through mode using the ship's uncontaminated seawater for most of the cruise duration.

2.3 Results

Optical data were successfully collected from BIOMAPER II during each of the deep basin surveys. Initial processing suggests that operation in tow-yo mode proved very successful in mapping distributions of optical properties. An example of the type of data collected in the survey of Wilkinson Basin shows spatial variations in scattering and absorption coefficients associated with water column structure (Figure 10 a-f). Highest values were found near the bottom and in conjunction with phytoplankton patches in the upper 50 m. Absorption by dissolved material exhibited less patchiness than found for particles, but in the blue region of the spectrum, the dissolved component consistently appeared to be the major source of absorption in the mid-water column.

Approximately 80 water samples were analyzed for pigment and high spectral resolution absorption. Water was collected from 10 or 11 depths selected from throughout the water column on 8 CTD/rosette casts (CTD3-10). Pigment concentrations and particle absorption coefficients exhibited subsurface maxima (several $\mu\text{g l}^{-1}$) at a depth of approximately 30 m, with magnitude falling off rapidly below 50 m. Absorption by non-phytoplankton particulates was very low in the surface waters.

Figure 10. Bio-optical and hydrographic data obtained from sensors deployed on BIOMAPER II during three towyo sections across Wilkinson Basin on 13-15 October 1997. a) temperature, b) salinity, c) chlorophyll fluorescence, d) beam attenuation coefficient for particles (c_p), e) absorption coefficient for particles (a_p), f) absorption coefficient for soluble material (a_s). Absorption and attenuation coefficients have been corrected for instrumental temperature dependence in the ac-9's and for differences in temperature and salinity from the calibration water. Preliminary corrections for residual scattering effects on absorption estimates have also been applied. The distributions presented here have not been completely corrected for the time lag in a_s measurements (due to slower flow caused by the in-line particle filter); some distortions are evident particularly during the third transect (when the filter throughput was decreasing).

Figure 10. b) salinity. See Figure 10 a for complete legend.

Figure 10. c) chlorophyll fluorescence. See Figure 10 a for complete legend.

Figure 10. d) beam attenuation coefficient for particles (c_p). See Figure 10 a for complete legend.

Figure 10. e) absorption coefficient for particles (a_p). See Figure 10 a for complete legend.

Figure 10. f) absorption coefficient for soluble material (a_s). See Figure 10 a for complete legend.

The free-fall radiometer was successfully deployed at 8 stations with 2-3 replicate vertical profiles conducted during each deployment. Casts with the sensor caps in place were also carried out to allow correction for temperature dependence of dark values. These data will be analyzed to determine vertical profiles of diffuse attenuation coefficients and remote-sensing reflectance.

After some initial problems with data acquisition, several days of data were collected with the FRR fluorometer. Preliminary results show daily variations in photosystem II efficiency, with inhibition evident just after local noon on a sunny day and absent on a cloudy day.

3.0 Distribution and relative abundance of *Pseudocalanus* spp. in the Gulf of Maine (Ancillary Project)

(Ann Bucklin)

3.1 Introduction

The calanoid copepod species, *Pseudocalanus moultoni* and *P. newmani*, differ in geographic distribution and life history - but they cannot be reliably distinguished using morphological characters. Previous studies have concluded that *Pseudocalanus* is endemic to Georges Bank and Davis (1984: J. Mar. Res. 42:573) considered that the life history of *Pseudocalanus* sp. may be adapted to ensure retention in the cyclonic gyre patterns over the Bank. A revision of the genus by Frost (1989: Can. J. Zool. 67:525) concluded that two sibling species of *Pseudocalanus* occur sympatrically on Georges Bank. Both species are thought to be present in waters over the Bank throughout much of the year and may reproduce nearly continuously on the Bank.

The primary source of recruitment may be local reproduction of Bank populations, in contrast to another copepod, *Calanus finmarchicus*, that repopulates the Bank each spring from surrounding waters. This project identifies and discriminates individuals of the two species by sequence-specific gene amplification by the polymerase chain reaction (PCR). Temporal and spatial distributions of larval, juvenile, and adult female stages of both species are being determined from zooplankton samples of the Georges Bank Study Broadscale Survey cruises. Patterns of distribution will be characterized monthly from January to June of 1997 and 1998 to determine how stage-specific distributions interact with circulation patterns on the Bank. Image analysis will be used to size the individuals of each stage to determine whether rates of growth and development differ between the species.

Collaborative work with bio-physical modelers will be done to place the stage-structured populations of each species in realistic flow fields. It is hypothesized that the life histories of the *Pseudocalanus* spp. on Georges Bank differ in ways that are suited to the geographic distribution and reproductive ecology of the species. Failure to discriminate the species has prevented our understanding of how zooplankton life histories interact with Bank circulation patterns to determine the likelihood of retention and successful recruitment. Comparison between the life histories of *P. moultoni* and *P. newmani*, based on stage-specific distributions in time and space over Georges Bank, will help reveal the mechanisms of population maintenance for each species and determine whether and how the sibling species differ.

3.2 Methods

Samples from all 9 MOCNESS tows were split and preserved in alcohol for molecular analysis. *Pseudocalanus moultoni* adult females will be sorted from the #7 net, the 50 - 25 m depth interval on most tows. Species-specific PCR amplifications will be used to identify the species. The distribution and relative abundance of female *P. moultoni* will be determined for the sampled domain. In addition, the DNA sequence of the mitochondrial cytochrome oxidase I (COI) gene will be sequenced for female *P. moultoni*, and the sequence data will be used for population genetic analysis of the species from the Gulf of Maine and Georges Bank.

MOCNESS samples that consisted predominantly of *Calanus finmarchicus* were size-sorted by washing the sample through a stacked series of sieves with decreasing mesh sizes (2000 um > 1000 um > 500 um > 333 um). The contents of each sieve were visually checked for *Calanus*; up to 300 cc of sample volume was removed with a spoon from the sieve with the greatest concentration of *Calanus*, placed in a plastic bag, wrapped in aluminum foil, and flash-frozen in liquid nitrogen. One size-sorted sample of *Calanus* was frozen for each MOCNESS tow, for a total of nine samples. These samples of nearly pure *C. finmarchicus* will be used for molecular genetic analyses. Portions of the samples will be shipped to Dr. Pat Hassett (Miami University, Oxford, Ohio) as he has requested.

3.3 Results

There appeared to be dense populations of *Pseudocalanus* spp. in some of the MOCNESS samples. Some of the individuals were females with attached egg clusters. These individuals will be targeted for molecular identification, to determine whether one or both of the species are actively reproducing at this time in the Gulf of Maine.

There were dense populations of *C. finmarchicus* at some locations along the cruise track. The MOCNESS samples at these sites yielded nearly pure samples of the copepod, which will be useful for a suite of molecular and biochemical analyses.

CRUISE PARTICIPANTS

Scientific Personnel

1. Charles Greene Cornell University (Chief Scientist)
2. Louise McGarry Cornell University
3. Bruce Monger Cornell University
4. Karen Fisher Cornell University
5. Mark Benfield Louisiana State University
6. Peter H. Wiebe Woods Hole Oceanographic Institution
7. Tom Austin Woods Hole Oceanographic Institution
8. Richard Arthur Woods Hole Oceanographic Institution
9. Joseph Warren Woods Hole Oceanographic Institution
10. Andrew Seitz Woods Hole Oceanographic Institution
11. Erhan Mutlu Woods Hole Oceanographic Institution
12. Heidi Sosik Woods Hole Oceanographic Institution
13. Anne Canaday Woods Hole Oceanographic Institution
14. Benjamin Halpern Woods Hole Oceanographic Institution
15. Sean Hill University of New Hampshire
16. Sam Johnson Hydroacoustic Technology Incorporated
17. William Fanning University of Rhode Island

Officers and Crew

1. Thomas R. Tyler Master
2. Everett A. McMunn Chief Mate
3. Stephen S. Vetra Second Mate
4. Jack E. Buss Boat-Swain
5. Glen D. Prouty Able-Seaman
6. Richard P. Foley Able-Seaman
7. David T. J. Rocha Able-Seaman
8. James P. Cobleigh Assistant Engineer
9. William A. Appleton Chief Engineer
10. Timothy S. Varney Assistant Engineer
11. Daniel T. Butler Steward/Cook

APPENDIX 1. Event Log for R/V ENDEAVOR Cruise 307.

U.S. GLOBEC Gulf of Maine Event Log (October 1997)

