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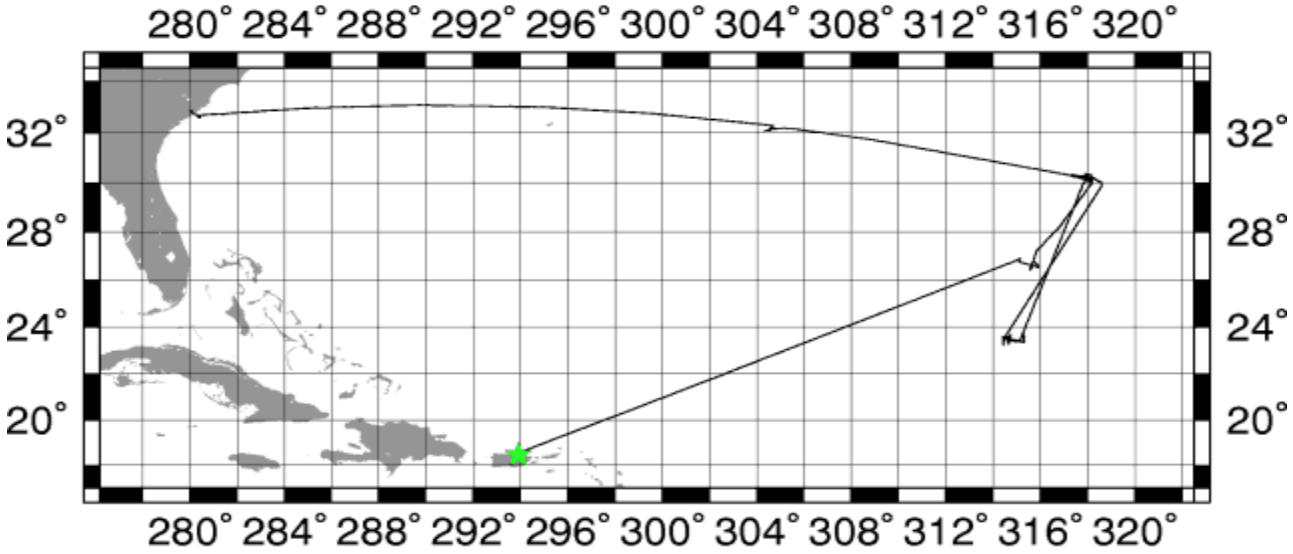
R/V Maurice Ewing Data Reduction Summary

EW−0102 Charleston, SC − San Juan, Puerto Rico

Date	Julian Date	Time	Port
March 10, 2001	69	22:00:00	Charleston, SC
April 5, 2001	95	12:03:00	San Juan, Puerto Rico



Project Summary

Mid−Atlantic Ridge Megamullions MCS

Background and Scientific Objectives

Understanding the geological and geophysical structure of ocean crust is a fundamental goal of the earth science community. Primary data on lithology and lithological−structural relations of the sub−volcanic section in the ocean basins have been acquired by ocean drilling and to some extent by submersible studies. However, this record is very incomple, and ocean drilling to penetrate the entire crust (or even a large fraction thereof) is unlikely to be achieved in the near future. Data on seismic velocity in ocean crustal layers have been correlated with laboratory measurements of velocity in mafic and ultramafic oceanic rocks and with some borehol seismic results in order to infer a layered lithology similar to the Penrose ophiolite model. However, it is uncertain to what degree the idealized Penrose model is representative of normal ocean crust.

The recent discovery of megamullions provides an outstanding new opportunity to study the geological and geophysical character of ocean lithosphere on spreading ridges that have limited magma supply. These features are interpreted to be footwall blocks of long−lived (~1 − 2.5 my) normal faults and the appear to expose extensive (~15 − 35 km) cross sections of the crust and uppermost mantle at the seafloor (*Tucholke et al.*, 1998b.). This exposure offers relatively unimpeded access for both geological and geophysical sampling to determine the true nature of in−situ ocean crust.

The present cruise was a multi−channel seismic (MCS) investigation of three of the best−developed megamullions known on the Mid−Atlantic Ridge (MAR) in the central North Atlantic ocean. The geometric characteristics of the megamullions (unusually smooth surface, shallow depths) are very favorable for high−resolution seismic determination of seismic velocity and structure, in contrast to MCS study of normal, slow−spreading crust whicih is hampered by multiple reflections from the extremely irregular topography. By obtaining several seismic lines over each megamullion, our program attempts to establis lateral coherence or variablility of crustal structure in both strike and dip directions. Our goals are 1) to obtain high−resolution velocity structure of the megamullions, 2) to relate this to probable composition, including possible alteration effects such as serpentization of mantle ultramafics and 3) where possible to image structural discontinuities including the relict detachment shear zone dipping through the lithosphere at the young end (termination) of the megamullion. To the extent possible within the time allowed, we also obtained MCS profiles on crust conjugate to the megamullions, so as to investigate how the structure of this 'hanging−wall crust' was affected during the period of megamullion formation. Interpretations of our seismic results will be further constrained by modelling density distribution in the megamullion s from gravity data obtained during the survey. The three megamullions studied here have near−bottom survey and sampling programs either planned, proposed or already conducted.

Our MCS studies and the sampling studies are complementary and will benefit one another in interpretation of results.

