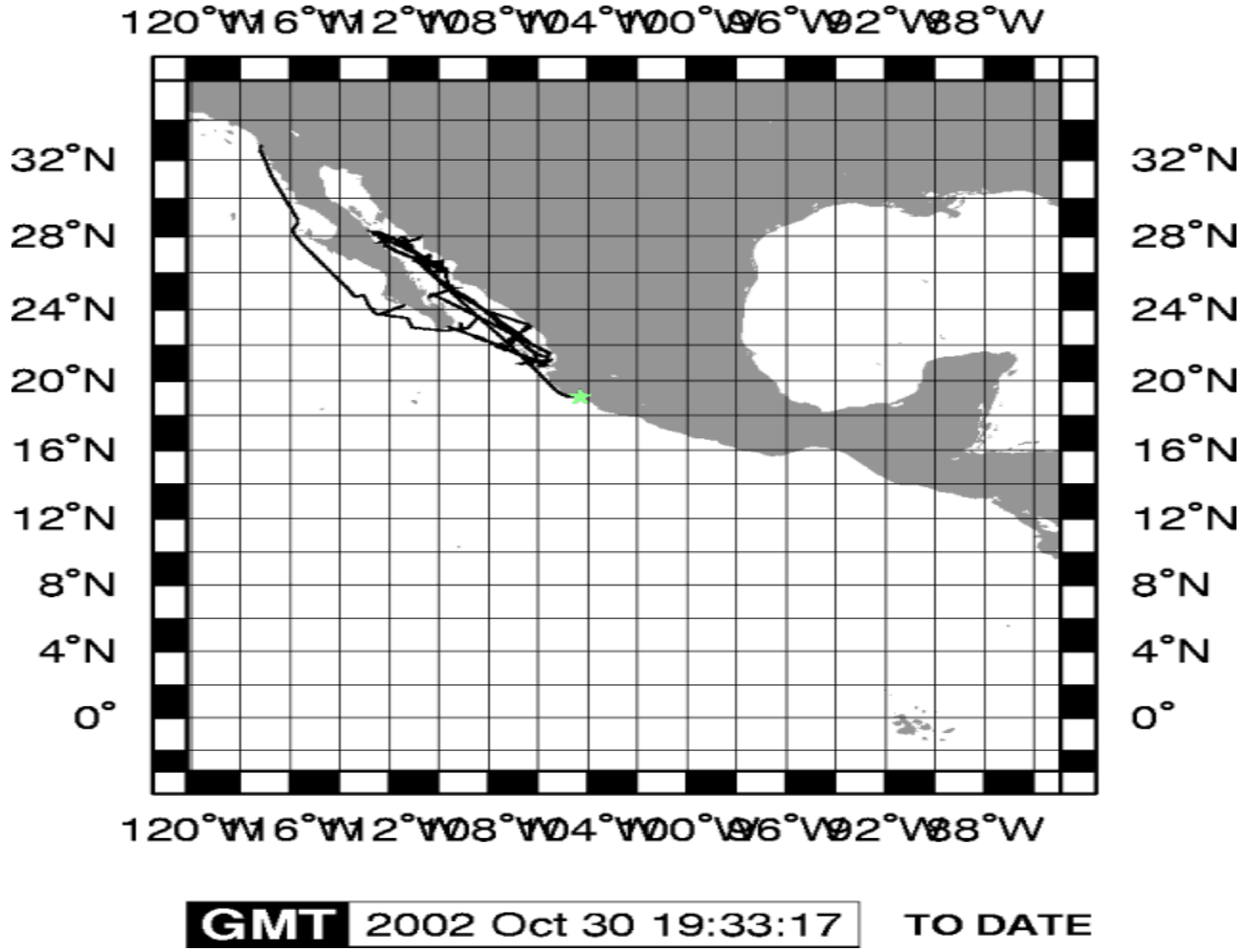
Lamont– Doherty Earth Observatory
Office of Marine Affairs
61 Route 9W
Palisades, NY 10969