| | | | | | | 10/97 | Local +4 | Start | | | Water | Cast | | | | |
|---------|-------|-------------|---------|---------|-------|-------|----------|----------|------------|------------|-----------|--------------|----------------|-----------------|------------------------------|-----------------|
| YearDay | Event | Instrument | Cast #. | Station | Turn | Date | h:mn | End | Lat (N) | Lon (W) | Depth (m) | Depth (m) | Investigator | Region | Comments | |
| 281.792 | 1 | Calibration | | | 1:2 | 8 | 19:00:00 | | | | | | Greene | WHOI | Finish calibrations; depart | |
| 281.875 | 2 | BIOMAPER | BMP1 | | 1:2 | 8 | 21:00:00 | s | 4125.62 | 7048.55 | 21 | 3 | Greene | Vineyard Sound | BIOMAPER II Dip test | |
| 281.938 | 3 | BIOMAPER | BMP1 | | 1:2 | 8 | 22:31:00 | e | 4122.24 | 7054.93 | 15 | 3 | Greene | Vineyard Sound | Recover BIOMAPER II | |
| 282.434 | 4 | CTD | CTD1 | 1 | | 9 | 10:25:00 | s | 4148.82 | 6822.98 | 213 | 200 | Sosik/Houghton | Georges Basin | Deploy CTD | |
| 282.460 | 5 | CTD | CTD1 | 1 | | 9 | 11:02:00 | e | 4148.65 | 6823.05 | 213 | | | | Recover CTD (bottle misfire) | |
| 282.470 | 6 | Radiometer | SPMR1 | 1 | | 9 | 11:17:00 | s | 4148.63 | 6823.12 | 210 | 200 | Sosik | Georges Basin | Deploy Radiometer | |
| 282.491 | 7 | Radiometer | SPMR1 | 1 | | 9 | 11:47:00 | e | 4148.63 | 6823.34 | 210 | | | | Recover Radiometer | |
| 282.499 | 8 | CTD | CTD2 | 1 | | 9 | 11:58:00 | s | 4148.65 | 6823.39 | 210 | | Sosik/Houghton | Georges Basin | Deploy CTD | |
| 282.514 | 9 | CTD | CTD2 | 1 | | 9 | 12:20:00 | e | 4148.75 | 6823.53 | 210 | 200 | | | Bottle Misfire | |
| 282.516 | 10 | CTD | CTD3 | 1 | | 9 | 12:23:00 | s | 4148.75 | 6823.53 | 210 | | Sosik/Houghton | Georges Basin | Deploy CTD | |
| 282.530 | 11 | CTD | CTD3 | 1 | | 9 | 12:43:00 | e | 4148.87 | 6823.63 | 210 | | | | Recover CTD | |
| 282.573 | 12 | BIOMAPER | BMP2 | 1 | 3:4 | 9 | 13:45:00 | s | 4149.71 | 6823.40 | 210 | | Greene | Georges Basin | Deploy BIOMAPER II | |
| 282.606 | 13 | BIOMAPER | BMP2 | 1 | 3:4 | 9 | 14:32:00 | e | 4150.74 | 6822.02 | 210 | | | | Recover BIOMAPER II | |
| 282.653 | 14 | BIOMAPER | BMP3 | 1 | 3:4 | 9 | 15:41:00 | s | 4152.19 | 6820.34 | 207 | 40 | Greene | Georges Basin | Deploy BIOMAPER II | |
| 282.850 | 15 | BIOMAPER | BMP3 | 1 | 3:4 | 9 | 20:24:00 | e | 4210.74 | 6753.26 | 243 | | | | Recover BIOMAPER II | |
| 282.885 | 16 | BIOMAPER | BMP4 | | 3:4 | 9 | 21:15:00 | s | 4210.62 | 6753.19 | 250 | 200 | Greene | Georges Basin | RE-redeploy BIOMAPER | |
| 283.065 | 17 | MOCNESS | MOC1 | 2 | | 10 | 01:33:00 | s | 4221.78 | 6735.36 | 275 | 244 | Wiebe | Georges Basin | Deploy MOCNESS | |
| 283.146 | 18 | MOCNESS | MOC1 | 2 | | 10 | 03:30:00 | e | 4217.18 | 6734.17 | | | | | Recover MOCNESS | |
| 283.486 | 19 | BIOMAPER | BMP4 | | | 10 | 11:40:00 | e | 4216.53 | 6629.07 | 250 | | | | Recover BIOMAPER II | |
| 283.507 | 20 | CTD | CTD4 | 3 | 4:5 | 10 | 12:10:00 | s | 4215.71 | 6627.96 | 250 | 240 | Sosik/Houghton | Georges Basin | Deploy CTD | |
| 283.528 | 21 | CTD | CTD4 | 3 | 4:5 | 10 | 12:41:00 | e | 4215.63 | 6627.02 | | | | | Recover CTD | |
| 283.542 | 22 | Radiometer | SPMR2 | 3 | 4:5 | 10 | 13:00:00 | s | 4215.78 | 6627.89 | 250 | 100 | Sosik | Georges Basin | Deploy Radiometer | |
| 283.564 | 23 | Radiometer | SPMR2 | 3 | 4:5 | 10 | 13:32:00 | e | 4215.18 | 6626.69 | 250 | | | | Recover Radiometer | |
| 283.624 | 24 | MOCNESS | MOC2 | 3 | | 5 | 10 | 14:58:00 | s | 4213.87 | 6625.01 | 225 | | Wiebe | Georges Basin | Deploy MOCNESS |
| 283.688 | 25 | MOCNESS | MOC2 | 3 | | 5 | 10 | 16:30:00 | e | 4211.49 | 6623.73 | | | | | Recover MOCNESS |
| 283.792 | 26 | BIOMAPER | BMP5 | | | 10 | 19:00:00 | s | 4227.90 | 6640.00 | | | Greene/Wiebe | Georges Basin | Deploy BIOMAPER | |
| 284.151 | 27 | MOCNESS | MOC3 | 4 | 6:7 | 11 | 03:38:00 | s | 4225.30 | 6700.25 | 360 | 330 | Wiebe | Georges Basin | Deploy MOCNESS | |
| 284.210 | 28 | MOCNESS | MOC3 | 4 | 6:7 | 11 | 05:02:00 | e | 4226.31 | 6703.30 | | | | | Recover MOCNESS | |
| 284.478 | 29 | CTD | CTD5 | 5 | | 11 | 11:29:00 | s | 4235.28 | 6730.91 | 245 | | Sosik/Houghton | Georges Basin | Deploy CTD | |
| 284.500 | 30 | CTD | CTD5 | 5 | | 11 | 12:00:00 | e | 4235.29 | 6730.75 | | | | | Recover CTD | |
| 284.508 | 31 | Radiometer | SPMR3 | 5 | | 11 | 12:12:00 | s | 4235.34 | 6730.60 | 245 | 180 | Sosik | | Deploy Radiometer | |
| 284.531 | 32 | Radiometer | SPMR3 | 5 | | 11 | 12:44:00 | e | 4235.60 | 6730.59 | | | | | Recover Radiometer | |
| 285.049 | 33 | MOCNESS | MOC4 | 6 | | 12 | 01:10:00 | s | 4330.94 | 6753.20 | 254 | 240 | Wiebe | Jordan Basin | Deploy MOCNESS | |
| 285.101 | 34 | MOCNESS | MOC4 | | | 12 | 02:25:00 | e | 4333.22 | 6753.56 | | | | | Recover MOCNESS | |
| 285.322 | 35 | BIOMAPER | BMP5 | | | 12 | 07:44:00 | e | 4347.70 | 6730.42 | | | | Jordan Basin | Recover BIOMAPER | |
| 285.372 | 36 | MOCNESS | MOC5 | 7 | TP 8 | 12 | 08:55:00 | s | 4349.13 | 6729.60 | 202 | 190 | Wiebe | Jordan Basin | Deploy MOCNESS | |
| 285.420 | 37 | MOCNESS | MOC5 | 7 | | 12 | 10:05:00 | e | 4349.59 | 6729.56 | | | | | Recover MOCNESS | |
| 285.441 | 38 | CTD | CTD6 | 7 | | 12 | 10:35:00 | s | 4347.97 | 6730.09 | 230 | 220 | Sosik | Jordan Basin | Deploy CTD | |
| 285.460 | 39 | CTD | CTD6 | 7 | | 12 | 11:02:00 | e | 4347.83 | 6730.25 | | | | | Recover CTD | |
| 285.468 | 40 | Radiometer | SPMR4 | 7 | | 12 | 11:14:00 | s | 4347.75 | 6730.33 | 230 | | Sosik | Jordan Basin | Deploy Radiometer | |
| 285.483 | 41 | Radiometer | SPMR4 | 7 | | 12 | 11:35:00 | e | 4347.68 | 6730.38 | | | | | Recover Radiometer | |
| 285.528 | 42 | BIOMAPER | BMP6 | | | 12 | 12:40:00 | s | | | | | | | Deploy BIOMAPER | |
| 286.010 | 43 | Calibration | CMPS | | | 13 | 00:14:00 | s/e | 4314.28 | 6810.39 | 230 | | | | Compass calib, noise test | |
| 286.115 | 44 | BIOMAPER | BMP6 | | | 13 | 02:45:00 | e | 4314.28 | 6810.39 | | | | | Recover BIOMAPER | |
| 286.115 | 45 | Radiometer | SPMR5 | | | 13 | 02:45:00 | s | | | | | | | Deploy Radiometer | |
| 286.594 | 46 | Radiometer | SPMR5 | 8 | | 13 | 14:16:00 | e | 4320.06 | 7001.71 | | | Sosik | Wilkinson Basin | Recover Radiometer | |
| 286.601 | 47 | CTD | CTD7 | 8 | | 13 | 14:25:00 | s | 4320.09 | 7001.77 | 180 | 172 | Sosik | Wilkinson Basin | Deploy CTD | |
| 286.618 | 48 | CTD | CTD7 | 8 | | 13 | 14:50:00 | e | 4320.11 | 7001.63 | 165 | | Sosik | Wilkinson Basin | Recover CTD | |
| 286.712 | 49 | BIOMAPER | BMP7 | | | 13 | 17:05:00 | s | 4259.05 | 6955.12 | 240 | | Greene | | Deploy BIOMAPER | |
| 287.014 | 50 | MOCNESS | MOC6 | 9 | | 14 | 00:20:00 | s | 4239.40 | 6925.13 | 240 | 220 | Wiebe | Wilkinson Basin | Deploy MOCNESS | |
| 287.097 | 51 | MOCNESS | MOC6 | 9 | | 14 | 02:20:00 | e | | | | | | | Recover MOCNESS | |
| 287.451 | 52 | CTD | CTD8 | 10 | | 14 | 10:50:00 | s | 4214.90 | 6844.83 | 200 | | | | Deploy CTD | |
| 287.467 | 53 | CTD | CTD8 | 10 | | 14 | 11:12:00 | e | 4215.03 | 6844.70 | | | Sosik/Houghton | | Recover CTD | |
| 287.472 | 54 | Radiometer | SPMR6 | 10 | | 14 | 11:20:00 | s | 4215.01 | 6844.64 | 200 | 150 | Sosik | | Deploy Radiometer | |
| 287.490 | 55 | Radiometer | SPMR6 | 10 | | 14 | 11:45:00 | e | 4215.60 | 6844.69 | | | | | Recover Radiometer | |
| 287.620 | 56 | MOCNESS | MOC7 | 11 | | 14 | 14:53:00 | s | 4224.04 | 6849.03 | 205 | 185 | Wiebe | Wilkinson Basin | Deploy MOCNESS | |
| 287.686 | 57 | MOCNESS | MOC7 | 11 | | 14 | 16:28:00 | e | 4224.93 | 6844.22 | | | Wiebe | Wilkinson Basin | Recover MOCNESS | |
| 288.477 | 58 | BIOMAPER | BMP7 | 12 | | 15 | 11:27:00 | e | 4216.63 | 6915.57 | | | Greene | Wilkinson Basin | Recover BIOMAPER | |
| 288.479 | 59 | Radiometer | SPMR7 | 12 | | 15 | 11:30:00 | s | 4216.63 | 6915.57 | 230 | | Sosik | Wilkinson Basin | Deploy Radiometer | |
| 288.493 | 60 | Radiometer | SPMR7 | 12 | | 15 | 11:50:00 | e | 4216.72 | 6915.23 | | | | | Recover Radiometer | |
| 288.503 | 61 | CTD | CTD9 | 12 | | 15 | 12:05:00 | s | 4216.70 | 6915.15 | 230 | | Sosik/Houghton | Wilkinson Basin | Deploy CTD | |
| 288.523 | 62 | CTD | CTD9 | 12 | | 15 | 12:33:00 | e | 4216.70 | 6915.15 | | | | | Recover CTD | |
| 288.594 | 63 | BIOMAPER | BMP8 | | | 15 | 14:15:00 | s | 4204.98 | 6912.53 | 197 | | Greene/Wiebe | Wilkinson Basin | Deploy BIOMAPER II | |
| 289.019 | 64 | MOCNESS | MOC8 | 13 | | 16 | 00:27:00 | s | 4206.23 | 6940.48 | | | Wiebe | Wilkinson Basin | Deploy MOCNESS | |
| 289.081 | 65 | MOCNESS | MOC8 | 13 | | 16 | 01:57:00 | e | 4204.48 | 6936.04 | 226 | 200 | | | Recover MOCNESS | |
| 289.535 | 66 | CTD | CTD10 | 14 | | 16 | 12:50:00 | s | 4224.96 | 6844.68 | 210 | | Sosik/Houghton | Wilkinson Basin | Deploy CTD | |
| 289.562 | 67 | CTD | CTD10 | 14 | | 16 | 13:29:00 | e | 4225.20 | 6844.29 | | | | | Recover CTD | |
| 289.896 | 68 | MOCNESS | MOC9 | 15 | TP 13 | 16 | 21:30:00 | s | 4228.70 | 6845.00 | 180 | 170 | Wiebe | Wilkinson Basin | Deploy MOCNESS for soliton | |
| 289.949 | 69 | MOCNESS | MOC9 | 15 | | 16 | 22:46:00 | e | 4230.97 | 6846.69 | 200 | | | | Recover MOCNESS | |
| 289.951 | 70 | BIOMAPER | BMP8 | 15 | | 16 | 22:50:00 | e | 4230.97 | 6846.69 | 200 | | | | Recover BIOMAPER | |

APPENDIX 2. MOCNESS tow details.

| MOCNESS Tow Summary Table | | | | |
|---------------------------|---------------------|------------|-------------|-----------------------|
| Tow/File Number | Date 1997 (yearday) | Time Local | Start | End |
| | | (+4 GMT) | Lat/Lon | Lat/Lon |
| M-01-001 PRO | 10 October | 22:16 | 42.369473 | 42.290423 |
| M-01-001 RAW | (282) | 00:20 | -067.593958 | -067.557 |
| M-01-01B PRO | | | | |
| M-01-002 PRO | 11 October | 14:49 | 42.234527 | 42.284400 -066.425680 |
| M-01-002 RAW | (283) | 17:36 | -066.421407 | |
| M-01-02B PRO | | | | |
| M-01-003 PRO M-01-003 RAW | 12 October | 03:00 | 42.415045 | 42.438582 |
| M-01-03B PRO | (284) | 05:03 | -066.982088 | -067.055007 |
| M-01-004 PRO | 12 October | 00:30 | 43.497600 | 43.553743 -067.892618 |
| M-01-004 RAW | (285) | 02:28 | -067.882165 | |
| M-01-005. PRO | 12 October | 08:54 | 43.8164 | 43.8391 |
| M-01-005 .RAW | (285) | 09:52 | -067.4939 | -067.4898 |
| M-01-006. PRO | 14 October | 00:19 | 42.684370 | 42.579158 |
| M-01-006. RAW | (287) | 03:38 | -069.493045 | -069.220497 |
| M-01-006. TAB | | | | |
| M-01-007. PRO | 14 October | 14:47 | 42.400900 | 42.417122 |
| M-01-007. RAW | (287) | 17:20 | -068.821992 | -068.841355 |
| M-01-008. PRO | 16 October | 00:27 | 42.103848 | 42.074440 |
| M-01-008. RAW | (289) | 01:58 | -69.675125 | -69.6000462 |
| M-01-009. PRO | 16 October | 21:34 | 424.478703 | 42.511017 |
| M-01-009. RAW | (289) | 22:37 | -68.750728 | -68.772520 |

APPENDIX 3. BIOMAPER II event log.