Cruise Members

Science Party

Brian Tucholke	Chief Scientist	btucholke@whoi.edu
John Collins		jcollins@whoi.edu
Tom Bolmer		tbolmer@whoi.edu
Juan Pablo Canales		jpcanales@whoi.edu
Robin Kelly		rkelly@whoi.edu

Ship's Science

Chris Leidhold	Science Officer	sci@ewing.ldeo.columbia.edu
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Jeff Turmelle	Data Reduction	jefft@ldeo.columbia.edu
Justin Walsh	Gunner	cabinboy@ldeo.columbia.edu

Ship Crew

James O'Loughlin	Captain	captain@ewing.ldeo.columbia.edu
Steven Pica	Chief Engineer	engine@ewing.ldeo.columbia.edu
Gilbert Thurston	1st Mate	
Jeffrey Sylvia	2nd Mate	
RJ DiMattia	3rd Mate	
Gartz Gould	1st A/Engineer	
Miguel Flores	2nd A/Engineer	
Daniel LoCasto	3rd A/Engineer	
John Smith	Steward	
David Philbrick	Bosun	
Aubrey, Benjamin	A/B	
Grieg, Alexander	A/B	
Malloy, Robert	Oiler	
Moqo, Luke	Messman	
Peck, Scott	A/B	
Schwartz, Jack	Electrician	
Spruill, Michael	Oiler	
Sypongco, Arnold	O/S	
Taylor, Kelly	Cook	
Uribe, Fernando	Oiler	
Wheeler, Christopher	O/S	

All data in this report is logged using GMT time and Julian days in order to avoid confusion with local time changes.

Spectra

Spectra logs data to files in UKOOA[1] P1/90 format and P2/94 Format. The file formats are included in separate PDF documents on the tape. The contents of these files contain all the parameters used during shooting each of the lines, as well as the positions of all the sensors. I have included perl scripts for extracting shot times and positions from the P1 and P2 files on the tape.

This cruise was the first cruise running the Spectra navigation and seismic shooting system. There were some problems related to this:

1. Tailbuoy configuration was initially incorrect due to several configuration problems:
   Manual compass configuration was set to a depth bird instead of a compass bird.
   No magnetic declination was input for the compass data.
   Tailbuoy range did not take into account the Vessel Reference Offset.
   This was fixed by the time the MEG−1 line was shot.
2. P2 data was not logged for all the shots on the first few lines due to a configuration error in the Spectra logging configuration:
   Since the *approach shots* do not count as the *actual shot start*, it is necessary to start logging **approach shots** *before* the **actual shot point.**
3. Problems combining the Spectra output shot header and various Ewing input logs caused some data (*line 1*) for shots to be unrecoverably lost (see #2).
4. Shot times are not accounted for in the millisecond range in the P2 files.
5. An RTNu (spectra box) hung causing Hydrosweep data to be lost in the Seg−D headers for much of Day 083.

Positioning of Sensors

The Spectra system defines a reference point which is used as a reference to all points which need an offset (range and bearing to TB, for example). This reference point has been defined as the center of the ship's mast, at sealevel.

Any documentation included herein that refers to the vessel reference or reference or master will be referring to this reference point.

However, daily navigation files that are not related to spectra (ie. n., hb.n, mg.n, files) are referenced to the Tasmon P−Code GPS filtered positions.

Offset information can be found under the **Ship Diagrams** section of this document.

Data Reduction

Since spectra positions its shots precisely based on a Kalman filtering algorithm, we will assume that it has the correct shot location. However, as a fallback measure, I have also processed the shots using our normal navigation filtering.

Therefore you will find the following shotlog files:

1 *United Kingdom Offshore Operators Association*

- nb0.r Contains shot times and positions based on Spectra positioning.
- nb2.r Contains shot times and positions based on Spectra navigation
- ts.n Contains shot times and positions based on Ewing navigation
- shots.p1 Contains shot times and positions based on Spectra P1 files
- shots.p2 Contains shot times and positions based on Spectra P2 files

Please see the File Formats section for more information on these files.

Hydrosweep

Hydrosweep acquisition was extremely bad during this cruise with 18% average dropouts. No processing was done on the Hydrosweep bathymetry