Prepared By: Ethan Gold
etgold@ldeo.columbia.edu
845 365–8677

R/V Maurice Ewing Data Reduction Summary

EW0210 San Diego − Manzanillo, Mexico

Date	Julian Date	Time	Port
September 16, 2002	259	18:00:00UTC	San Diego, California
October 30, 2002	303	16:00UTC	Manzanillo, Mexico



Project Summary

DESCRIPTION

Rifting of continental lithosphere is a fundamental process in the growth and evolution of continents, yet we lack a full understanding of both the magnitude and cause of the stresses that drive rifting, the deformational mechanisms of extension, and the key parameters that control this deformation. Basic questions persist about the style of lithospheric extension − whether it deforms symmetrically in pure shear or asymmetrically in simple shear; about the roles of lower−crustal flow, magmatism and sedimentation in evolving rift architecture; and about the sensitivity of rift evolution to variations in key parameters such as lithospheric strength and temperature, strain rate, and crustal thickness. Answering these and other questions is a fundamental goal of the Rupturing Continental Lithosphere (RCL) initiative of NSF's MARGINS program, and the Gulf of California has been selected as one of two focus sites for this initiative. The Gulf is particularly well suited to a large−scale study of rift processes, because it is actively rifting, contains clear rift segments that will allow reconstruction of the entire rift−drift history across unambiguous conjugate margins, has a reasonably well understood geologic and tectonic history, shows along−strike variations in extensional style, and is logistically accessible. Because of these characteristics, complete delineation of deformational patterns along the Gulf of California rift should provide fundamental new insights into the processes of lithospheric rupture.

This seismic experiment, along with a linked onshore structural geology program, was designed to delineate the geometries and patterns of crustal extension and rift magmatism along four main conjugate−margin transects across the Alarcón, Farallon, Guaymas, and Delfín Basins. Each of these basins exhibits a different rift morphology, reflecting the along−axis variation that exists within the Gulf. In the south, strain localized in the Alarcón Basin early on, initiating seafloor spreading; most extensional deformation here is below sea−level and the spreading center is lightly sedimented. The Farralon basin exhibits a variation of this style, in that it is a narrow segment featuring an amagmatic, rhombochasmic spreading center at the plate boundary. In the north, extension in Delfín Basin has not achieved seafloor spreading, much of the extensional deformation is subaerial, including a potentially active low−angle detachment fault to the west, and the active rift is heavily sedimented. The Guaymas Basin, in the center of the gulf, has distinct spreading−center grabens overlain by significant sediment that is intruded by spreading−center magmas.

These profiles would have represented the first crustal−scale transects across truly conjugate rifted continental margins and together would have provided the framework for understanding an entire rift system and for characterizing along−strike changes in crustal architecture and rift processes related to differences in key parameters, such as crustal thickness, lithospheric strength, and sediment input. They were designed with the following specific objectives:

− Determine the spatial and temporal partitioning of strain across the full width and throughout the entire history of the rift along four main transects from north to south in the Gulf of California.

− Determine the volume and emplacement style of rift magmatism and assess its role in

strain localization.

− Relate along−axis differences in extensional style to possible controlling factors, such as the rheology of continental lithosphere, magmatic input, and sedimentation.

− Assess the influence of sedimentation on deformation, subsidence, magmatic processes, and the formation of "transitional" crust.

As things turned out, only the Alarcon and Guaymas transects were completed during this cruise. In addition, a separate transect was acquired along a plate kinematic flow line connecting Cabo San Lucas and Puerto Vallarta. Though the experiment was incomplete, these data will enable us to reconstruct the tectonic, sedimentary, and magmatic histories of the rift from initiation to seafloor spreading along these key transects and will establish an observational framework of crustal architecture that will substantially address our scientific objectives and form a basis for anticipated future work in this MARGINS focus site.