| Gulf of Maine ACOUSTIC Log Form (Oct. 1997) | | | | | | | | | | | | |
|---|--------|--------|--------|--------|--------|-----|------|-------|---------|---------|---|--|
| | | | GLOBEC | DAT | VPR | | | | | | | |
| Yearday | DECLAT | DECLON | Event | Tape # | Tape # | Day | S.D. | Time | Lat (N) | Lon (W) | Comments | |
| 281.792 | 41.427 | 70.809 | 2 | 0 | 001 | 8 | 281 | 19:00 | 4125.62 | 7048.55 | Dip Test (Noise Assessment,Ducers Off, Slow Speed, 4 knots) | |
| 281.899 | 41.400 | 70.853 | 2 | 0 | 001 | 8 | 281 | 21:35 | 4124.01 | 7051.16 | Increase to 6 knots, Noise Assessment, Cross Talk Checks | |
| 281.928 | 41.361 | 70.929 | 2 | 0 | 001 | 8 | 281 | 22:16 | 4121.65 | 7055.75 | Change direction toward Leg 2 | |
| 281.938 | 41.371 | 70.915 | 3 | 0 | 001 | 8 | 281 | 22:31 | 4122.24 | 7054.93 | Dip Test Ended (Fish out) | |
| 282.573 | 41.829 | 68.390 | 12 | 1 | 001 | 9 | 282 | 13:45 | 4149.71 | 6823.40 | Short test, winch brake needs repair | |
| 282.606 | 41.846 | 68.367 | 13 | 1 | 001 | 9 | 282 | 14:32 | 4150.74 | 6822.02 | fish out | |
| 282.653 | 41.870 | 68.339 | 14 | 1 | 001 | 9 | 282 | 15:41 | 4152.19 | 6820.34 | fish in, no data logging yet, thresholds being set, no VPR, radiometer only | |
| 282.688 | 0.000 | 0.000 | 14 | 1 | 001 | 9 | 282 | 16:30 | | | Increased spd to 6.2 knots | |
| 282.706 | 0.000 | 0.000 | 14 | 1 | 001 | 9 | 282 | 16:57 | | | data logging on | |
| 282.712 | 0.000 | 0.000 | 14 | 1 | 001 | 9 | 282 | 17:05 | | | fish lowered for pressure sensor calibration | |
| 282.722 | 0.000 | 0.000 | 14 | 1 | 001 | 9 | 282 | 17:20 | | | at 4 meters for dinner, then decision for pressure/depth | |
| 282.772 | 0.000 | 0.000 | 14 | 1 | 001 | 9 | 282 | 18:32 | | | to 3 knots | |
| 282.776 | 0.000 | 0.000 | 14 | 1 | 001 | 9 | 282 | 18:38 | | | change to 6 knots at surface | |
| 282.836 | 42.162 | 67.914 | 14 | 1 | 001 | 9 | 282 | 20:04 | 4209.75 | 6754.83 | start tow-yo from 38 meters depth, wire angle 30degrees | |
| 282.840 | 42.170 | 67.903 | 14 | 1 | 001 | 9 | 282 | 20:10 | 4210.18 | 6754.19 | shut down data acquisition after single tow; adjust stabilizer to reduce roll (+2degrees) | |
| 282.850 | 42.179 | 67.888 | 15 | 1 | 001 | 9 | 282 | 20:24 | 4210.74 | 6753.26 | Recover BIOMAPER | |
| 282.885 | 42.177 | 67.887 | 16 | 1 | 001 | 9 | 282 | 21:15 | 4210.62 | 6753.19 | RE-redeploy BIOMAPER (NOTE: This Lat/Lon is NavTrac NOT P-code) | |
| 282.895 | 0.000 | 0.000 | 16 | 1 | 001 | 9 | 282 | 21:29 | | | Down to 26.5m. Monitor readings. 6 knots. | |
| 282.903 | 0.000 | 0.000 | 16 | 1 | 001 | 9 | 282 | 21:40 | | | Start down again. (At 100m switch to 5 knots.) | |
| 282.956 | 0.000 | 0.000 | 16 | 1 | 001 | 9 | 282 | 22:56 | | | Slow to 4 knots ~147m down. | |
| 282.958 | 0.000 | 0.000 | 16 | 1 | 001 | 9 | 282 | 23:00 | | | 175m Test winch for pull up. Lever pulled only 1/3. So continue down. | |
| 282.972 | 0.000 | 0.000 | 16 | 2 | 002 | 9 | 282 | 23:19 | | | Tape change 004. fish 12 m below surface | |
| 282.979 | 42.322 | 67.684 | 16 | | | 9 | 282 | 23:30 | 4219.32 | 6741.02 | 200m. Start bringing BIOMAPER up. | |
| 282.999 | 0.000 | 0.000 | 16 | | | 9 | 282 | 23:59 | | | Patch. VPR Time: 03:59:24 | |
| 283.047 | 0.000 | 0.000 | 16 | 4 | 3? | 10 | 283 | 01:07 | | | several acoustic test files, tape 004 in | |
| 283.078 | 0.000 | 0.000 | 16 | 4 | | 10 | 283 | 01:52 | | | steady fish tow at 10 meters | |
| 283.158 | 0.000 | 0.000 | 16 | 4 | | 10 | 283 | 03:47 | | | new file, tow down to 150 meters | |
| 283.174 | 0.000 | 0.000 | 16 | 5 | 4 | 10 | 283 | 04:11 | | | VPR tape 4 in, tape 3 had run out, partially overwritten | |
| 283.202 | 0.000 | 0.000 | 16 | 5 | 4 | 10 | 283 | 04:51 | | | Software restarted after screen freeze; gps suspected | |
| 283.218 | 42.273 | 67.358 | 16 | 5 | 4 | 10 | 283 | 05:14 | 4216.40 | 6721.50 | TOWYO from 120 meters to 25 meters begins UP | |
| 283.232 | 0.000 | 0.000 | 16 | 6 | 4 | 10 | 283 | 05:34 | | | tape 6 in, tape 5 had run out, oscill. stopped (How long?) | |
| 283.232 | 0.000 | 0.000 | 16 | 6 | 4 | 10 | 283 | 05:34 | | | TOWYO down from 17 meters DOWN | |
| 283.262 | 0.000 | 0.000 | 16 | 6 | 5 | 10 | 283 | 06:17 | | | VPR tape 005 | |

| | | | | | | | | | | | |
|---------|--------|--------|----|-----|-----|----|-----|-------|---------|---------|--|
| 283.262 | 42.278 | 67.228 | 16 | 6 | 5 | 10 | 283 | 06:17 | 4216.67 | 6713.66 | TOWYO up from 200? UP |
| 283.283 | 42.275 | 67.171 | 16 | 6 | 5 | 10 | 283 | 06:48 | 4216.52 | 6710.27 | TOWYO DOWN: patch pass through at 10:53:30; siphonophores at 11:24:15 |
| 283.309 | 42.271 | 67.090 | 16 | 6 | 5 | 10 | 283 | 07:25 | 4216.28 | 6705.39 | TOWYO from 220 meters (in 240m depth) UP |
| 283.317 | 0.000 | 0.000 | 16 | 7 | 5 | 10 | 283 | 07:37 | | | DAT TAPE 007 in |
| 283.328 | 42.269 | 67.024 | 16 | 7 | 5 | 10 | 283 | 07:53 | 4216.16 | 6701.46 | TOWYO down from 29 meters DOWN |
| 283.347 | 0.000 | 0.000 | 16 | 7 | 6 | 10 | 283 | 08:20 | | | VPR TAPE 006 in |
| 283.352 | 42.269 | 66.939 | 16 | 7 | 6 | 10 | 283 | 08:27 | 4216.15 | 6656.32 | 217m depth. On last wrap. Start up. Stop. Pay out. Paint drum. |
| 283.356 | 42.269 | 66.927 | 16 | 7 | 6 | 10 | 283 | 08:32 | 4216.15 | 6655.59 | Start up again. |
| 283.369 | 42.269 | 66.875 | 16 | 7 | 6 | 10 | 283 | 08:52 | 4216.11 | 6652.49 | 150m. Pay out to 204m to fix wrap problem. |
| 283.401 | 0.000 | 0.000 | 16 | 8 | 6 | 10 | 283 | 09:37 | | | DAT TAPE 008 in. |
| 283.415 | 42.266 | 66.705 | 16 | 8 | 6 | 10 | 283 | 09:57 | 4215.99 | 6642.32 | 182m. Start Biomaper back up. Wrap problem fixed. |
| 283.433 | 0.000 | 0.000 | 16 | 8 | 7 | 10 | 283 | 10:24 | | | VPR TAPE 007 in. |
| 283.440 | 42.264 | 66.604 | 16 | 8 | 7 | 10 | 283 | 10:34 | 4215.81 | 6636.21 | 19m Turn off acoustics. Hold fish at this depth to test. |
| 283.442 | 0.000 | 0.000 | 16 | 8 | 7 | 10 | 283 | 10:36 | | | DAT TAPE turned off. Put in fresh tape with restart. |
| 283.444 | 0.000 | 0.000 | 16 | 8 | 7 | 10 | 283 | 10:40 | | | VPR TAPE turned off. |
| 283.486 | 42.275 | 66.485 | 19 | | 7 | 10 | 283 | 11:40 | 4216.53 | 6629.07 | Recover BIOMAPER |
| 283.507 | 42.265 | 66.466 | | | | 10 | 283 | 12:10 | 4215.91 | 6627.96 | Deploy ctd |
| 283.486 | 42.260 | 66.450 | | | | 10 | 283 | 12:41 | 4215.63 | 6627.02 | Recover CTD |
| 283.792 | 42.465 | 66.667 | 20 | 9 | 7 | 10 | 283 | 19:00 | 4227.90 | 6640.00 | BIOMAPER GOING IN; up and down adjust; pressure recalib |
| 283.842 | 0.000 | 0.000 | | 9 | 7 | 10 | 283 | 20:13 | | | TOWYO down on new course |
| 283.842 | 0.000 | 0.000 | 26 | 9 | 7 | 10 | 283 | 20:13 | | | Patch VPR (30M) |
| 283.848 | 42.427 | 66.635 | 26 | 9 | 7 | 10 | 283 | 20:21 | 4225.60 | 6638.11 | Holding near sfc (16m). Bring to sfc to begin towyo down. |
| 283.850 | 42.424 | 66.638 | 26 | 9 | 7 | 10 | 283 | 20:24 | 4225.46 | 6638.27 | Begin towyo down. |
| 283.860 | 42.411 | 66.656 | 26 | 9 | 7 | 10 | 283 | 20:38 | 4224.66 | 6639.34 | Slow to 4 knots. 109m. Stop Payout. |
| 283.868 | 0.000 | 0.000 | 26 | 9 | 8 | 10 | 283 | 20:50 | | | Start VPR tape 008 |
| 283.869 | 0.000 | 0.000 | 26 | 10 | 8 | 10 | 283 | 20:52 | | | Start DAT tape 010 |
| 283.875 | 0.000 | 0.000 | 26 | 10 | 8 | 10 | 283 | 21:00 | | | At 255m stop to test pull up. |
| 283.876 | 42.398 | 66.675 | 26 | 10 | 8 | 10 | 283 | 21:02 | 4223.86 | 6640.48 | 275m. Hold depth. |
| 283.882 | 42.393 | 66.680 | 26 | 10 | 8 | 10 | 283 | 21:10 | 4223.59 | 6640.81 | Start new file (s2832110) 275m. Start towyo up. NOTE: Calanus (?) at 225m? |
| 283.895 | 42.383 | 66.695 | 26 | 10 | 8 | 10 | 283 | 21:29 | 4222.97 | 6641.70 | Increase to 5 knots |
| 283.898 | 0.000 | 0.000 | 26 | 10 | 8 | 10 | 283 | 21:33 | | | BIG layer at 45m. |
| 283.901 | 0.000 | 0.000 | 26 | 10 | 8 | 10 | 283 | 21:37 | | | 20m. Stop. Hold position. Bring up slowly with Wire Watch. |
| 283.903 | 42.375 | 66.708 | 26 | 10 | 8 | 10 | 283 | 21:41 | 4222.52 | 6642.50 | Bring plastic 1' our of water. Start back down. |
| 283.906 | 0.000 | 0.000 | 26 | 10 | 8 | 10 | 283 | 21:44 | | | Open new file (S2832143). Winch oil temp 140F. Hold at 20m. |
| 283.916 | 42.363 | 66.727 | 26 | 10 | 8 | 10 | 283 | 21:59 | 4221.78 | 6643.63 | Start back down. |
| 283.929 | 42.350 | 66.745 | 26 | 10 | 8 | 10 | 283 | 22:18 | 4220.97 | 6644.68 | 200m. Reduce to 4 knots. |
| 283.934 | 42.346 | 66.752 | 26 | 10 | 8 | 10 | 283 | 22:25 | 4220.76 | 6645.14 | 280m. Hold. |
| 283.935 | 42.346 | 66.752 | 26 | 10 | 8 | 10 | 283 | 22:27 | 4220.74 | 6645.14 | Start towyo up. |
| 283.947 | 42.347 | 66.766 | 26 | 10 | 8 | 10 | 283 | 22:44 | 4220.84 | 6645.95 | Increase to 5 knots. |
| 283.949 | 0.000 | 0.000 | 26 | 10 | 8 | 10 | 283 | 22:46 | | | 47m. Siphonophores? |
| 283.952 | 42.349 | 66.773 | 26 | 10 | 8 | 10 | 283 | 22:51 | 4220.96 | 6646.38 | Open new file (S2832252) |
| 283.955 | 42.351 | 66.779 | 26 | 11 | 9 | 10 | 283 | 22:55 | 4221.09 | 6646.75 | Start VPR tape 9. Start DAT tape 11. Start towyo down. |
| 283.960 | 42.354 | 66.787 | 26 | 11 | 9 | 10 | 283 | 23:02 | 4221.23 | 6647.19 | Reduce to 4 knots. |
| 283.971 | 42.358 | 66.800 | 26 | 11 | 9 | 10 | 283 | 23:18 | 4221.49 | 6647.97 | Reduce to 3 knots. |
| 283.975 | 42.359 | 66.801 | 26 | 11 | 9 | 10 | 283 | 23:24 | 4221.54 | 6648.08 | 274m. Start towyo back up. |
| 283.981 | 0.000 | 0.000 | 26 | 11 | 9 | 10 | 283 | 23:32 | | | 200m. Calanus. |
| 283.988 | 42.363 | 66.813 | 26 | 11 | 9 | 10 | 283 | 23:42 | 4221.78 | 6648.79 | Increase to 4 knots. |
| 283.994 | 42.366 | 66.822 | 26 | 11 | 9 | 10 | 283 | 23:52 | 4221.97 | 6649.32 | Top of ascent <5m from surface. |
| 283.997 | 0.000 | 0.000 | 26 | 11 | 9 | 10 | 283 | 23:55 | | | New file. |
| 283.997 | 0.000 | 0.000 | 26 | 11 | 9 | 10 | 283 | 23:56 | | | Start towyo down. |
| 284.006 | 42.371 | 66.838 | 26 | 11 | 9 | 11 | 284 | 00:08 | 4222.25 | 6650.29 | Slow to 3 knots. |
| 284.006 | 0.000 | 0.000 | 26 | 11 | 9 | 11 | 284 | 00:08 | | | TIMEOUT ERROR in setting BNC Sync Out Command. |
| 284.014 | 0.000 | 0.000 | 26 | 11 | 9 | 11 | 284 | 00:20 | | | COMMUNICATIONS ERROR. Echo Sounder Sequences not synchronized. Or problem sending next sampling sequence definition. |
| 284.015 | 42.372 | 66.846 | 26 | 11 | 9 | 11 | 284 | 00:22 | 4222.34 | 6650.74 | 270m. Hold. |
| 284.016 | 0.000 | 0.000 | 26 | 11 | 9 | 11 | 284 | 00:23 | | | Problems encountered in sending stop processing command. |
| 284.018 | 0.000 | 0.000 | 26 | 11 | 9 | 11 | 284 | 00:26 | | | New file. S2840025 |
| 284.018 | 0.000 | 0.000 | 26 | 11 | 9 | 11 | 284 | 00:26 | | | Problems encountered. Exited program. Desktop colors changed. Lost mouse. Tried ALT F4. Tried CTRL/ALT/DEL. POWERED OFF. |
| 284.022 | 0.000 | 0.000 | 26 | 11 | 9 | 11 | 284 | 00:32 | | | New file. S2840032. |
| 284.023 | 42.374 | 66.854 | 26 | 11 | 9 | 11 | 284 | 00:33 | 4222.42 | 6651.24 | 257m. Start towyo ascent. |
| 284.042 | 0.000 | 0.000 | 29 | 12? | 10? | 11 | 284 | 01:00 | | | Begin surface tow through MOCNESS |
| 284.044 | 42.382 | 66.880 | 29 | | | 11 | 284 | 01:03 | 4222.95 | 6652.81 | End S2840032 Biomaper @11.8meters; Begin S2840105 Biomaper DOWN |
| 284.060 | 42.389 | 66.900 | 29 | | | 11 | 284 | 01:27 | 4223.35 | 6654.00 | Begin S2840128 TOWYO UP |
| 284.079 | 42.399 | 66.930 | 29 | | | 11 | 284 | 01:54 | 4223.96 | 6655.80 | Begin S2840156 TOW @5meters during MOCNESS |
| 284.124 | 42.414 | 66.981 | 29 | 13? | 11? | 11 | 284 | 02:59 | 4224.86 | 6658.87 | Begin S2840301 TOW@5 meters |
| 284.226 | 42.443 | 67.083 | 29 | 14? | 12? | 11 | 284 | 05:25 | 4226.60 | 6705.00 | Begin S2840525 TOW @5 meters, MOC in, new ESSBM2_007.pro(.raw) |
| 284.243 | 42.367 | 67.096 | 29 | | | 11 | 284 | 05:50 | 4222.05 | 6705.77 | TOWYO DOWN |
| 284.249 | 0.000 | 0.000 | 29 | | | 11 | 284 | 05:58 | | | Salinity peak at 50 meters, strong scatter on all 5 down lookers |
| 284.251 | 42.458 | 67.117 | 29 | | | 11 | 284 | 06:02 | 4227.50 | 6707.00 | Salinity off scale, interleaved water masses, strong layer scatter, 130 meters salinity leaves, > 34.5 |
| 284.271 | 0.000 | 0.000 | 29 | | | 11 | 284 | 06:30 | | | 250 meters: TOWYO UP |
| 284.290 | 42.487 | 67.195 | 29 | | | 11 | 284 | 06:57 | 4229.20 | 6711.70 | surface: TOWYO DOWN, seas rising |
| 284.291 | 0.000 | 0.000 | 29 | 15 | 13 | 11 | 284 | 06:59 | | | DAT 015 VPR 013in, Begin S2840525 Bottom layer green, 95 meters thick on 43 and 120, we hit the upper edge... |
| 284.315 | 42.507 | 67.248 | 29 | 15 | 13 | 11 | 284 | 07:33 | 4230.40 | 6714.90 | TOWYO up from 65 meters above bottom (315 meters) LAYERING DISTINCT |
| 284.337 | 42.522 | 67.298 | 29 | 15 | 13 | 11 | 284 | 08:05 | 4231.34 | 6717.85 | Begin S2840802, TOWYO DOWN from 2 meters |
| 284.356 | 42.530 | 67.326 | 26 | 15 | 13 | 11 | 284 | 08:32 | 4231.83 | 6719.55 | NOTE: Vert Vel went from -10m/min to +5.6m/min. Shear? Screen captured. ~200m. |
| 284.361 | 42.533 | 67.336 | 26 | 15 | 13 | 11 | 284 | 08:40 | 4231.97 | 6720.18 | 250m. Bottom of towyo. Start S2840842 file. Start towyo ascent. |
| 284.364 | 0.000 | 0.000 | 26 | 15 | 13 | 11 | 284 | 08:44 | | | Patch 225m. |
| 284.375 | 0.000 | 0.000 | 26 | 16 | 14 | 11 | 284 | 09:00 | | | Begin DAT tape 16 and VPR tape 14. |