Gravity

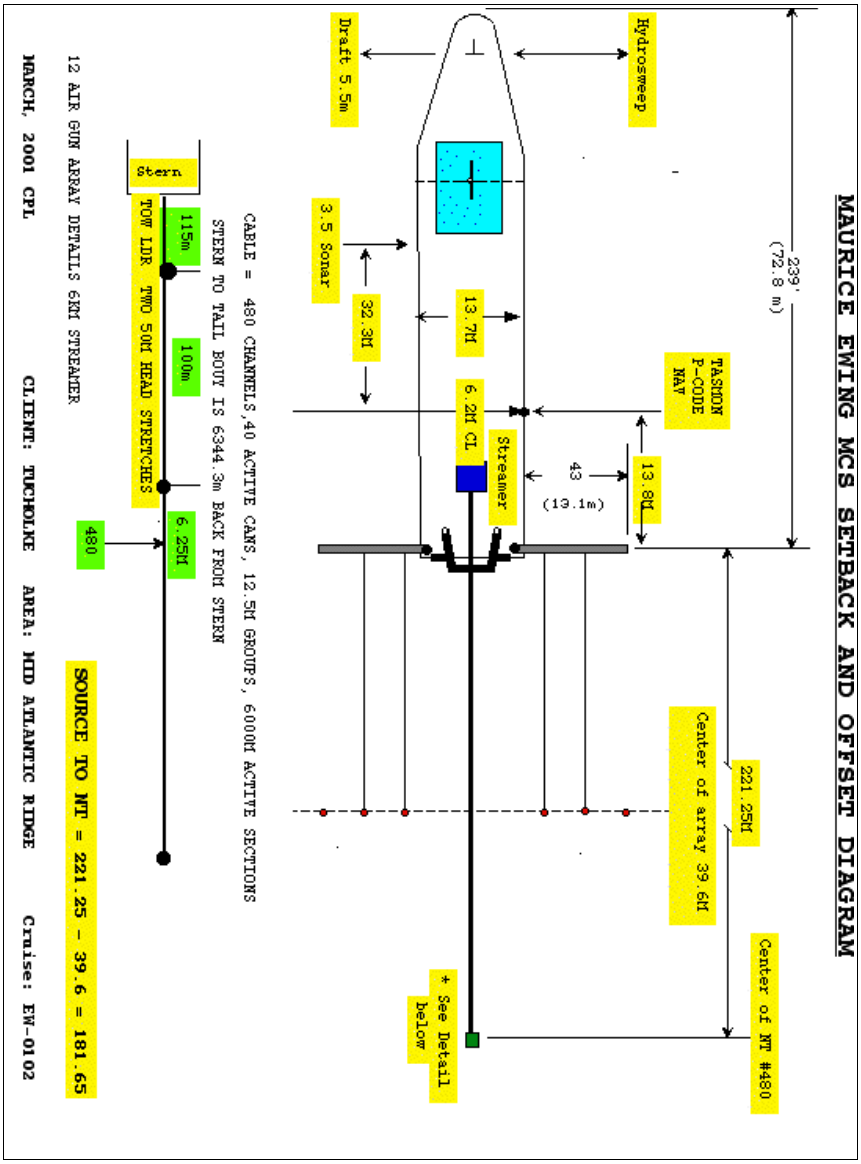
One of the gyros failed on Julian Day 088 at 0200Z, and was promptly replaced by Chris by 0800Z on the same day

Seismic Acquisition

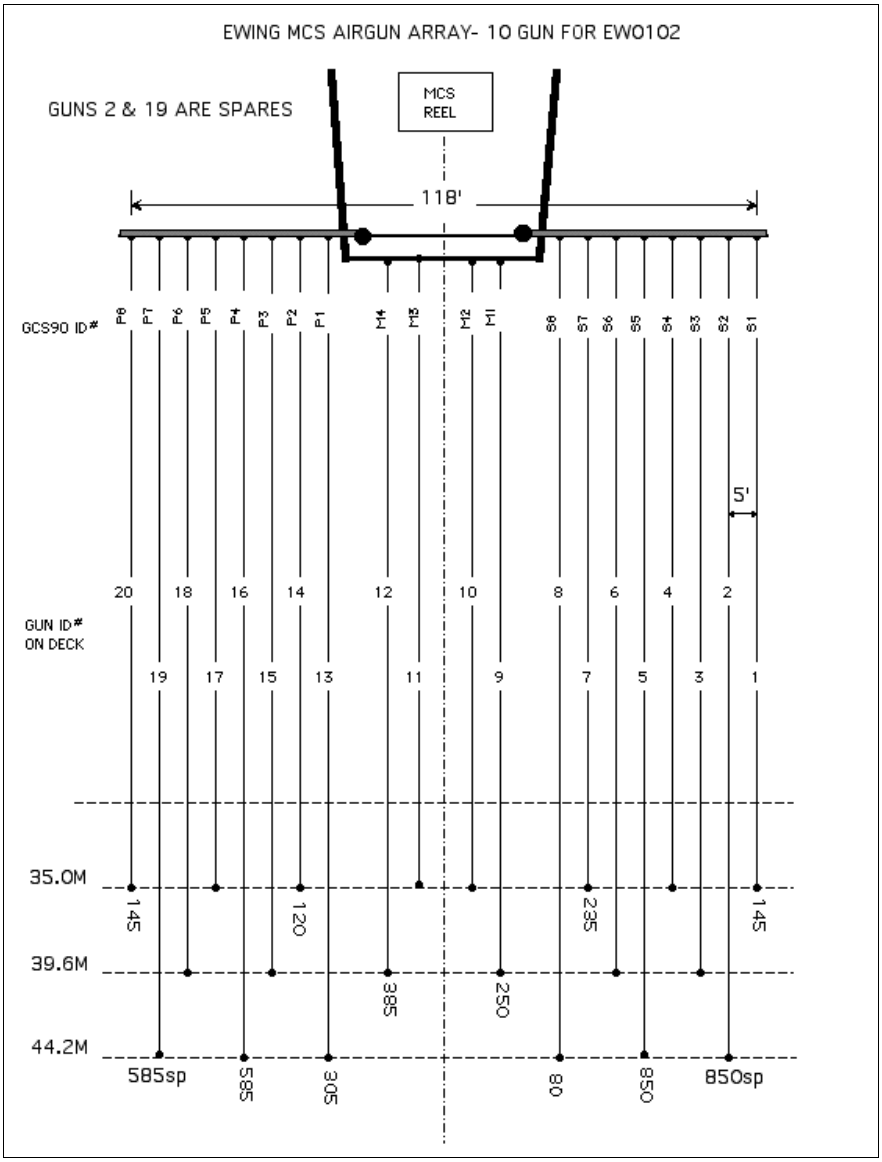
There were 2 failures of the Syntron system this cruise. Both related to tape drive failures. Streamer configuration files are included on the tape in Excel 97 format.