Cruise Members

Science Party

Dan Lizarralde	Chief Scientist	danl@eas.gatech.edu
Steve Holbrook	Scientist	steveh@uwyo.edu
Paul Umhoefer	Scientist	paul.umhoefer@nau.edu
John Fletcher	scientist	jfletche@cicese.mx
Paul Henkart	scientist	phenkart@ucsd.edu
Dan Kahn	scientist	dan.kahn@eas.gatech.edu
Hillary Brown	scientist	hbrown@uwyo.edu
Pedro Paramo	scientist	paramo@uwyo.edu
Sarah Stoltz	mammalist	
Roger Strimback	mammalist	
Johnny Carter	mammalist	
Ernesto Vasquez	mammalist	
Elizabeth Zuniga	mammalist	

Ship's Science

Chris Leidhold	Science Officer	sci@ewing.ldeo.columbia.edu
Johnny DiBernardo	Gunner	honey@ewing.ldeo.columbia.edu
Karl Hagel	ET	hagel@ewing.ldeo.columbia.edu
Ethan Gold	Computing	etgold@ldeo.columbia.edu
John Byrne	Gunner	johnby@ewing.ldeo.columbia.edu
Justin Walsh	Gunner	cabinboy@ldeo.columbia.edu

Ship Crew

Jim O'Laughlin	Captain	captain@ewing.ldeo.columbia.edu
Steve Pica	Chief Engineer	engine@ewing.ldeo.columbia.edu
Stan Zeigler	1st Mate	stan@ewing.ldeo.columbia.edu
David Wolford	2nd Mate	wolf@ewing.ldeo.columbia.edu
Rick Thomas	3rd Mate	rickt@ewing.ldeo.columbia.edu
Matthew Tucke	1st A/Engineer	tuk@ewing.ldeo.columbia.edu
Ed Church	2nd A/Engineer	echurch@ewing.ldeo.columbia.edu
Stefan Martinsen	3rd A/Engineer	stefan@ewing.ldeo.columbia.edu
Ryan Dennis	Steward	ryan@ewing.ldeo.columbia.edu
Kelly Tomas	Bosun	tomask@ewing.ldeo.columbia.edu
Michael Burdish	Cook	burdish@ewing.ldeo.columbia.edu
Arnold Sypongco	O/S	arnold@ewing.ldeo.columbia.edu
Jim Syferd	O/S	jims@ewing.ldeo.columbia.edu

Fernando Uribe	Oiler	gato@ewing.ldeo.columbia.edu
Brian Matthiesen	A/B	brian@ewing.ldeo.columbia.edu
LukeMoqo	Utility	luke@ewing.ldeo.columbia.edu
Ian McRae	Oiler	ian@ewing.ldeo.columbia.edu
Kelly Bertroch	Oiler	bertroch@ewing.ldeo.columbia.edu
Garry Espiritu	A/B	garry@ewing.ldeo.columbia.edu
Wakefield Walker	A/B	walker@ewing.ldeo.columbia.edu

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

Navigation

The primary p−code GPS receiver fell down early in the cruise, and all primary nav was switched to the new WAAS receiver at the same offset location. The p−code receiver was revived on day 285, but remained as gp03 instead of gp01 for the remainder of the cruise.

On days 281 and 282 there were several short primary GPS failures due to exposed wiring in A−booth. The booth was cleaned and the data wiring rebuilt completely.

Spectra

Seismic lines were shot for both MCS (50−meter spacing) and OBS (100−meter spacing).

Two lines were shot with only the GI guns.

The long−missing bird headers were re−inserted into the shot headers by fixing a bug in the log_spectra process.

Shot times in the Ewing ts.n files are Spectra's GPS shot time. Position in the ts.n files is the Ewing's interpolated primary GPS receiver location at the time of the shot. The position in the shot headers on the tapes is Spectra's vessel reference location.

The usual untraceable P1 logging errors plagued some of the early lines. Restarting Spectra solved this problem several times.

Hydrosweep

A sound velocity profile based on a local XBT and Levitus was entered into the hydrosweep on day 274 which was used for 2 days. A slightly edited version of the first profile was then entered on day 275, which was then used for the remainder of the cruise.