| | | | | | | | | | | | |
|---------|--------|--------|----|----|-------|----|-----|-------|---------|---------|---|
| 284.383 | 42.545 | 67.375 | 26 | 16 | 14 | 11 | 284 | 09:11 | 4232.72 | 6722.50 | Surface. Start new file. Start down. |
| 284.407 | 42.558 | 67.419 | 26 | 16 | 14 | 11 | 284 | 09:46 | 4233.48 | 6725.13 | 240m. Hold. Errors on HTI program. Exit program. Reboot. |
| 284.409 | 0.000 | 0.000 | 26 | 16 | 14 | 11 | 284 | 09:49 | | | New File S2840948. Start up. |
| 284.425 | 0.000 | 0.000 | 26 | 16 | 14 | 11 | 284 | 10:12 | | | Patch 35m. |
| 284.428 | 42.570 | 67.458 | 26 | 16 | 14 | 11 | 284 | 10:16 | 4234.21 | 6727.49 | Biomap at surface. New file. Towyo back down. |
| 284.435 | 0.000 | 0.000 | 26 | 16 | 14 | 11 | 284 | 10:27 | | | Patch 100m. Slow to 3.5 knots. |
| 284.443 | 42.580 | 67.489 | 26 | 16 | 14 | 11 | 284 | 10:38 | 4234.78 | 6729.31 | 220m. Bottom of towyo. New File S2841039. Patch. Start ascent. |
| 284.455 | 0.000 | 0.000 | 26 | 16 | 14 | 11 | 284 | 10:55 | | | Patch 60m. |
| 284.459 | 0.000 | 0.000 | 26 | 16 | 14 | 11 | 284 | 11:01 | | | END TAPES: DAT 016 and VPR 014. Holding BIOMAPER at surface during CTD. |
| 284.460 | 0.000 | 0.000 | 26 | 17 | ----- | 11 | 284 | 11:02 | | | Recording no tapes. New file: s2841102. |
| 284.478 | 42.588 | 67.515 | 26 | 17 | ----- | 11 | 284 | 11:29 | 4235.29 | 6730.91 | ctd deployed |
| 284.622 | 0.000 | 0.000 | 26 | 17 | 15 | 11 | 284 | 14:55 | | | new vpr tape #015 |
| 284.628 | 42.838 | 67.510 | 26 | 17 | 15 | 11 | 284 | 15:05 | 4250.30 | 6730.57 | start descent of biomapper |
| 284.638 | 0.000 | 0.000 | 26 | 17 | 15 | 11 | 284 | 15:18 | | | biomaper at 50 m begin ascent |
| 284.642 | 0.000 | 0.000 | 26 | 17 | 15 | 11 | 284 | 15:25 | | | biomaper at surface begin descent |
| 284.650 | 0.000 | 0.000 | 26 | 17 | 15 | 11 | 284 | 15:36 | | | biomaper at 50m begin ascent |
| 284.658 | 0.000 | 0.000 | 26 | 17 | 15 | 11 | 284 | 15:47 | | | biomaper at surface begin descent |
| 284.668 | 0.000 | 0.000 | 26 | 18 | 15 | 11 | 284 | 16:02 | | | change DAT tape to 018 |
| 284.669 | 0.000 | 0.000 | 26 | 18 | 15 | 11 | 284 | 16:03 | | | biomaper at 53m begin ascent |
| 284.688 | 42.992 | 67.507 | 26 | 18 | 15 | 11 | 284 | 16:30 | 4259.50 | 6730.40 | tow @5 meters (hawk on board); layer structure strongest on 120 kHz, thick layers (50m), something at 200 meters, just out of range...) |
| 284.706 | 0.000 | 0.000 | 26 | 18 | 16 | 11 | 284 | 16:57 | | | change VPR to 016 thick layer structure persists, layer at 200 meters |
| 284.752 | 43.203 | 67.505 | 26 | 19 | 17 | 11 | 284 | 18:03 | 4312.20 | 6730.30 | resync of DAT and VPR Tapes; strong layer at 200 meters, one at approx 30 meters, thick layers gone |
| 284.773 | 43.237 | 67.533 | 26 | 19 | 17 | 11 | 284 | 18:33 | 4314.23 | 6731.97 | TOWYO DOWN from 5 meters |
| 284.778 | 0.000 | 0.000 | 26 | 19 | 17 | 11 | 284 | 18:40 | | | TOWYO UP from 143 meters/180 depth |
| 284.791 | 43.260 | 67.564 | 26 | 19 | 17 | 11 | 284 | 18:59 | 4315.57 | 6733.83 | TOWYO DOWN from 4 meters (sight) |
| 284.805 | 43.277 | 67.583 | 26 | 19 | 17 | 11 | 284 | 19:19 | 4316.62 | 6735.00 | TOWYO UP from 170/220 |
| 284.821 | 43.295 | 67.612 | 26 | 19 | 17 | 11 | 284 | 19:42 | 4317.70 | 6736.70 | TOWYO DOWN from sight, begin S2841942 |
| 284.831 | 43.305 | 67.627 | 26 | 19 | 17 | 11 | 284 | 19:56 | 4318.30 | 6737.60 | TOWYO UP 165/220 |
| 284.839 | 0.000 | 0.000 | 26 | 20 | 18 | 11 | 284 | 20:08 | | | Patch at surface (virtual patch in layer due to cross through?) |
| 284.844 | 43.320 | 67.645 | 26 | 20 | 18 | 11 | 284 | 20:15 | 4319.20 | 6738.70 | TOWYO DOWN from sight |
| 284.858 | 43.336 | 67.666 | 26 | 20 | 18 | 11 | 284 | 20:35 | 4320.18 | 6739.99 | Bottom of descent. 191.4m. |
| 284.870 | 0.000 | 0.000 | 26 | 20 | 18 | 11 | 284 | 20:53 | | | Patch 35m...looks to continue throught towyo. |
| 284.874 | 43.352 | 67.689 | 26 | 20 | 18 | 11 | 284 | 20:58 | 4321.14 | 6741.36 | End S2841942. Begin S2842058. Top of towyo. Boot to sfc. |
| 284.888 | 43.366 | 67.710 | 26 | 20 | 18 | 11 | 284 | 21:19 | 4321.97 | 6742.59 | Bottom of towyo descent 200m. |
| 284.901 | 43.380 | 67.730 | 26 | 20 | 18 | 11 | 284 | 21:38 | 4322.80 | 6743.81 | Top of ascent. Boot to sfc. |
| 284.919 | 43.397 | 67.754 | 26 | 20 | 18 | 11 | 284 | 22:03 | 4323.84 | 6745.25 | S2842204 New file. Bottom of towyo descent. 220m |
| 284.922 | 0.000 | 0.000 | 26 | 21 | 18 | 11 | 284 | 22:07 | | | Start DAT tape 21. |
| 284.924 | 0.000 | 0.000 | 26 | 21 | 19 | 11 | 284 | 22:10 | | | Start VPR tape 19. |
| 284.935 | 0.000 | 0.000 | 26 | 21 | 19 | 11 | 284 | 22:27 | | | HUGE patch of critters on VPR. |
| 284.939 | 43.419 | 67.786 | 26 | 21 | 19 | 11 | 284 | 22:32 | 4325.16 | 6747.14 | Top of towyo ascent. Boot to sfc. Abundant critters. |
| 284.955 | 43.433 | 67.806 | 26 | 21 | 19 | 11 | 284 | 22:55 | 4326.00 | 6748.38 | Bottom of descent 204m. |
| 284.957 | 0.000 | 0.000 | 26 | 21 | 19 | 11 | 284 | 22:58 | | | Resync VPR mid tape. |
| 284.969 | 0.000 | 0.000 | 26 | 21 | 19 | 11 | 284 | 23:16 | | | LOTS of critters! |
| 284.972 | 43.451 | 67.830 | 26 | 21 | 19 | 11 | 284 | 23:19 | 4327.07 | 6749.78 | Top of ascent. Boot to sfc. New file S2842320 |
| 284.988 | 43.469 | 67.855 | 26 | 21 | 19 | 11 | 284 | 23:43 | 4328.12 | 6751.31 | 217m bottom of towyo. Start up. |
| 285.004 | 43.486 | 67.878 | 26 | 21 | 19 | 12 | 285 | 00:06 | 4329.13 | 6752.66 | S2850006 New file. Top of ascent. Hold at 5m for MOCNESS. LOTS of critters. |
| 285.008 | 0.000 | 0.000 | 26 | 22 | 20 | 12 | 285 | 00:11 | | | Start new DAT tape #22. Start new VPR tape #20. |
| 285.053 | 0.000 | 0.000 | 26 | 22 | 20 | 12 | 285 | 01:16 | | | Begin S2850116 (computer crashed); Moc tow#4, ESS BM@_010.pro/.raw |
| 285.092 | 43.544 | 67.891 | 26 | 23 | 21 | 12 | 285 | 02:13 | 4332.65 | 6753.48 | Start dat 23 while towing moc, new vpr 021 for bugs |
| 285.131 | 43.578 | 67.878 | 26 | 23 | 21 | 12 | 285 | 03:08 | 4334.67 | 6752.70 | End S2850116 |
| 285.134 | 43.581 | 67.872 | 26 | 23 | 21 | 12 | 285 | 03:13 | 4334.87 | 6752.30 | Begin S2850313 Transect leg to #8, towyo |
| 285.178 | 43.636 | 67.782 | 26 | 24 | 22 | 12 | 285 | 04:16 | 4338.16 | 6746.94 | Restart computer, rewind tapes |
| 285.194 | 43.659 | 67.745 | 26 | 24 | 22 | 12 | 285 | 04:39 | 4339.52 | 6744.68 | S2850437 TOWYO DOWN |
| 285.218 | 43.687 | 67.696 | 26 | 24 | 22 | 12 | 285 | 05:14 | 4341.19 | 6741.74 | TOWYO UP from 180/220 |
| 285.233 | 43.704 | 67.667 | 26 | 24 | 22 | 12 | 285 | 05:36 | 4342.21 | 6740.02 | TOWYO surfaces; close files |
| 285.235 | 43.704 | 67.666 | 26 | 24 | 22 | 12 | 285 | 05:38 | 4342.25 | 6739.94 | Begin S2850537, TOWYO DOWN |
| 285.267 | 43.741 | 67.598 | 26 | 24 | 22 | 12 | 285 | 06:24 | 4344.45 | 6735.90 | Screen CAPTURE S2850537.bmp, begin S2850629 |
| 285.271 | 43.743 | 67.597 | 26 | 24 | 22 | 12 | 285 | 06:30 | 4344.56 | 6735.83 | TOWYO DOWN |
| 285.281 | 43.753 | 67.579 | 26 | 25 | 23 | 12 | 285 | 06:44 | 4345.19 | 6734.76 | Change tapes, VPR full of action, 1mHz heavy scatter at bottom |
| 285.298 | 43.772 | 67.548 | 26 | 25 | 23 | 12 | 285 | 07:09 | 4346.31 | 6732.89 | Surface, remove seaweed from termination |
| 285.299 | 43.773 | 67.547 | 26 | 25 | 23 | 12 | 285 | 07:10 | 4346.35 | 6732.82 | SCRCAP S2850629.bmp |
| 285.301 | 43.775 | 67.542 | 26 | 25 | 23 | 12 | 285 | 07:14 | 4346.52 | 6732.52 | Begin S2850714 |
| 285.303 | 43.776 | 67.540 | 26 | 25 | 23 | 12 | 285 | 07:17 | 4346.55 | 6732.40 | TOWYO DOWN from Surface |
| 285.316 | 43.789 | 67.517 | 26 | 25 | 23 | 12 | 285 | 07:35 | 4347.33 | 6731.03 | TOWYO UP calanus in VPR, thick "green layer" over bottom |
| 285.322 | 43.795 | 67.507 | 38 | 25 | 23 | 12 | 285 | 07:44 | 4347.70 | 6730.42 | RECOVER BIOMAPER to check rad. stuff |
| 285.516 | 0.000 | 0.000 | 42 | 25 | 23 | 12 | 285 | 12:23 | | | Biomaper back in water |
| 285.531 | 43.730 | 67.498 | 42 | 25 | 23 | 12 | 285 | 12:44 | 4343.77 | 6729.88 | Biomaper starts down |
| 285.545 | 43.700 | 67.498 | 42 | 25 | 23 | 12 | 285 | 13:05 | 4341.98 | 6729.88 | biomaper at 205 m begin up |
| 285.555 | 43.682 | 67.503 | 42 | 26 | 24? | 12 | 285 | 13:19 | 4340.91 | 6730.17 | change DAT tape to #26 |
| 285.561 | 43.668 | 67.503 | 42 | 26 | 24? | 12 | 285 | 13:28 | 4340.09 | 6730.17 | biomaper at surface begin down |
| 285.577 | 43.630 | 67.509 | 42 | 26 | 24? | 12 | 285 | 13:51 | 4337.82 | 6730.55 | biomaper at 200m begin up |
| 285.592 | 43.595 | 67.519 | 42 | 26 | 24? | 12 | 285 | 14:13 | 4335.67 | 6731.16 | biomaper at surface change file !S2851415 |
| 285.615 | 43.546 | 67.525 | 42 | 26 | 24? | 12 | 285 | 14:46 | 4332.78 | 6731.48 | biomaper at 208m begin up |
| 285.633 | 43.517 | 67.538 | 42 | 26 | 24? | 12 | 285 | 15:12 | 4331.02 | 6732.29 | drag on winch - possible snag with lobster trap... |
| 285.638 | 0.000 | 0.000 | 42 | 26 | 24? | 12 | 285 | 15:19 | | | ...check-out okay; disable ducers and check in-air switch |
| 285.642 | 43.510 | 67.542 | 42 | 27 | 25 | 12 | 285 | 15:24 | 4330.58 | 6732.50 | biomaper restarted at surface new file !S2851525 new DAT tape #27 |
| 285.646 | 43.504 | 67.545 | 42 | 27 | 25 | 12 | 285 | 15:30 | 4330.23 | 6732.71 | biomaper begin down |