Ship Diagrams

Ship Offset Diagram



Guns Diagram



Data Logging

The R/V Maurice Ewing data logging system is run on a Sparc Ultra Enterprise Server. Attached are 48 serial ports via 3 16−port Digi International SCSI Terminal Servers. Generally, all data logged by the Ewing Data Acquisition System (DAS) is time stamped with the CPU time of the server, and broadcast to the Ewing network using UDP packet broadcasts. The CPU time of the server is synchronized once every half hour to a Datum UTC gps time clock.

GPS times are also time−tagged with cpu time, although the time of the GPS position is from the GPS fix itself.

The following tables describe the data instruments which performed logging during this cruise. The tables associated with the instruments describe logging periods and data losses for that instrument.

Time Reference

Datum StarTime 9390−1000

logging interval: 30 minutes
file id: tr2

Used as the CPU synchronization clock. This clock is polled once every half hour to synchronize the CPU clock of the data logger to UTC time. The logger (octopus) is responsible for updating the times of the other CPUs.

This clock was running and synchronizing the system the entire cruise.

Interruption s greater than 30 minutes are displayed in the following table

Log Date	LogDate	Comment
2001+069:19:53:30.128		Logging officially started
2001+095:16:30		Logging officially ends

Spectra

Spectra uses its own Trimble gps receiver for synchronizing its hardware to UTC time. This is the time the shot points are referenced to; not the CPU time.

Spectra P2 files were logged, although due to some configuration problems, not all shots at the beginning of the lines were logged.

GPS Receivers

GPS data is usually logged at 10 second intervals. The NMEA strings GPGGA and GPVTG are logged for position, speed, and heading fixes. This data was logged constantly throughout the cruise.

The Tasmon GPS was the primary GPS for this cruise.

Trimble Tasmon P/Y Code Receiver

logging interval: 10 seconds
file id: gp1

The Tasmon is the primary GPS receiver for the Ewing Logging system and the primary GPS for Spectra fixes. The accuracy is around 15 meters. There were no interruptions during this cruise.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	LogDate	Comment
2001+069:19:54:54.360		Logging officially started
2001+095:16:30:00		Logging officially ends

Trimble NT200D

logging interval: 10 seconds
file id: gp2

The Trimble is the secondary receiver for GPS data. Data is logged at 10 second intervals and is also used as an input to Spectra, although it is weighed at a lower value than the Tasmon receiver.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	LogDate	Comment
2001+069:19:55:03.310		Logging officially started
2001+070:00:39:46.010	2001+070:00:56:43.650	Data interruption
2001+070:22:13:48.067	2001+071:20:33:15.798	Data interruption
2001+073:02:06:47.968	2001+073:02:21:26.131	Data interruption
2001+095:16:30:		Logging Ends

Tailbuoy Garmin GP8

logging interval: 10 seconds
file id: tb1

The tailbuoy receiver was not working for the first 3 MEG lines. After this the tailbuoy worked during all lines with the exception of minor blackouts during turns and during the streamer failure on line KANE−7. Also note that often, the tailbuoy was being logged while it was on deck for testing purposes.

Interruptions greater than 30 minutes are displayed in the following table

Log Date	Log Date	Comment
2001+070:00:00:15.362	2001+070:12:53:21.811	Tailbuoy logging starts
2001+070:16:44:11.018	2001+071:18:21:45.334	
2001+071:19:31:22.632	2001+071:20:13:07.786	
2001+071:22:23:55.743	2001+071:22:37:35.688	
2001+071:23:40:29.962	2001+071:23:49:08.511	
2001+072:00:46:56.377	2001+072:12:53:25.941	
2001+072:13:38:43.579	2001+074:15:08:21.597	
2001+074:15:55:05.932	2001+074:16:05:18.766	
2001+074:19:15:55.166	2001+074:19:27:54.002	
2001+075:00:54:30.554	2001+075:02:38:32.641	
2001+075:08:08:38.979	2001+075:12:22:10.260	
2001+075:13:52:44.824	2001+076:12:36:45.708	
2001+076:19:22:58.309	2001+077:21:32:48.410	
2001+077:22:04:14.033	2001+078:19:47:49.875	
2001+078:20:50:25.341	2001+080:22:15:23.761	
2001+080:22:49:43.931	2001+082:16:43:14.794	
2001+082:19:00:08.925	2001+086:11:37:41.578	
2001+086:12:22:29.325	2001+086:13:00:28.535	
2001+086:14:53:48.197	2001+089:05:29:43.639	
2001+089:06:30:40.732	2001+089:09:50:45.903	
2001+089:12:37:40.947	2001+090:16:23:30.722	Tailbuoy logging officially ends

Speed and Heading

Furuno CI−30 Dual Axis Speed Log
Sperry MK−27 Gyro

logging interval: 6 seconds
file id: fu

The Furuno and Gyro are combined to output speed, heading and course information to a raw Furuno file, as well as an NMEA VDVHW signal used as an input to various systems including steering and Spectra.

Interruptions greater than 30 minutes are displayed in the following table

Log Date	Log Date	Comment
2001+069:19:56:07.600		Official start date
2001+095::16:30:00		Official end date

Gravity

Bell Aerospace BGM−3 Marine Gravity Meter System

logging interval: 1 second
file id: vc. (raw), vt. (processed)
drift per day: 0.035

The BGM consists of a forced feedback accelerometer mounted on a gyro stabilized platform. The gravity meter outputs raw counts approximately once per second which are logged and processed to provide real−time gravity displays during the course of the cruise as well as adjusted gravity data at the end of the cruise.