Data Logging/Processing

Ship Diagrams

Ship Offset 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

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.

GPS Receivers

GPS data is usually logged at 1−2 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 WAAS GPS was the primary GPS for this cruise.

Trimble Tasmon P/Y Code Receiver

logging interval: 1 second
file id: gp3

The Tasmon is usually the primary GPS receiver for the Ewing Logging system and the primary GPS for Spectra fixes. The accuracy is around 15 meters.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	LogDate	Comment
2002+259:16:59:14.546		Tasmon logging starts
2002+282:01:40:21.865	2002+282:02:17:04.110	
2002+282:02:19:12.227	2002+282:02:43:33.425	
2002+283:03:49:42.776	2002+283:04:07:40.687	
2002+283:23:43:28.346	2002+285:01:03:10.879	
2002+303:17:34:17.115		Tasmon logging ends

Trimble NT200D

logging interval: 2 seconds
file id: gp2

The Trimble is the secondary receiver for GPS data. Data is logged at 2 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
2002+259:16:59:18.267		Trimble logging started
2002+261:06:40:32.601	2002+261:06:51:46.789	
2002+261:09:34:17.941	2002+261:15:33:06.973	
2002+261:16:06:18.023	2002+261:16:18:20.575	
2002+261:16:37:56.731	2002+261:18:01:11.008	
2002+261:22:25:34.055	2002+262:01:16:56.812	
2002+262:03:15:12.001	2002+262:07:42:13.798	
2002+277:03:26:18.118	2002+277:04:47:28.759	

Log Date	LogDate	Comment
2002+277:10:39:45.926	2002+277:16:34:34.741	
2002+282:05:40:55.912	2002+282:05:51:06.563	
2002+286:02:50:51.341	2002+286:07:03:09.779	
2002+286:08:00:09.984	2002+286:08:45:04.559	
2002+286:08:48:57.731	2002+287:17:33:36.656	
2002+287:18:18:13.570	2002+287:18:46:49.018	
2002+297:20:54:38.676	2002+298:05:51:45.908	
2002+303:17:34:17.055		Trimble logging ends

Garmin WAAS

logging interval: 2 seconds
file id: gp1

The WAAS is usually the tertiary receiver for GPS data, but was the primary for most of this cruise. Data is logged at 2 second intervals and is also used as an input to Spectra.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	LogDate	Comment
		WAAS logging started
2002+261:00:30:23.093	2002+261:02:37:48.521	
2002+261:02:38:57.532	2002+261:16:21:58.353	
2002+280:20:56:19.290	2002+280:21:06:26.303	
2002+282:01:39:11.408	2002+282:02:36:44.120	
2002+282:15:50:39.803	2002+282:16:27:01.304	
2002+283:01:27:39.256	2002+283:01:44:09.289	
2002+283:01:46:04.259	2002+283:02:05:48.239	
2002+283:02:27:01.298	2002+283:04:07:58.756	
2002+283:01:27:39.256	2002+283:01:44:09.289	
2002+283:01:46:04.259	2002+283:02:05:48.239	
2002+283:02:27:01.298	2002+283:04:07:58.756	
2002+303:17:34:17.243		WAAS logging ends

TSS POS/MV 320

logging interval: 1 second
file id: pm01

The POS/MV is the fourth receiver for Gps data. Data is logged at 2 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	Log Date	Comment
2002+259:16:59:24.964		POS/MV logging starts
2002+303:17:34:17.121		POS/MV logging officially ends

Tailbuoy Garmin GP8

logging interval: 1 second
file id: tb1

The tailbuoy GPS is a WAAS receiver.