| | | | | | | | | | | | |
|---------|--------|--------|----|-------|-------|----|-----|-------|---------|---------|--|
| 285.660 | 43.478 | 67.558 | 42 | 27 | 25 | 12 | 285 | 15:51 | 4328.69 | 6733.47 | TOWYO UP from 200 meters |
| 285.675 | 43.450 | 67.568 | 42 | 27 | 25 | 12 | 285 | 16:12 | 4327.00 | 6734.10 | SCR CAP begin S2851525, change to D drive for data |
| 285.685 | 0.000 | 0.000 | 42 | 27 | 25 | 12 | 285 | 16:27 | | | Restart software/data acq. begin S2851627, TOWYO DOWN from surface |
| 285.714 | 43.372 | 67.606 | 42 | 27 | 25 | 12 | 285 | 17:08 | 4322.34 | 6736.36 | TOWYO UP from 200/226 |
| 285.728 | 43.345 | 67.621 | 42 | 28 | 26 | 12 | 285 | 17:29 | 4320.69 | 6737.27 | Changed VPR and DAT tapes- last 15 min VPR missing |
| 285.733 | 43.339 | 67.624 | 42 | 28 | 26 | 12 | 285 | 17:36 | 4320.35 | 6737.44 | TOWYO DOWN from termination at surf. SCRCAP, begin S2851738 |
| 285.756 | 43.302 | 67.643 | 42 | 28 | 26 | 12 | 285 | 18:09 | 4318.10 | 6738.59 | TOWYO UP from 217/247 |
| 285.774 | 43.267 | 67.650 | 42 | 28 | 26 | 12 | 285 | 18:35 | 4316.00 | 6739.00 | TOWYO DOWN begin S2851838 |
| 285.792 | 43.239 | 67.683 | 42 | 28 | 26 | 12 | 285 | 19:01 | 4314.34 | 6740.95 | TOWYO UP from 200/230 |
| 285.808 | 43.228 | 67.703 | 42 | 28 | 26 | 12 | 285 | 19:24 | 4313.70 | 6742.18 | Surface tow to #9 (9.6 meters on 43kHz) |
| 285.810 | 43.229 | 67.705 | 42 | 29 | 27 | 12 | 285 | 19:26 | 4313.72 | 6742.30 | Tape Swaps, TOWYO DOWN interrupt in data file begin S2851935 |
| 285.827 | 43.231 | 67.748 | 42 | 29 | 27 | 12 | 285 | 19:51 | 4313.85 | 6744.86 | TOWYO UP 190/220 |
| 285.840 | 43.231 | 67.776 | 42 | 29 | 27 | 12 | 285 | 20:09 | 4313.84 | 6746.53 | top of towyo ascent seaweed check... |
| 285.843 | 0.000 | 0.000 | 42 | 29 | 27 | 12 | 285 | 20:14 | | | ...s2851935 close open s2852014 |
| 285.844 | 43.232 | 67.822 | 42 | 29 | 27 | 12 | 285 | 20:16 | 4313.89 | 6749.34 | bottom of towyo |
| 285.879 | 43.233 | 67.872 | 42 | 29 | 27 | 12 | 285 | 21:06 | 4313.95 | 6752.30 | top of ascent new file s2852110 |
| 285.890 | 0.000 | 0.000 | 42 | 29 | 27 | 12 | 285 | 21:22 | | | re-boot monitor computer (ground fault monitor) new file s2852131 |
| 285.901 | 0.000 | 0.000 | 42 | 30 | 28 | 12 | 285 | 21:38 | | | vpr tape #28 and DAT tape #30 stoped decent at 2120h contiued at 2147h |
| 285.913 | 43.235 | 67.967 | 42 | 30 | 28 | 12 | 285 | 21:55 | 4314.12 | 6758.04 | bottom 177m |
| 285.925 | 43.236 | 67.994 | 42 | 30 | 28 | 12 | 285 | 22:12 | 4314.17 | 6759.64 | top of ascent close s2852131 new file 2852214 |
| 285.947 | 43.238 | 68.043 | 42 | 30 | 28 | 12 | 285 | 22:43 | 4314.25 | 6802.56 | BOTTOM OF towyo big patches of critters at 03:04:10 UCT |
| 285.965 | 43.238 | 68.086 | 42 | 30 | 28 | 12 | 285 | 23:09 | 4314.30 | 6805.18 | top of ascent open new file s2852311 |
| 285.981 | 43.239 | 68.127 | 42 | 30 | 28 | 12 | 285 | 23:33 | 4314.37 | 6807.60 | bottom of towyo |
| 285.987 | 43.239 | 68.144 | 42 | 31 | 29 | 12 | 285 | 23:41 | 4314.34 | 6808.63 | new vpr tape #29 new dat tape #31 |
| 286.002 | 43.256 | 69.166 | 42 | 31 | 29 | 13 | 286 | 00:03 | 4315.34 | 6909.96 | top of ascent stop towyo for testing stop tapes (vpr 29, DAT 31) |
| 286.010 | 43.238 | 68.173 | 43 | ----- | ----- | 13 | 286 | 00:14 | 4314.28 | 6810.39 | compass calibration/ noise assessments no tapes software reset to pulse from chirp |
| 286.115 | 0.000 | 0.000 | 44 | ----- | ----- | 13 | 286 | 02:45 | | | BIOMAPER back on board |
| 286.712 | 0.000 | 0.000 | 49 | 31 | 29 | 13 | 286 | 17:05 | | | BIOMAPER redeployed; powered up |
| 286.728 | 42.984 | 69.919 | 49 | 31 | 29 | 13 | 286 | 17:29 | 4259.05 | 6955.12 | BIOMAPER file S2861727 |
| 286.751 | 42.984 | 69.919 | 49 | 31 | 29 | 13 | 286 | 18:01 | 4259.05 | 6955.12 | HTI program locked - rebooted new file S2861801 |
| 286.760 | 42.931 | 69.919 | 49 | 31 | 29 | 13 | 286 | 18:15 | 4255.87 | 6955.13 | bottom of towyo |
| 286.785 | 42.884 | 69.918 | 49 | 31 | 29 | 13 | 286 | 18:51 | 4253.04 | 6955.05 | top of towyo |
| 286.787 | 0.000 | 0.000 | 49 | 31 | 29 | 13 | 286 | 18:53 | | | closed file S2861801 |
| 286.792 | 0.000 | 0.000 | 49 | 31 | 29 | 13 | 286 | 19:00 | | | started file BM2_016.pro + M2_016.raw |
| 286.801 | 0.000 | 0.000 | 49 | 31 | 29 | 13 | 286 | 19:13 | | | end DAT tape 31 |
| 286.804 | 0.000 | 0.000 | 49 | 32 | 30 | 13 | 286 | 19:18 | | | start DAT tape 32 start VPR tape 30 |
| 286.809 | 0.000 | 0.000 | 49 | 32 | 30 | 13 | 286 | 19:25 | | | offset about 4 meters as BMP turned from 9 to 12 |
| 286.813 | 42.831 | 69.909 | 49 | 32 | 30 | 13 | 286 | 19:31 | 4249.85 | 6954.54 | S2861902 make turn to transect leg 2 Wilkinson Basin note surface sadata at top of file |
| 286.839 | 42.812 | 69.854 | 49 | 32 | 30 | 13 | 286 | 20:08 | 4248.70 | 6951.22 | bottom of towyo |
| 286.842 | 42.809 | 69.838 | 49 | 32 | 30 | 13 | 286 | 20:13 | 4248.54 | 6950.26 | HTI locked up Open new file S2862051 |
| 286.858 | 42.798 | 69.810 | 49 | 32 | 30 | 13 | 286 | 20:36 | 4247.88 | 6948.60 | top of towyo |
| 286.879 | 42.782 | 69.762 | 49 | 32 | 30 | 13 | 286 | 21:06 | 4246.95 | 6945.73 | bottom of towyo descent |
| 286.881 | 0.000 | 0.000 | 49 | 32 | 30 | 13 | 286 | 21:08 | | | end S2863108 begin S2862108 |
| 286.882 | 0.000 | 0.000 | 49 | 32 | 30 | 13 | 286 | 21:10 | | | error communication cannot connect to DES |
| 286.882 | 0.000 | 0.000 | 49 | 32 | 30 | 13 | 286 | 21:10 | | | came up to 160m |
| 286.889 | 0.000 | 0.000 | 49 | 32 | 30 | 13 | 286 | 21:20 | | | restart collect data communication software |
| 286.890 | 0.000 | 0.000 | 49 | 33 | 30 | 13 | 286 | 21:21 | | | start new file S286118 start VPR tape 31 |
| 286.892 | 0.000 | 0.000 | 49 | 33 | 31 | 13 | 286 | 21:24 | | | start DAT tape 33 |
| 286.903 | 42.758 | 69.701 | 49 | 33 | 31 | 13 | 286 | 21:40 | 4245.49 | 6942.06 | top of towyo |
| 286.913 | 42.749 | 69.675 | 49 | 33 | 31 | 13 | 286 | 21:55 | 4244.94 | 6940.47 | stop winch for squeaky bearings at 94m |
| 286.932 | 42.732 | 69.624 | 49 | 33 | 31 | 13 | 286 | 22:22 | 4243.93 | 6937.43 | bottom of towyo |
| 286.958 | 42.710 | 69.561 | 49 | 33 | 31 | 13 | 286 | 22:59 | 4242.61 | 6933.64 | top of towyo end file S286118 begin file S2862300 |
| 286.978 | 0.000 | 0.000 | 49 | 33 | 32 | 13 | 286 | 23:28 | | | new VPR tape |
| 286.979 | 0.000 | 0.000 | 49 | 34 | 32 | 13 | 286 | 23:30 | | | new DAT tape |
| 286.984 | 42.682 | 69.487 | 49 | 34 | 32 | 13 | 286 | 23:37 | 4240.94 | 6929.22 | 225 bottom of towyo |
| 287.002 | 42.667 | 69.443 | 49 | 34 | 32 | 14 | 287 | 00:03 | 4240.00 | 6926.58 | top of towyo close file S2862300 mocness started |
| 287.002 | 0.000 | 0.000 | 49 | ----- | ----- | 14 | 287 | 00:03 | | | open file S2870005 |
| 287.015 | 0.000 | 0.000 | 49 | ----- | ----- | 14 | 287 | 00:22 | | | VPR and DAT tape turned off |
| 287.099 | 42.603 | 69.294 | 49 | 34 | 32 | 14 | 287 | 02:22 | 4236.16 | 6917.63 | 5 knots, TOWYO DOWN still on S2870005, surface data at top no tape |
| 287.116 | 0.000 | 0.000 | 49 | 34 | 32 | 14 | 287 | 02:47 | | | 4 knots, at 100 meters |
| 287.125 | 42.581 | 69.226 | 49 | 34 | 32 | 14 | 287 | 03:00 | 4234.87 | 6913.56 | TOWYO UP BIO_ENG locked up at 02:33 data ok |
| 287.138 | 42.573 | 69.195 | 49 | 34 | 32 | 14 | 287 | 03:19 | 4234.38 | 6911.70 | 5 knots |
| 287.149 | 42.563 | 69.168 | 49 | 35 | 33 | 14 | 287 | 03:34 | 4233.78 | 6910.05 | TOWYO surfaces, new file, new Tapes, software rebooted, BIO_ENG and fish restarted, powered up |
| 287.160 | 0.000 | 0.000 | 49 | 35 | 33 | 14 | 287 | 03:50 | | | begin S2870350; |
| 287.163 | 42.549 | 69.130 | 49 | 35 | 33 | 14 | 287 | 03:54 | 4232.96 | 6907.77 | TOWYO DOWN |
| 287.176 | 0.000 | 0.000 | 49 | 35 | 33 | 14 | 287 | 04:14 | | | 4knots, bmp at 100 meters |
| 287.183 | 42.531 | 69.080 | 49 | 35 | 33 | 14 | 287 | 04:24 | 4231.83 | 6904.82 | TOWYO UP |
| 287.191 | 0.000 | 0.000 | 49 | 35 | 33 | 14 | 287 | 04:35 | | | 5knots |
| 287.201 | 0.000 | 0.000 | 49 | 35 | 33 | 14 | 287 | 04:50 | | | coming up |
| 287.202 | 42.514 | 69.037 | 49 | 35 | 33 | 14 | 287 | 04:51 | 4230.82 | 6902.20 | back to surface |
| 287.204 | 0.000 | 0.000 | 49 | 35 | 33 | 14 | 287 | 04:54 | | | TOWYO DOWN |
| 287.219 | 0.000 | 0.000 | 49 | 35 | 33 | 14 | 287 | 05:16 | | | 4knots |
| 287.229 | 0.000 | 0.000 | 49 | 35 | 33 | 14 | 287 | 05:30 | | | TOWYO UP from 183/222 |
| 287.231 | 42.492 | 68.976 | 49 | 35 | 33 | 14 | 287 | 05:32 | 4229.51 | 6858.58 | TOWYO ACTUALLY UP, 200/222 |
| 287.244 | 42.483 | 68.948 | 49 | 36 | 34 | 14 | 287 | 05:52 | 4228.96 | 6856.90 | TAPE CHANGE |
| 287.252 | 42.478 | 68.935 | 49 | 36 | 34 | 14 | 287 | 06:03 | 4228.67 | 6856.11 | TOP again, reboot bioeng, (locked up with calculator running?) |
| 287.258 | 0.000 | 0.000 | 49 | 36 | 34 | 14 | 287 | 06:12 | | | begin S2870611 |