The BGM lost a gyro on day 088 of the cruise and was fixed 4 hours later by Chris.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	Log Date	Comment
2001+069:19:57:10.772		Official start date
2001+088:02:09:50.970	2001+088:06:39:33.717	Lost BGM output
2001+095:16:30		Official end time

Bathymetry

Krupp Atlas Hydrosweep−DS

logging interval: variable based on water depth
file id: hb (centerbeam), hs (swath)

The hydrosweep full swath data is continuously logged for every cruise, and centerbeam data is extracted and processed separately. The centerbeam operates at a logging frequency dependent on the water depth.

The full swath data is not routinely processed, but can be processed with the MB−System software which can be downloaded for free. For instructions, use the website: http://www.ldeo.columbia.edu/MB−System.

MBSystem, version 4.6.10 is necessary to process data after Jan 1, 2000.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	LogDate	Comment
2001+069:22:23:05.000		Official start logging
2001+073:02:06:36.000	2001+073:02:18:55.000	HS Interruption
2001+078:03:12:58.000	2001+078:03:35:56.000	HS Interruption
2001+088:23:24:22.000	2001+089:00:42:16.000	HS Interruption
2001+095:16:30		Official end logging

Weather Station

RM Young Precision Meteorological Instruments, 26700 series

logging interval: 1 minute
file id: wx

The weather station is used to log wind speed, direction, air temperature, and barometric pressure. We log this information at 1−minute intervals.

Log Date	LogDate	Comment
2001+069:19:57:45.736		Official start logging
2001+073:02:07:00.189	2001+073:02:17:17.327	Interruption
2001+074:20:45:00.763	2001+074:20:57:55.603	Interruption
2001+095:16:		Official end logging

Magnetics

Varian Magnetometer

logging interval: 12 seconds
file id: mg

The following table shows the times the magnetometer was logging

Start Log Date	End LogDate	Comment
2001+077:02:39:25.537	2001+077:20:24:23.970	Logging interval 1
2001+079:14:30:05.838	2001+080:11:52:11.516	Logging interval 2
2001+082:21:07:16.963	2001+084:23:43:28.668	Logging interval 3
2001+086:20:12:25.017	2001+087:16:12:08.402	Logging interval 4
2001+087:17:20:20.147	2001+088:03:46:41.557	Logging interval 5
2001+089:06:43:10.716	2001+089:19:35:28.228	Logging interval 6
2001+089:21:14:18.575	2001+090:08:04:29.841	Logging interval 7

Seismic Lines

The Spectra system was used for the first time as the system to fire the guns and log the shot times. Since we are still in the process of integrating the Spectra system into the Ewing system, this resulted in some compromises in shot logging.

The following items were of concern during this cruise:

- The P2 and P1 formats do not store the shot time in millisecond range
- SIOSEIS cannot handle the Spectra output header for SEG−D

Due to these facts, I created a system where we would use data from the Spectra header, data from the Digicourse cable output, data from the gun depths, and real−time data from the Ewing logging system to compose a Ewing standard SEG−D header readable by SIOSEIS to place on the 3490 tape for each shot.

Due to several bugs in my software, some shot data was lost during the first few lines. Due to configuration errors in Spectra, the P2 file format wasn't being logged for up to 60 of the first shots in a line. The Spectra default logging was for 20 shots before the start of line. Since Spectra doesn't count the approach length as the start of line, any approach length greater than 20 shots (50 shots was standard for this cruise) was not logged until we realized this.

Also, tailbuoy information could be incorrect in the Spectra files, as we did not have the tailbuoy correctly configured for the first half of the cruise. The tailbuoy data in the processed files tb1.c, is the raw data and will be correct.

There are several files for each line reflecting the line status:

File	**Description**
ts.n	Shot time is merged with Ewing navigation to determine shot location
nb2.r	Navigation is from Spectra, and includes tailbuoy, tailbuoy range and bearing
shotlog.p1	Shots are from the p1 file. (should be identical to nb2.r), includes source position
shotlog.p2	Shots are from the p2 file (should be identical to tss.n), includes source position

Shot Files Table

Line Name	Times ()	Ewing(ts.n, nb2.r)		Spectra (shots.p1, shotlog.p2)		
		Shots	Missing	P1 Shots	P2 Shots	Missing
MEGA−1	079:15:20:57 079:20:47:43	140−1353	100−139, 260−262, 383−386, 507−509, 627−634, 978−1139, 1150−1163, 1170, 1175−1181, 1192−1200, 1203, 1218−1219	170−1353	172−1353	
MEGA−2	080:00:00:05 080:03:48:41	1727−2569	2412−2430	1393−2569	1395−2569	
MEGA−3	080:05:55:34 080:11:08:34	2571−3730	2783	2610−3730	2612−3730	
MEG−4	086:21:20:38 087:02:00:45	12656−13707		12786−13707	12788−13707	
MEG−5	087:03:21:28 087:06:46:40	13707−14460	13891	13707−14460	13709−14460	
MEG−6	087:08:02:34 087:10:33:43	14462−15035		14461−15035	14463−15035	
MEG−7	087:11:05:36 087:13:31:23	15037−15569		15036−15569	15038−15569	
MEG−8	087:14:12:36 087:17:35:29	15571−16318		15570−16318	15572−16318	
MEG−9	087:19:45:27 087:22:19:23	16320−16904		16319−16904	16321−16904	
MEG−10	087:23:43:11 088:03:20:46	16905−17711		16905−17711	16907−17711	
KANE−1	082:21:32:55 083:07:43:42	4000−6296	6090	4039−6296	4041−6296	
KANE−2	083:08:28:43 083:10:55:28	6298−6858	6336?	6337−6858	6339−6858	
KANE−3	083:12:48:52 083:15:11:00	6860−7385		6859−7385	6861−7385	