Interruptions greater than 30 minutes are displayed in the following table

Log Date	Log Date	Comment
2002+261:16:35:26.537		Tailbuoy logging starts
2002+261:19:00:32.511	2002+261:20:15:27.794	
2002+261:23:59:14.200	2002+262:01:24:31.848	
2002+262:01:52:22.494	2002+262:02:43:34.575	
2002+262:05:05:10.542	2002+262:07:21:18.529	
2002+262:15:17:49.522	2002+262:16:33:20.564	
2002+267:21:10:02.524	2002+267:21:43:34.530	
2002+268:09:36:44.513	2002+268:10:13:30.527	
2002+271:07:31:24.482	2002+271:08:22:23.510	
2002+273:16:15:41.584	2002+280:08:03:56.521	
2002+285:15:24:32.643	2002+285:19:05:34.158	
2002+286:21:47:00.506	2002+288:01:34:17.452	
2002+288:01:36:17.615	2002+288:04:18:38.707	
2002+288:08:19:58.529	2002+288:08:53:51.492	
2002+289:12:01:07.515	2002+289:12:31:37.584	
2002+290:08:06:42.510	2002+290:08:42:28.519	
2002+290:12:02:04.507	2002+290:12:35:20.586	
2002+293:19:36:34.503	2002+293:20:07:42.515	
2002+296:06:42:43.506	2002+296:07:15:22.544	
2002+297:08:02:04.524	2002+297:08:42:21.518	
2002+299:03:39:54.178	2002+299:05:49:06.569	
2002+299:12:16:44.503	2002+299:12:48:10.513	
2002+300:10:33:06.516	2002+300:11:06:00.522	
2002+300:12:22:12.496	2002+300:12:56:35.527	

Log Date	Log Date	Comment
2002+302:18:55:45.502		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
2002+259:16:59:37.770		Furuno logging starts
2002+303:17:34:16.343		Furuno logging ends

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.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	Log Date	Comment
2002+259:16:59:44.442		Gravity logging starts
2002+303:17:34:17.003		Gravity logging ends

Bathymetry

Krupp Atlas Hydrosweep−DS2

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 5.0beta3 is necessary to process data after June 1, 2001.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	LogDate	Comment
2002+259:16:59:34.000		Hydrosweep logging starts
2002+303:17:34:35.000		Hydrosweep logging ends

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
2002+259:17:00:24.555		Weather logging starts
2002+303:17:34:00.399		Official end logging

Magnetics

Varian Magnetometer

logging interval: 12 seconds
file id: mg

The following table shows the times the magnetometer was logging

Log Date	LogDate	Comment
2002+262:20:37:36.384	2002+273:16:15:47.444	
2002+274:00:12:33.487	2002+279:12:05:56.665	
2002+280:07:18:00.027	2002+286:02:28:55.866	
2002+288:07:27:03.297	2002+297:18:56:15.628	
2002+299:04:50:29.016	2002+301:00:57:42.490	
2002+299:04:50:29.016	2002+301:00:57:42.490	

Currently, we 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.

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

LOCATION 1

EW0209 San Diego, CA

Pier/Ship	Latitude	Longitude
	32 42.005N	117 09.623W
OSU Pier		

Reference	Latitude	Longitude
	44 37.2N	124 02.8N
Next to the large cleat across from door #9 of Berth 3 at the 10th Ave terminal See Tie of Oct 23, 1994		

	Id	Julian	Date	Mistie	Drift/Day	Prev Mistie
Pre Cruise	EW0208	251	08. Sep 02	12.68	0.02	11.98
Post Cruise	EW0209	254	11. Sep 02	23.81	3.711	12.68
Total Days			3.00	11.13		

Time	Entry	Value	
1835	CDeck Level BELOW Pier	1.00	
18:35:00	Pier 1 L&R Value	4262.45	L&R
1110	Reference L&R Value	4262.79	L&R
1020	Pier 2 L&R Value	4262.45	L&R
	Reference Gravity	979512.23	mGals
	Gravity Meter Value (BGM Reading)	979537.70	mGals
	Potsdam Referenced	0	1 if referenced

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

Difference in meters between Gravity Meter and Pier: 6.50 meters

Height Cor = Pier Height*	FAA Constant				
6.50	0.31			2.02	mGals/min

Difference in mGals between Pier and Gravity Meter

Pier (avg) −	Reference	*1.06 L&R/mGal		Delta L&R	
4262.45	4262.79	1.06		−0.36	mGals