| | | | | | | | | | | | |
|---------|---------|--------|----|-------|-------|----|-----|-------|----------|---------|--|
| 287.265 | 0.000 | 0.000 | 49 | 36 | 34 | 14 | 287 | 06:22 | | | BIOESS restarts on umpteenth try |
| 287.268 | 42.465 | 68.898 | 49 | 36 | 34 | 14 | 287 | 06:26 | 4227.92 | 6853.88 | Start new towyo down (S2870611) |
| 287.296 | 42.449 | 68.842 | 49 | 36 | 34 | 14 | 287 | 07:06 | 4226.94 | 6850.50 | Bottom of towyo |
| 287.315 | 42.435 | 68.824 | 49 | 36 | 34 | 14 | 287 | 07:34 | 4226.07 | 6849.44 | Top of towyo. Close File S2870611 |
| 287.318 | 42.437 | 68.821 | 49 | 36 | 34 | 14 | 287 | 07:38 | 4226.22 | 6849.24 | New File Started S2870737 |
| 287.331 | 42.427 | 68.787 | 49 | 37 | 35 | 14 | 287 | 07:57 | 4225.63 | 6847.19 | Tape Change DAT/VPR |
| 287.333 | 0.000 | 0.000 | 49 | 37 | 35 | 14 | 287 | 08:00 | | | Hold Fish near surface while waiting for turn. |
| 287.347 | 42.415 | 68.751 | 49 | 37 | 35 | 14 | 287 | 08:19 | 4224.88 | 6845.07 | Begin descent. |
| 287.354 | 42.394 | 68.750 | 49 | 37 | 35 | 14 | 287 | 08:30 | 4223.65 | 6845.01 | Bottom of towyo. Begin ascent. Very shallow <200m to bottom. |
| 287.365 | 42.378 | 68.750 | 49 | 37 | 35 | 14 | 287 | 08:46 | 4222.69 | 6845.02 | Top of ascent. 5m from surface. |
| 287.367 | 0.000 | 0.000 | 49 | 37 | 35 | 14 | 287 | 08:48 | | | Close File S2870737. Open S2870848. |
| 287.376 | 42.358 | 68.750 | 49 | 37 | 35 | 14 | 287 | 09:01 | 4221.45 | 6845.02 | Bottom of descent 180m. |
| 287.389 | 42.336 | 68.750 | 49 | 37 | 35 | 14 | 287 | 09:20 | 4220.14 | 6845.01 | Top of ascent. |
| 287.403 | 422.460 | 68.748 | 49 | 37 | 35 | 14 | 287 | 09:40 | 42187.60 | 6844.88 | Bottom of descent 190m. |
| 287.413 | 0.000 | 0.000 | 49 | 38 | 36 | 14 | 287 | 09:55 | | | Start VPR tape 36 and DAT tape 38. |
| 287.419 | 42.285 | 68.747 | 49 | 38 | 36 | 14 | 287 | 10:03 | 4217.08 | 6844.79 | Close File S2870848. Open File S2871003. |
| 287.431 | 0.000 | 0.000 | 49 | 38 | 36 | 14 | 287 | 10:20 | | | VPR something stuck on film...Fishing Line? |
| 287.431 | 42.264 | 68.745 | 49 | 38 | 36 | 14 | 287 | 10:21 | 4215.85 | 6844.68 | Bottom of towyo 189m. |
| 287.442 | 42.249 | 68.749 | 49 | 38 | 36 | 14 | 287 | 10:37 | 4214.96 | 6844.92 | Top of ascent. Hold at surface for CTD. Check what's on VPR. VPR item clears itself. |
| 287.443 | 0.000 | 0.000 | 49 | 38 | 36 | 14 | 287 | 10:38 | | | Turn off VPR and DAT tapes for CTD. |
| 287.444 | 0.000 | 0.000 | 49 | 38 | 36 | 14 | 287 | 10:39 | | | Close File S2871003. Stop recording for CTD. |
| 287.450 | 42.247 | 68.749 | 49 | 38 | 36 | 14 | 287 | 10:48 | 4214.84 | 6844.91 | CTD deployed. |
| 287.467 | 42.245 | 68.752 | 49 | 38 | 36 | 14 | 287 | 11:12 | 4214.72 | 6845.10 | CTD recovered. |
| 287.472 | 42.251 | 68.744 | 49 | 38 | 36 | 14 | 287 | 11:20 | 4215.07 | 6844.64 | Radiometer depolyed. |
| 287.494 | 42.260 | 68.745 | 49 | 38 | 36 | 14 | 287 | 11:51 | 4215.60 | 6844.69 | Radiometer recovered. |
| 287.499 | 42.263 | 68.750 | 49 | 38 | 36 | 14 | 287 | 11:58 | 4215.76 | 6845.01 | TOWYO DOWN after CTD and Radiometer; no bmp data during station; |
| 287.511 | 0.000 | 0.000 | 49 | 38 | 36 | 14 | 287 | 12:16 | | | fish diving under hull though wind on stbd. course change to 350; wave packet/soliton pass through |
| 287.519 | 0.000 | 0.000 | 49 | 38 | 36 | 14 | 287 | 12:28 | | | course change another 10 degrees |
| 287.552 | 42.359 | 68.817 | 49 | 38 | 36 | 14 | 287 | 13:15 | 4221.52 | 6849.03 | TOWYO BACK TO SURFACE, new files starting |
| 287.558 | 42.359 | 68.817 | 49 | 39 | 37 | 14 | 287 | 13:23 | 4221.52 | 6849.03 | begin S2871322 |
| 287.567 | 42.361 | 68.842 | 49 | 39 | 37 | 14 | 287 | 13:37 | 4221.63 | 6850.53 | TOWYO DOWN |
| 287.585 | 42.381 | 68.865 | 49 | 39 | 37 | 14 | 287 | 14:02 | 4222.87 | 6851.87 | TOWYO UP |
| 287.600 | 42.401 | 68.846 | 49 | 39 | 37 | 14 | 287 | 14:24 | 4224.09 | 6850.78 | TOWYO BACK TO SURFACE for MOC |
| 287.604 | 42.403 | 68.840 | 49 | 39 | 37 | 14 | 287 | 14:30 | 4224.17 | 6850.38 | begin S2871430 |
| 287.685 | 42.416 | 68.737 | 49 | ----- | ----- | 14 | 287 | 16:26 | 4224.93 | 6844.23 | paused, no tape change, started data tranfer |
| 287.686 | 42.416 | 68.737 | 49 | ----- | ----- | 14 | 287 | 16:28 | 4224.93 | 6844.22 | took out tapes 39 and 37, new tapes not started; data transfer and steam back to track from MOC end. |
| 287.755 | 42.418 | 68.952 | 49 | 40 | 38 | 14 | 287 | 18:07 | 4225.08 | 6857.14 | Begin S2871809, start tapes, TOWYO DOWN at 5.5knots, drop to 4.5 at 100meters depth |
| 287.785 | 0.000 | 0.000 | 49 | 40 | 38 | 14 | 287 | 18:50 | | | TOWYO UP from 185/204 |
| 287.797 | 0.000 | 0.000 | 49 | 40 | 38 | 14 | 287 | 19:08 | | | back to 5.5knots at 100 meters |
| 287.810 | 42.418 | 69.106 | 49 | 40 | 38 | 14 | 287 | 19:27 | 4225.08 | 6906.33 | TOWYO at SURFACE, begin S2871928, Low T layer at 150 meters, resync VPR, |
| 287.813 | 0.000 | 0.000 | 49 | 40 | 38 | 14 | 287 | 19:30 | | | TOWYO DOWN at 5.5 knots |
| 287.829 | 0.000 | 0.000 | 49 | 40 | 38 | 14 | 287 | 19:54 | | | drop to 4.5 knots |
| 287.836 | 42.418 | 69.186 | 49 | 40 | 38 | 14 | 287 | 20:04 | 4225.06 | 6911.15 | TOWYO UP |
| 287.842 | 42.417 | 69.202 | 49 | 41 | 39 | 14 | 287 | 20:12 | 4225.01 | 6912.09 | Change VPR and DAT to 39 and 41 respectively |
| 287.854 | 0.000 | 0.000 | | 41 | 39 | 14 | 287 | 20:30 | | | Winch OVERHEATING (135 degrees)... due to faster tow? |
| 287.857 | 42.424 | 69.245 | 49 | 41 | 39 | 14 | 287 | 20:34 | 4225.41 | 6914.71 | Top of ascent |
| 287.860 | 42.427 | 69.253 | 49 | 41 | 39 | 14 | 287 | 20:38 | 4225.60 | 6915.20 | Winch temp 135F. Hold at 30m to check winch. |
| 287.869 | 42.436 | 69.280 | 49 | 41 | 39 | 14 | 287 | 20:52 | 4226.16 | 6916.79 | Bring fish to sfc to evaluate winch temp prob. |
| 287.872 | 42.439 | 69.289 | 49 | 41 | 39 | 14 | 287 | 20:56 | 4226.36 | 6917.33 | Tow fish at sfc |
| 287.906 | 42.476 | 69.385 | 49 | 41 | 39 | 14 | 287 | 21:44 | 4228.56 | 6923.10 | Winch temp 120F. Begin towyo down. Active VPR screen. |
| 287.917 | 42.487 | 69.415 | 49 | 41 | 39 | 14 | 287 | 22:01 | 4229.20 | 6924.88 | Active VPR screen still. |
| 287.928 | 42.494 | 69.437 | 49 | 42 | 40 | 14 | 287 | 22:16 | 4229.63 | 6926.24 | Change DAT/VPR tapes. |
| 287.938 | 42.501 | 69.458 | 49 | 42 | 40 | 14 | 287 | 22:30 | 4230.08 | 6927.47 | Bottom of towyo descent. |
| 287.963 | 42.521 | 69.516 | 49 | 42 | 40 | 14 | 287 | 23:06 | 4231.26 | 6930.94 | Top of towyo. Start new file: S2872306. Winch 140F keep towyoing. |
| 287.989 | 42.540 | 69.571 | 49 | 42 | 40 | 14 | 287 | 23:44 | 4232.42 | 6934.24 | Bottom of descent. Begin ascent. |
| 288.010 | 42.556 | 69.610 | 49 | 43 | 41 | 15 | 288 | 00:15 | 4233.36 | 6936.59 | towyo at surface - kept at surface |
| 288.013 | 42.556 | 69.610 | 49 | 43 | 41 | 15 | 288 | 00:19 | 4233.36 | 6936.59 | new DAT tape # 43, VPR tape #41 |
| 288.021 | 42.556 | 69.610 | 49 | 43 | 41 | 15 | 288 | 00:30 | 4233.36 | 6936.59 | begin record, begin down cast file S2880030 |
| 288.052 | 42.587 | 69.691 | 49 | 43 | 41 | 15 | 288 | 01:15 | 4235.23 | 6941.48 | bottom of towyo begin up |
| 288.076 | 42.604 | 69.733 | 49 | 43 | 41 | 15 | 288 | 01:49 | 4236.24 | 6943.97 | top of towyo stop S2880154 |
| 288.079 | 42.607 | 69.743 | 49 | 43 | 41 | 15 | 288 | 01:54 | 4236.42 | 6944.55 | begin down cast S2880154 |
| 288.106 | 42.629 | 69.803 | 49 | 43 | 41 | 15 | 288 | 02:32 | 4237.74 | 6948.19 | bottom of towyo begin up |
| 288.108 | 42.631 | 69.809 | 49 | 43 | 41 | 15 | 288 | 02:36 | 4237.87 | 6948.53 | new DAT tape #43, VPR tape #42 |
| 288.130 | 42.645 | 69.855 | 49 | 44 | 42 | 15 | 288 | 03:07 | 4238.72 | 6951.28 | top of towyo - begin run at surface |
| 288.154 | 42.664 | 69.916 | 49 | 44 | 42 | 15 | 288 | 03:42 | 4239.81 | 6954.99 | end file S2880154, shut down system and transect south to next turning point |
| 288.226 | 0.000 | 0.000 | 49 | ----- | ----- | 15 | 288 | 05:25 | | | leg 16 to 17, start file S2880545 @6knots, |
| 288.237 | 42.484 | 69.865 | 49 | 44 | 42 | 15 | 288 | 05:41 | 4229.06 | 6951.88 | starting up ESS and sonar, trying to get software running |
| 288.408 | 42.480 | 69.853 | 49 | 44 | 42 | 15 | 288 | 09:47 | 4228.78 | 6951.16 | TOWYO DOWN 5knots |
| 288.256 | 0.000 | 0.000 | 49 | 44 | 42 | 15 | 288 | 06:08 | | | 100 meters, 4knots |
| 288.261 | 0.000 | 0.000 | 49 | 44 | 42 | 15 | 288 | 06:16 | | | Layer just off bottom on 43 and 120, 10 meters thick, T min at 80 meters |
| 288.272 | 0.000 | 0.000 | 49 | 44 | 42 | 15 | 288 | 06:32 | | | begin S2880632 after: hold off on winch, sonar off ??? button hit on mouse, restarting software, depth from bridge 134 fathoms, flat line until restart to get pulse |
| 288.278 | 42.454 | 69.774 | 49 | 45 | 43 | 15 | 288 | 06:41 | 4227.22 | 6946.46 | change tapes, descending at 6.4 meters/min |
| 288.285 | 42.441 | 69.761 | 49 | 45 | 43 | 15 | 288 | 06:51 | 4226.43 | 6945.65 | TOWYO UP |
| 288.306 | 0.000 | 0.000 | 49 | 45 | 43 | 15 | 288 | 07:20 | | | 5 knots, 100 meters |
| 288.315 | 42.428 | 69.701 | 49 | 45 | 43 | 15 | 288 | 07:33 | 4225.67 | 6942.07 | TOWYO at surface |
| 288.317 | 42.426 | 69.695 | 49 | 45 | 43 | 15 | 288 | 07:37 | 4225.58 | 6941.70 | begin S2880736 TOWYO DOWN |