Line Name	Times ()	Ewing(ts.n, nb2.r)		Spectra (shots.p1, shotlog.p2)		
		Shots	Missing	P1 Shots	P2 Shots	Missing
KANE−4	083:15:54:47 084:01:34:29	7397−9605	8745	7396−9605	7398−9605	9058−9062 9064−9070 9072−9073 9075−9079
KANE−5	084:05:04:02 084:07:15:01	9606−10109		9606−10109	9608−10109	
KANE−6	084:08:20:45 084:11:11:55	10110−10766		10110−10766	10112−10766	
KANE−7	084:12:28:03 084:16:34:01	10768−11707		10767−11707	10769−11707	
KANE−8	084:19:39:34 084:23:36:19	11761−12655		11761−12655	11763−12655	
DANTE−1	089:06:47:05 089:12:23:30	17713−18973	17953, 18187	17749−18973	17751−18973	
DANTE−2	089:13:35:15 089:17:19:40	18975−19809		18974−19809	18976−19809	
DANTE−3	089:18:10:50 089:21:14:10	19811−20505		19810−20506	19812−20506	
DANTE−4	089:22:29:41 090:07:41:33	20508−22687		20507−22687	20509−22687	

Charleston, SC

EW0102 Charleston, SC

Pier/Ship	Latitude	Longitude
	32 51.119N	079 56.8611W

Pier N, Old Charleston Navy Base, near the second "shack" in the middle of the doc

Reference	Latitude	Longitude
	32 47.80 N	079 57.80W

Citadel University, Bond Hall in front of the Registrar's Office between the mechanic room and the elevator.

EW0007 230 09.03.01 3.44 0.02 3.44

	Id	Julian	Date	Mistie	Drift/Day	Prev Mistie
Pre Cruise	EW0007	230	12.08.00	3.44	0.02	3.44
Post Cruise	EW0102	230	09.03.01	**7.30**	**0.018**	**3.44**
Total Days			**209.00**	**3.86**		

Time	Entry	Value	
20:40	CDeck Level BELOW Pier	1.30	
20:40	Pier 1 L&R Value	3165.11	L&R
21:20	Reference L&R Value	3154.22	L&R
21:50	Pier 2 L&R Value	3165.11	L&R
###	Reference Gravity	979550.05	mGals
22:55	Gravity Meter Value (BGM Reading)	979571.00	mGals
	Potsdam Corrected	0	1 if corrected

*Gravity meter is **5.5** meters below CDeck*

Difference in meters between Gravity Meter and Pier: **6.80** meters

Height Cor = Pier Height* FAA Constant

Pier Height*	FAA Constant			
6.80	**0.31**			**2.11** mGals/min

Difference in mGals between Pier and Gravity Meter

Pier (avg) –	Reference *	1.06 L&R/mGal		Delta L&R
3165.11	**3154.22**	**1.06**		**11.54** mGals

Gravity in mGals at Pierside

Reference + Delta mGals [+ Potsdam]				Pier Gravity
979550.05	**11.54**	**0.00**		**979561.59** mgals

Gravity in mGals at Meter

Pier Gravity+	Height Correction			Gravity@meter
979561.59	**2.11**			**979563.70** mGals

Current Mistie

BGM Reading	Calculated Gravity			Current Mistie
979571.00	**979563.70**			**7.30** mGals

Gravity Ties

San Juan, Puerto Rico

EW0102 Charleston, SC

Pier/Ship	Latitude	Longitude
	32 51.119N	079 56.8611W

Pier N, Old Charleston Navy Base, near the second "shack" in the middle of the doc

Reference	Latitude	Longitude
	32 47.80 N	079 57.80W

Citadel University, Bond Hall in front of the Registrar's Office between the mechanic room and the elevator.

EW0007 230 09.03.01 3.44 0.02 3.44

	Id	Julian	Date	Mistie	Drift/Day	Prev Mistie
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Time	Entry	Value	
20:40	CDeck Level BELOW Pier	1.30	
20:40	Pier 1 L&R Value	3165.11	L&R
21:20	Reference L&R Value	3154.22	L&R
21:50	Pier 2 L&R Value	3165.11	L&R
###	Reference Gravity	979550.05	mGals
22:55	Gravity Meter Value (BGM Reading)	979571.00	mGals
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*Gravity meter is **5.5** meters below CDeck*

Difference in meters between Gravity Meter and Pier: **6.80** meters

Height Cor = Pier Height* FAA Constant

Pier Height*	FAA Constant				
6.80	**0.31**			**2.11**	mGals/min

Difference in mGals between Pier and Gravity Meter

Pier (avg) –	Reference *	1.06 L&R/mGal		Delta L&R	
3165.11	**3154.22**	**1.06**		**11.54**	mGals

Gravity in mGals at Pierside

Reference + Delta mGals [+ Potsdam]				Pier Gravity	
979550.05	**11.54**	**0.00**		**979561.59**	mgals

Gravity in mGals at Meter

Pier Gravity+	Height Correction			Gravity@meter	
979561.59	**2.11**			**979563.70**	mGals

Current Mistie

BGM Reading	Calculated Gravity			Current Mistie	
979571.00	**979563.70**			**7.30**	mGals

For all formats, a – in the time field means an invalid value for some reason.