Gravity in mGals at Pierside

Reference + Delta mGals [+ Potsdam]				Potsdam Referenced Pier (	
979512.23	−0.36	0.00		979511.87	mgals

Gravity in mGals at Meter

Pier Gravity+	Height Correction			Gravity@meter	
979511.87	2.02			979513.89	mGals

Current Mistie

BGM Reading	Calculated Gravity			Current Mistie	
979537.70	979513.89			23.81	mGals

Location 2

EW0210 Manzanillo, Mexico

Pier/Ship	Latitude	Longitude
	19 03.365N	104 18.856W
OSU Pier		

Reference	Latitude	Longitude
	19 03.759N	104 18.146W
On the sidewalk across from the hotel entrance near the barrier. This is the old oceanograhic institute location. no marker.		

	Id	Julian	Date	Mistie	Drift/Day	Prev Mistie
Pre Cruise	EW0209	254	11. Sep 02	10.21	−0.82	12.68
Post Cruise	EW0210	304	31. Oct 02	3.05	−0.143	10.21
Total Days			50.00	−7.16		

Time	Entry	Value	
08:00:00	CDeck Level BELOW Pier	2.00	
08:00:00	Pier 1 L&R Value	22537.00	L&R
1110	Reference L&R Value	22526.00	L&R
1020	Pier 2 L&R Value	22537.00	L&R
	Reference Gravity	978581.46	mGals
	Gravity Meter Value (BGM Reading)	978612.10	mGals
	Needs Potsdam Correction	1	0 if referenced

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

Difference in meters between Gravity Meter and Pier: **7.50** meters

Height Cor = Pier Height* FAA Constant

7.50	0.31			2.33 mGals/min

Difference in mGals between Pier and Gravity Meter

Pier (avg) −	Reference * 1.06 L&R/mGal			Delta L&R
22537.00	22526.00	1.06		11.66 mGals

Gravity in mGals at Pierside

Reference + Delta mGals [+ Potsdam]				Potsdam Referenced Pier
978581.46	11.66	13.60		978606.72 mgals

Gravity in mGals at Meter

Pier Gravity+	Height Correction			Gravity@meter
978606.72	2.33			978609.05 mGals

Current Mistie

BGM Reading	Calculated Gravity			Current Mistie
978612.10	978609.05			3.05 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
```

Merged Meteorological Data mmet

```
TSG, WX, CT merged with Nav at 1 minute fixes
date        time        lat       lon       gpu head spd
2001+244:00:00:00.000 12.14071 44.98469 gp1 10.2 83.0

tws  twd   temp hum  press  cti  cte  con sal  ct
26.5 228.0 30.6 87.0 1000.8 28.8 28.8 5.9 36.3 28.8

gpu  = gps unit in use
head = ship's heading
spd  = ship's speed in knots
tws  = true wind speed
twd  = true wind direction
temp = air temp (celcius)
hum  = relative humidity (%)
press= pressure in mb
cti  = sea temp from the internal TSG sensor
cte  = sea temp from the external TSG sensor
con  = conductivity, Siemens/meter
sal  = salinity, practical salinity units
ct   = sea temp from the C-keel sensor (to tenths of a degree)
```

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

Included are 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 included in the scripts directory, or at least include that directory in your PERL5LIB environment. The use of perl is beyond the scope of this document.

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

EW0210/

CruiseReport_EW0210.pdf	this document
ew0210.cdf	NetCDF database file of this cruise
ew0210.cdf_nav	NetCDF database file of this cruise' navigation
configs/	Ewing logging/reduction configuration files
docs/	File Formats, Spectra manuals
processed/	Processed datafiles merged with navigation
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.
XBT/	XBT casts and customized SVPs
mammals/	mammal sighting log and plots
mbsystem/	latest mbsystem source
sodar/	3.5kHz digital files
spectra/	spectra UKOAA files