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|---------|--------|--------|----|----|----|----|-----|-------|---------|---------|---|
| 288.333 | 0.000 | 0.000 | 49 | 45 | 43 | 15 | 288 | 08:00 | | | down to 4knots |
| 288.345 | 42.404 | 69.635 | 49 | 45 | 43 | 15 | 288 | 08:17 | 4224.23 | 6938.07 | Bottom of towyo. 220/250m. Begin ascent. |
| 288.358 | 42.394 | 69.609 | 49 | 45 | 43 | 15 | 288 | 08:36 | 4223.63 | 6936.55 | Patch on VPR at 60m. |
| 288.364 | 42.389 | 69.595 | 49 | 46 | 44 | 15 | 288 | 08:44 | 4223.35 | 6935.71 | Close file. Open file: S2880844. Top of ascent. Change VPR/DAT tapes. |
| 288.388 | 42.370 | 69.541 | 49 | 46 | 44 | 15 | 288 | 09:18 | 4222.22 | 6932.44 | Bottom of descent. 222/240m. Begin ascent. |
| 288.402 | 42.359 | 69.511 | 49 | 46 | 44 | 15 | 288 | 09:39 | 4221.53 | 6930.64 | Patch on VPR at 100m. |
| 288.410 | 42.353 | 69.488 | 49 | 46 | 44 | 15 | 288 | 09:51 | 4221.18 | 6929.28 | Top of ascent. Close file: S2880844. Open file: S2880951. |
| 288.417 | 42.354 | 69.469 | 49 | 46 | 44 | 15 | 288 | 10:00 | 4221.26 | 6928.14 | Stop descent at 50m. Start fish to sfc. |
| 288.420 | 42.351 | 69.458 | 49 | 46 | 44 | 15 | 288 | 10:05 | 4221.06 | 6927.48 | Hold fish at sfc. to get back on course. Steam to waystop #17. |
| 288.425 | 42.346 | 69.445 | 49 | 46 | 44 | 15 | 288 | 10:12 | 4220.74 | 6926.71 | Bringing speed to 8 knots. |
| 288.451 | 42.301 | 69.336 | 49 | 47 | 45 | 15 | 288 | 10:50 | 4218.08 | 6920.14 | New DAT/VPR tapes (probably missed a couple of minutes.) Winch temp 115F. |
| 288.469 | 42.273 | 69.259 | 49 | 47 | 45 | 15 | 288 | 11:15 | 4216.41 | 6915.51 | Close file: S2880951. Stop DAT/VPR tapes. |
| 288.477 | 42.277 | 69.259 | 49 | 47 | 45 | 15 | 288 | 11:27 | 4216.63 | 6915.57 | BIOMAPER recovered. |
| 288.000 | 0.000 | 0.000 | | 47 | 45 | 15 | 288 | 00:00 | | | |
| 288.624 | 42.088 | 69.223 | | 47 | 45 | 15 | 288 | 14:58 | 4205.28 | 6913.41 | Begin S2881453, ducers soaped, vpr cleaned, bmp redeployed, rebooted |
| 288.627 | 42.098 | 69.232 | | 47 | 45 | 15 | 288 | 15:03 | 4205.88 | 6913.90 | Begin S2881502 to change interval duration in seq. summ. from 0.5 to 0.17 |
| 288.628 | 0.000 | 0.000 | | 47 | 45 | 15 | 288 | 15:05 | | | changes did not take effect, see 16:44 entry |
| 288.631 | 42.095 | 69.241 | | 47 | 45 | 15 | 288 | 15:08 | 4205.71 | 6914.44 | Begin S2881507try again with interval duration at 0.167...bmp at surface, waiting |
| 288.635 | 42.099 | 69.250 | | 47 | 45 | 15 | 288 | 15:15 | 4205.96 | 6915.02 | TOWYO DOWN |
| 288.667 | 42.126 | 69.316 | | 47 | 45 | 15 | 288 | 16:01 | 4207.57 | 6918.96 | Dat tape not recording (on pause), now 1 hour out of sync with vpr |
| 288.670 | 0.000 | 0.000 | | 47 | 45 | 15 | 288 | 16:05 | | | TOWYO UP Begin S2881613, SCRCAP |
| 288.674 | 0.000 | 0.000 | | 47 | 45 | 15 | 288 | 16:10 | | | TOWYO DOWN |
| 288.685 | 0.000 | 0.000 | | 47 | 46 | 15 | 288 | 16:26 | | | VPR tape change |
| 288.691 | 0.000 | 0.000 | | 47 | 46 | 15 | 288 | 16:35 | | | spd to 4 knots |
| 288.695 | 42.155 | 69.368 | | 47 | 46 | 15 | 288 | 16:41 | 4209.30 | 6922.09 | TOWYO UP from 156/186 |
| 288.702 | 0.000 | 0.000 | | 47 | 46 | 15 | 288 | 16:51 | | | 5knots |
| 288.706 | 0.000 | 0.000 | | 47 | 46 | 15 | 288 | 16:57 | | | bottom coming up dramatically under us on way up |
| 288.711 | 0.000 | 0.000 | | 47 | 46 | 15 | 288 | 17:04 | | | TOWYO at SURFACE, changing ping interval again, need to push add button, and delete other seq. |
| 288.712 | 42.172 | 69.422 | | 47 | 46 | 15 | 288 | 17:05 | 4210.33 | 6925.30 | Begin S2881705 |
| 288.730 | 42.191 | 69.469 | | 47 | 46 | 15 | 288 | 17:31 | 4211.48 | 6928.13 | Begin S2881729/fix interval duration to .167 seconds |
| 288.736 | 42.199 | 69.486 | | 48 | 46 | 15 | 288 | 17:40 | 4211.91 | 6929.16 | dat tape change |
| 288.749 | 0.000 | 0.000 | | 48 | 46 | 15 | 288 | 17:59 | | | TOWYO UP from 200/225 moon rise |
| 288.754 | 0.000 | 0.000 | | 48 | 46 | 15 | 288 | 18:06 | | | software crashed, 541 seconds behind due to interval shortening, stopped, winch being repaired too |
| 288.757 | 42.223 | 69.526 | | 48 | 46 | 15 | 288 | 18:10 | 4213.37 | 6931.56 | Begin S2881810, restart with 30 second integrations |
| 288.768 | 42.246 | 69.530 | | 48 | 46 | 15 | 288 | 18:26 | 4214.76 | 6931.80 | CRASH and RESTART, begin S2881826 |
| 288.776 | 42.270 | 69.525 | | 48 | 47 | 15 | 288 | 18:38 | 4216.22 | 6931.50 | VPR tape change |
| 288.778 | 42.271 | 69.525 | | 48 | 47 | 15 | 288 | 18:40 | 4216.25 | 6931.52 | TOWYO to surface |
| 288.781 | 42.275 | 69.535 | | 48 | 47 | 15 | 288 | 18:45 | 4216.47 | 6932.12 | Return to tract and start to 50 meters with wire checks by bridge |
| 288.783 | 0.000 | 0.000 | | 48 | 47 | 15 | 288 | 18:48 | | | 25 meters, wire ok |
| 288.786 | 0.000 | 0.000 | | 48 | 47 | 15 | 288 | 18:52 | | | 50 meters, wire ok |
| 288.790 | 0.000 | 0.000 | | 48 | 47 | 15 | 288 | 18:57 | | | 75 meters, wire ok |
| 288.792 | 42.279 | 69.565 | | 48 | 47 | 15 | 288 | 19:00 | 4216.72 | 6933.87 | 90 meters, TOWYO UP (wire not ok, headed under ship) |
| 288.797 | 0.000 | 0.000 | | 48 | 47 | 15 | 288 | 19:07 | | | 50 meters |
| 288.801 | 0.000 | 0.000 | | 48 | 47 | 15 | 288 | 19:14 | | | 15 meters |
| 288.802 | 42.282 | 69.602 | | 48 | 47 | 15 | 288 | 19:15 | 4216.90 | 6936.10 | TOWYO DOWN, ctenophores, SCRCAPa |
| 288.808 | 42.283 | 69.613 | | 48 | 47 | 15 | 288 | 19:24 | 4217.00 | 6936.80 | 50 meters |
| 288.813 | 42.285 | 69.626 | | 48 | 47 | 15 | 288 | 19:31 | 4217.08 | 6937.56 | 80 meters |
| 288.824 | 42.289 | 69.660 | | 48 | 47 | 15 | 288 | 19:47 | 4217.33 | 6939.59 | sit @surface, SCRCAP |
| 288.826 | 42.289 | 69.664 | | 48 | 47 | 15 | 288 | 19:49 | 4217.35 | 6939.82 | Begin S2881949, down to 210 meters |
| 288.851 | 42.298 | 69.741 | | 48 | 47 | 15 | 288 | 20:26 | 4217.89 | 6944.46 | TOWYO UP |
| 288.861 | 42.302 | 69.765 | 63 | 49 | 48 | 15 | 288 | 20:40 | 4218.14 | 6945.91 | Top of ascent. Came out of water. New VPR Tape. Hold at sfc for turn to south. Close file S2881949. Open file S2882043. |
| 288.866 | 42.298 | 69.770 | 63 | 49 | 48 | 15 | 288 | 20:47 | 4217.85 | 6946.21 | Turn on new course for turning point 20. Commencing tow. Large surface patch. |
| 288.883 | 42.274 | 69.767 | 63 | 49 | 48 | 15 | 288 | 21:12 | 4216.44 | 6946.00 | Begin ascent at 220m. |
| 288.900 | 42.244 | 69.761 | 63 | 49 | 48 | 15 | 288 | 21:36 | 4214.64 | 6945.69 | Top of ascent. Begin back down. |
| 288.907 | 42.231 | 69.761 | 63 | 50 | 49 | 15 | 288 | 21:46 | 4213.88 | 6945.63 | Replace DAT/VPR tapes to get tapes in sync. ~1 hour left on VPR tape. |
| 288.919 | 42.214 | 69.759 | 63 | 50 | 49 | 15 | 288 | 22:03 | 4212.84 | 6945.54 | Bottom of descent. 210/235m. |
| 288.938 | 42.179 | 69.755 | 63 | 50 | 49 | 15 | 288 | 22:30 | 4210.75 | 6945.32 | Errors @ 35m. |
| 288.000 | 0.000 | 0.000 | 63 | 50 | 49 | 15 | 288 | | | | "Problems Encountered in Sending Stop Processing Command." |
| 288.000 | 0.000 | 0.000 | 63 | 50 | 49 | 15 | 288 | | | | "Problems Getting Data from Echo Sounder." |
| 288.000 | 0.000 | 0.000 | 63 | 50 | 49 | 15 | 288 | | | | "The System has been disabled. Check the Sounder-PC Network Connections." |
| 288.000 | 0.000 | 0.000 | 63 | 50 | 49 | 15 | 288 | | | | Fish came out too high. |
| 288.941 | 42.172 | 69.754 | 63 | 50 | 49 | 15 | 288 | 22:35 | 4210.31 | 6945.24 | Exit program. Restart program. (Must have also started new file here.) |
| 288.942 | 42.168 | 69.754 | 63 | 50 | 49 | 15 | 288 | 22:37 | 4210.11 | 6945.21 | Start towyo down. |
| 288.958 | 42.141 | 69.751 | 63 | 50 | 49 | 15 | 288 | 23:00 | 4208.44 | 6945.04 | Bottom of towyo 194/215m. |
| 288.971 | 42.122 | 69.748 | 63 | 50 | 49 | 15 | 288 | 23:18 | 4207.31 | 6944.87 | Top of ascent. End File. Start New File: S2882319. |
| 288.982 | 42.131 | 69.750 | 63 | 51 | 50 | 15 | 288 | 23:34 | 4207.86 | 6945.00 | Change tapes. Start towyo down. (~15 minutes left on tapes.) |
| 288.997 | 42.120 | 69.715 | 63 | 51 | 50 | 15 | 288 | 23:56 | 4207.22 | 6942.89 | Bottom of towyo 195/220m. |
| 289.008 | 42.111 | 69.693 | 63 | 51 | 50 | 16 | 289 | 00:11 | 4206.69 | 6941.57 | Locked up the processing program-- REBOOT |
| 289.015 | 42.106 | 69.679 | 63 | 51 | 50 | 16 | 289 | 00:21 | 4206.37 | 6940.74 | begin S2890020 |
| 289.068 | 42.081 | 69.617 | 63 | 52 | 51 | 16 | 289 | 01:38 | 4204.85 | 6937.00 | change DAT and VPR tapes |
| 289.097 | 42.065 | 69.576 | 63 | 52 | 51 | 16 | 289 | 02:19 | 4203.91 | 6934.58 | Moc on board |
| 289.097 | 0.000 | 0.000 | 63 | 52 | 51 | 16 | 289 | 02:19 | | | begin S2890221 TOWYO DOWN |
| 289.126 | 42.036 | 69.499 | 63 | 52 | 51 | 16 | 289 | 03:01 | 4202.14 | 6929.95 | TOWYO UP |
| 289.147 | 42.013 | 69.442 | 63 | 52 | 51 | 16 | 289 | 03:32 | 4200.79 | 6926.54 | TOWYO at surface |
| 289.149 | 0.000 | 0.000 | 63 | 53 | 52 | 16 | 289 | 03:35 | | | new DAT and VPR tapes |
| 289.167 | 41.990 | 69.386 | 63 | 53 | 52 | 16 | 289 | 04:00 | 4159.43 | 6923.19 | TOWYO UP |
| 289.188 | 41.965 | 69.342 | 63 | 53 | 52 | 16 | 289 | 04:31 | 4157.91 | 6920.50 | TOWYO AT SURFACE, begin S2890434 |
| 289.190 | 41.963 | 69.335 | 63 | 53 | 52 | 16 | 289 | 04:34 | 4157.78 | 6920.10 | TOWYO DOWN to 75 meters |