Streamer Compass/Bird Data cb.r

This data is not processed, but can still be found in the "processed" data directory.

```
Shot Time               Line     Shot     Latitude      Longitude

2000+079:00:08:40.085  strike1 000296  N 15 49.6217 W 060 19.8019

2nd GPS Position                      Tailbuoy Position
Latitude     Longitude                Latitude     Longitude

N 15 49.6189 W 060 19.8101    N 15 47.1234 W 060 20.1901

Furuno  Streamer
Gyro    Compasses & Heading

344.1       C01 2.3 C02 1.7  ...
```

Gun Depths dg

Gun depths in tenths of meters. There will always be 20 gundepths even if only one gun was configured and shooting.

```
                        Gun Depths
Shot Time               1   2   3  4    5   6   7   8   9  ...  20

2001+089:06:47:05.909 189 068 005 005 096 005 060 054 005 ... 6
```

Raw Furuno Log fu.s

This data has been smoothed and output 1 fix per minute.

```
CPU Time Stamp         Track Speed Hdg   Gyro

2000+166:00:01:53.091 –     4.4   140.5 148.3
```

Hydrosweep Centerbeam hb.n

Hydrosweep data merged with navigation

```
                              Centerbeam
CPU Time Stamp       Latitude Longitude          Depth

2000+074:09:55:00.000  N 13 6.6206    W 59 39.3908   134.9
```

Merged Data m

```
                                                        GPS
CPU Time Stamp         Latitude     Longitude          Used  Set  Drift Depth

2000+200:12:25:00.000  N 45 54.1583 W 42 47.1770       gp1   0.0  0.0

Magnetic                        Gravity
Total Intensity   Anomaly     FAA  GRV       EOTVOS   Drift   Shift

49464.7           55.5        22.2 980735.0   –8.4     –0.1     2.8

Temperature Salinity Conductivity

0.0         0.0      0.0
```

The gravity drift and shift are values that have been added to the raw gravity to make up for drift in the meter that has been lost in accordance with a gravity check at each port stop.

Temperature,Salinity and Conductivity will only be valid while logging a Thermosalinograph, which is not usually the case.

Magnetics Data mg.n

- A minus sign in the time stamp is flagged as a spike point, probably noise...
- Anomaly is based on the International Geomagnetic Reference Field revision 2000

```
CPU Time Stamp        Latitude     Longitude      Raw Value Anomaly
200+077:00:23:00.000 N 16 11.2918 W  59 47.8258 36752.2   -166.8
```

Navigation File n

```
CPU Time Stamp         Latitude     Longitude       Used  Set  Drift
2000+074:00:03:00.000 N 13 6.2214  W  59 37.9399   gp1   0.0   0.0
```

Navigation Block nb0

Navigation is a compendium of Ewing logged data at shot time. The shot position here is the shot position from the Spectra system.

```
Shot Time               Shot # CPU Time               Shot Position
2001+088:00:00:00.606 016967 2001+088:00:00:03.031 N 30 11.8324 W 042 10.8162

Water  Sea    Wind   -------------Tailbuoy------------------ Line
Depth  Temp Spd  Dir Latitude     Longitude     Range Bearg Name   Speed Heading
2565.1 20.7 16.4 164 N 30 12.0427 W 042 14.7319 6296.3 93.5 MEG-10 4.2   101.1
```

Tailbuoy Navigation tb1.c

Raw tailbuoy fixes

```
CPU Time Stamp         Latitude     Longitude       GPS Precision
2001+088:00:00:02.000 N 30 12.0424 W 042 14.7309   SA
```

GPS Precision is either SA, DIFF or PCODE

Ewing Processed Shot Times ts.n

Shot times and positions based on the Ewing navigation data processing

```
CPU Time Stamp         Shot # Latitude     Longitude     Line Name
2000+079:00:08:01.507 000295 N 15 49.5703 W 060 19.7843 strike1
```

Shot Data Status ts.n.status

The ts.nxxx.status file describes the line information for that day, giving some basic statistics about the line: start, end times; missing shots; start and end shots.

```
LINE   strike1: 98+079:00:00:15.568 : 000283 .. 002286
        MISSING: 347, 410, 1727
LINE   dip2: 98+079:23:05:22.899 : 000002 .. 000151
```

This example says that on Julian Day 079 of 1998, two lines (strike1 and dip2) were run: the end of strike 1 (shots 000283 to 002286) and the start of dip2 (shots 000002 to 000151).

Line strike1 had some missing shots in the data file (probably missing on the SEG-d header as well).

Spectra Shot Times — nb2.r

The shot times and positions based on the Spectra positioning; with raw tailbuoy range and bearing.

```
CPU Time Stamp          Shot # Latitude      Longitude      Line Name
2001+084:00:00:05.924 009245 N 23 31.2410 W 045 25.0894

                                Tailbuoy
Latitude      Longitude      Range  Bearing  Line Name
N 23 30.4540 W 045 21.4338 6389.8 283.2    KANE-4
```

Raw Gravity Counts — vc.r

sample BGM-3 gravity count record (without time tag):

```
pp:dddddd ss
|    |    |___________ status: 00 = No DNV error; 01 = Platform DNV
|    |                         02 = Sensor DNV;   03 = Both DNV's
|    |________________ count typically 025000 or 250000
|_____________________ counting interval, 01 or 10
                       The input of data can be at 1 or 10 seconds.
```

Gravity Data — vt.n

* A minus sign in the time stamp is flagged as a spike point
* m_grv3 calculates the Eotvos correction as:
  eotvos_corr = 7.5038 * vel_east * cos(lat) + .004154 * vel*vel
* The theoretical gravity value is based upon different models for the earth's shape.
  - 1930 = 1930 International Gravity Formula
  - 1967 = 1967 Geodetic Reference System Formula
  - 1980 = 1980 Gravity Formula
* The FAA is computed as:
  faa = corrected_grv − theoretical_grv
* Velocity smoothing is performed w/ a 5 point window

```
CPU Time Stamp          Latitude      Longitude      Model FAA      RAW
2000+148:00:10:00.000 N 09 34.7255 W 085 38.5826 1980  9.48    978264.16

Eotvos  Drift DC      Raw  Velocity    Smooth Velocity
Smooth  Total Shift   North    East     North    East
-74.78  0.06  4.16    1.875 -10.373    1.927 \10.166
```

Datum Time — ts2.r

```
CPU Time                Datum Time        Time Reference
2001+069:00:15:29.727 069 00 15 29.378 datum
```

Raw GPS — gp[12].d, tb1.d

Raw GPS is in NMEA Format.

Meteorological Data — wx

```
                          True
CPU Time Stamp          Spd Dir

2001+045:00:00:00.967   7.8  22

Bird1:                                          Bird 2
Speed                    Direction              Speed                    Direction
Inst  60sA   60mA  60sM  Inst 60sA 60mA         Inst  60sA  60mA  60sM   Inst 60sA 60mA

7.8   6.6    8.5   16.8  277  291  5           0.0   0.0   0.0   0.0    0    0    0

Temperature                    Humidity
Inst  60mA  60mm  60mM        Inst 60mm 60mM          Barometer

15.0  14.2  14.3  15.1        92   90   93            1027.5

Inst:       Current

60sA:       60 second average

60mA:       60 minute average

60sM:       60 second maximum

60mm:       60 minute minimum

60mM:       60 minute maximum
```

Shot Times from Spectra P1 Files — shots.p1

These files were created with the script: *extract_shots_from_p1* ***-a 1***

```
Epoch Time     Shot#  Source Lat/Lon          TB Lat      TB Lon
985788741.000 015570 30.283881 -41.854536  30.320144  -41.886642
Vessel Ref Lat/Lon    Antenna GPS Lat/Lon      Water Depth
30.283478 -41.854117 30.283531  -41.854078  2894.2
```

- Source is the Center of the Guns
- TB is the Tailbuoy, according to Spectra
- Vessel Ref is the location of the center of the Mast
- Antenna GPS is the location of Antenna 1 (-a 1 flag); in this case is the Tasmon GPS
- Water Depth is the HS Centerbeam depth

Shot Times from Spectra P2 Files — shots.p2

These files were created with the script: *extract_shots_from_p2 -o "V1 G1"*

```
Epoch Time   Shot#     Vessel Ref Lat/Lon    Source Lat/Lon
985716772.4 00015572 30.282803 -41.866136 30.283207 \41.866540
```

- Vessel Ref is the location of the center of the Mast
- Source is the Center of the Guns

Scripts

I have included some scripts for extracting information out of the P1 and P2 formatted files. In order to use these scripts you will also need to install the Ewing Perl libraries I have included in the scripts directory, or at least include that directory in your PERL5LIB environment. It is not my intention to describe how to use perl in this document though.

extract_shots_from_p1 [−a antenna] [−h] filename

Given an input P1 File, create a shotpoint file with the times, and the positions of the given antenna [1 = tasmon, 2 = Trimble] and optionally the header records at the beginning of the file.

The output will be:

```
epochtime shotnumber sourcePos tbPos vesselPos antennaPos depth
```

- **epochtime** is the # of seconds since Jan 1, 1970
- **shotnumber** is the shot number
- **sourcePos** is the center position of the sound source [lat lon]
- **tbPos** is the position of the tailbuoy [lat lon]
- **vesselPos** is the position of the vessel reference (center of mast) [lat lon]
- **antennaPos** is the position of the specified antenna [lat lon]
  1 = tasmon, 2 = trimble
- **depth** is the water depth in meters

extract_shots_from_p2 [−s shotnumber] [−o "output values"]

−s define if you only want the statistics for a single shot

−o "*outputs*" defines the outputs you want from the P2 file.

This routine will output by default the shotpoint, the line name and the shot time. Optionally, you can output position (Lat Lon) info for a number of items:

Outputs can be one or more of the following:

- V1 Vessel 1 Reference
- V1G1 Tasmon GPS Receiver
- V1G2 Trimble GPS Receiver
- V1E1 Hydrosweep Transducer
- TB1 Tailbuoy 1
- S1 Streamer 1
- V1SC Streamer Compasses
- G1 Gun Array 1

All the formats output a Lat Lon pair in decimal degrees. (*West and South being negative*)

Output will be: `epochtime shotnumber [output lat/lon pairs]`

Tape Contents

EW0102/

EW0102.pdf	this document
ew0102.cdf	NetCDF database file of this cruise
ew0102.cdf_nav	NetCDF database file of this cruise' navigation
docs/	File Formats, Spectra manuals
processed/	Processed datafiles merged with navigation
shotlogs/	processed Shot Files
trackplots/	daily cruise track plots (*postscript*)
raw/	Raw data directly from logger
reduction/	Reduced data files
clean/	daily processing directory, includes daily postscript plots of the data.
fixes/	fixes for the RTNu HS loss of d088
scripts/	Perl scripts and their friends
spectra/	P1/90 and P2/94 files from MCS lines
streamer/	Excel spreadsheets of streamer configuration