| | | | | | | | | | | | |
|---------|--------|--------|----|----|----|----|-----|-------|---------|---------|--|
| 289.212 | 41.945 | 69.278 | 63 | 53 | 52 | 16 | 289 | 05:05 | 4156.69 | 6916.69 | END TOWYO at 90 meters |
| 289.239 | 41.921 | 69.211 | 63 | 53 | 52 | 16 | 289 | 05:44 | 4155.26 | 6912.66 | END TOWYO from 90 meters down, close file bmp at 7 meters for transit |
| 289.241 | 0.000 | 0.000 | 63 | 53 | 52 | 16 | 289 | 05:47 | | | Begin S2890546 |
| 289.243 | 0.000 | 0.000 | 63 | 54 | 53 | 16 | 289 | 05:50 | | | restarted tapes |
| 289.247 | 0.000 | 0.000 | 63 | 54 | 53 | 16 | 289 | 05:56 | | | Start turn, steam with fish at 7 meters toward SOLITON SURVEY (13 and 14) |
| 289.278 | 0.000 | 0.000 | 63 | 54 | 53 | 16 | 289 | 06:40 | | | Suns coming up, dat tapes running out. |
| 289.296 | 42.032 | 69.102 | 63 | 54 | 53 | 16 | 289 | 07:06 | 4201.93 | 6906.14 | Software locked up ð REBOOT, power down sonar |
| 289.299 | 0.000 | 0.000 | 63 | 54 | 53 | 16 | 289 | 07:11 | | | restart processing |
| 289.325 | 42.090 | 69.048 | 63 | 54 | 53 | 16 | 289 | 07:48 | 4205.42 | 6902.86 | wave structures and layers at 15, 130, 160 meters under fish |
| 289.327 | 0.000 | 0.000 | 63 | 55 | 54 | 16 | 289 | 07:51 | | | change VPR and DAT tapes |
| 289.365 | 0.000 | 0.000 | 63 | 55 | 54 | 16 | 289 | 08:45 | | | bottom dropping off with strong sSSC paralleling dropoff |
| 289.417 | 42.269 | 68.885 | 63 | 56 | 55 | 16 | 289 | 10:00 | 4216.13 | 6853.07 | tape change (bit late) lots of salps and siphns 15:10:00 |
| 289.501 | 42.414 | 68.750 | 63 | 57 | 56 | 16 | 289 | 12:02 | 4224.84 | 6844.99 | tape change, at turn pt. 13, begin S2891201 |
| 289.523 | 42.416 | 68.749 | 63 | 57 | 56 | 16 | 289 | 12:33 | 4224.94 | 6844.91 | total system RESTART after powerdown begin S2891240 |
| 289.585 | 42.431 | 68.733 | 63 | 58 | 57 | 16 | 289 | 14:02 | 4225.85 | 6843.98 | tape change at turn pt. 13 |
| 289.650 | 42.336 | 68.679 | 63 | 58 | 57 | 16 | 289 | 15:36 | 4220.16 | 6840.75 | BMP at surface in mid-SOLITON wave packet |
| 289.667 | 42.311 | 68.667 | 63 | 58 | 57 | 16 | 289 | 16:00 | 4218.68 | 6840.01 | turn 180 degrees to resample SOLITON |
| 289.672 | 42.311 | 68.671 | 63 | 59 | 58 | 16 | 289 | 16:08 | 4218.68 | 6840.27 | tape change begin S2891607, BMP to 50 meters |
| 289.692 | 42.346 | 68.687 | 63 | 59 | 58 | 16 | 289 | 16:37 | 4220.75 | 6841.25 | coming up on SOLITON again BMP@50 meters (47-56 meters) T structure from 15 at surface to 4 at 50 meters |
| 289.697 | 42.456 | 68.692 | 63 | 59 | 58 | 16 | 289 | 16:44 | 4221.36 | 6841.53 | Bridge RADAR: propagation wave packet at 310 degrees, 5 packets ahead |
| 289.754 | 42.462 | 68.747 | 63 | 59 | 58 | 16 | 289 | 18:06 | 4227.35 | 6844.84 | end of packet |
| 289.756 | 42.486 | 68.751 | 63 | 60 | 59 | 16 | 289 | 18:08 | 4227.70 | 6845.03 | tape replenishment |
| 289.771 | 42.506 | 68.763 | 63 | 60 | 59 | 16 | 289 | 18:30 | 4229.17 | 6845.79 | TOWYO DOWN from 50 meters |
| 289.783 | ERR | 68.772 | 63 | 60 | 59 | 16 | 289 | 18:47 | 4230.37 | 6846.34 | TOWYO UP from 171/200 (copepods deep) |
| 289.786 | 0.000 | 0.000 | 63 | 60 | 59 | 16 | 289 | 18:52 | | | wire rattling against hull; course mod. |
| 289.790 | 0.000 | 0.000 | 63 | 60 | 59 | 16 | 289 | 18:58 | | | 45 meters siphonophore layer |
| 289.794 | 42.527 | 68.782 | 63 | 60 | 59 | 16 | 289 | 19:03 | 4231.62 | 6846.92 | TOWYO SURFACES, goes to 5 meters for 180 degree turn to track @25 meters |
| 289.798 | 42.532 | 68.778 | 63 | 60 | 59 | 16 | 289 | 19:09 | 4231.90 | 6846.66 | TURN to 139 |
| 289.800 | 42.529 | 68.775 | 63 | 60 | 59 | 16 | 289 | 19:12 | 4231.74 | 6846.48 | begin S2891912, SCR CAP, TOWYO DOWN to 25 meters |
| 289.838 | 42.476 | 68.756 | 63 | 60 | 59 | 16 | 289 | 20:06 | 4228.57 | 6845.34 | approaching SOLITON, RADAR can see, we're on one, one ahead |
| 289.843 | 42.470 | 68.751 | 63 | 61 | 62 | 16 | 289 | 20:14 | 4228.21 | 6845.04 | tape change |
| 289.938 | 0.000 | 0.000 | 63 | 62 | 61 | 16 | 289 | 22:30 | | | late tape change |
| 289.951 | 42.512 | 68.773 | 63 | 62 | 61 | 16 | 289 | 22:50 | 4230.70 | 6846.35 | BMP on board, steaming for WHOI |