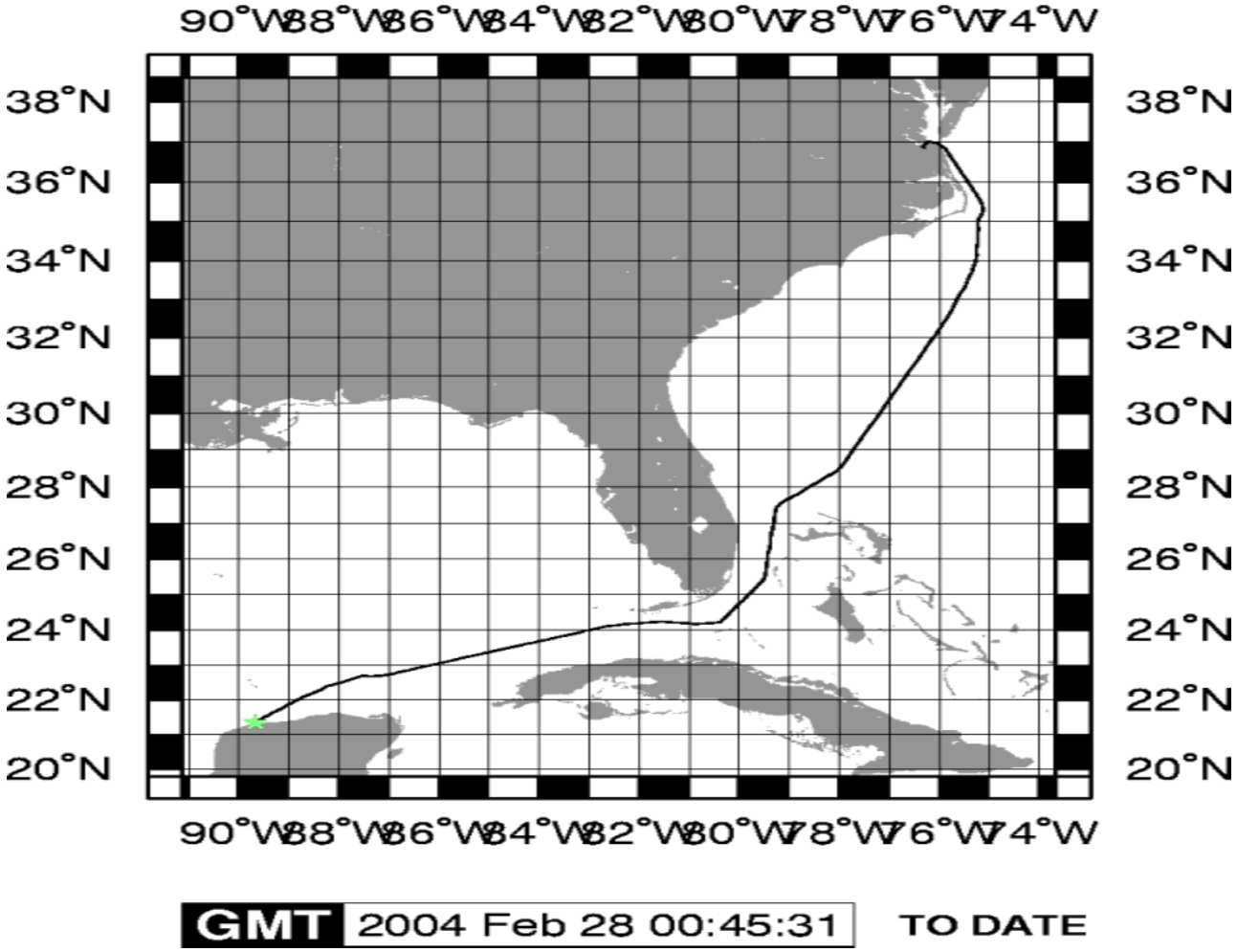
Lamont– Doherty Earth Observatory
Office of Marine Affairs
61 Route 9W
Palisades, NY 10969

Prepared By: Richard Oliver–Goodwin
richardo@ldeo.columbia.edu
845 365–8677

R/V Maurice Ewing Data Reduction Summary

EW–0401 Norfolk, VA – Progresso, Mexico

Date	Julian Date	Time	Port
February 20, 2004	51	00:00:00	Norfolk, Virginia
February 26, 2004	57	12:37:20	Progresso, Mexico



Project Summary

DESCRIPTION

Background and Scientific Objectives

Transit.

Cruise Members

Ship's Science

Ted Kocznski	Science Officer	sci@ewing.ldeo.columbia.edu
John Collins	E.T.	collins@ewing.ldeo.columbia.edu
John Dibernardo	PSSO	gunners@ewing.ldeo.columbia.edu
Howie Goldstein	MMO	hgolds@ewing.ldeo.columbia.edu
Carlos Gutierrez	PSSO	gunners@ewing.ldeo.columbia.edu
Karl Hagel	ET	hagel@ewing.ldeo.columbia.edu
Richard Oliver−Goodwin	Computing	richardo@ldeo.columbia.edu
Chad Robinson	Gunner	chad@ewing.ldeo.columbia.edu
Sarah Stoltz	MMO	stoltz@ewing.ldeo.columbia.edu
Justin Walsh	Gunner	cabinboy@ewing.ldeo.columbia.edu

Ship Crew

Mark Landow	Captain	captain@ewing.ldeo.columbia.edu
Steven Pica	Chief Engineer	engine@ewing.ldeo.columbia.edu
David Wolford	1st Mate	stan@ewing.ldeo.columbia.edu
Rick Thomas	2nd Mate	rickt@ewing.ldeo.columbia.edu
Meredith Mecketsy	3rd Mate	mecketsyj@ewing.ldeo.columbia.edu
Matt Tucke	1st A/Engineer	tuk@ewing.ldeo.columbia.edu
Alejandro Santiago	2nd A/Engineer	santiago@ewing.ldeo.columbia.edu
Michael Unger	3rd A/Engineer	unger@lewing.ldeo.columbia.edu
Ryan Dennis	Steward	ryan@ewing.ldeo.columbia.edu
David Philbrick	Bosun	davep@ewing.ldeo.columbia.edu
Gary Brodock	Cook	gary@ewing.ldeo.columbia.edu
Rudy Florendo	Oiler	florendo@ewing.ldeo.columbia.edu
George Mardones	Oiler	george@ewing.ldeo.columiba.edu
Luke Moqo	Utility	luke@ewing.ldeo.columbia.edu
Igor Myachin	A/B	igor@ewing.ldeo.columbia.edu
Jack Schwartz	Electrician	jack@ewing.ldeo.columbia.edu
Roger Strimback	O/S	
Jim Syferd	A/B	jims@ewing.ldeo.columbia.edu
Sypongco, Arnold	A/B	arnold@ewing.ldeo.columbia.edu
Christopher Toles	O/S	toles@ewing.ldeo.columbia.edu
Uribe, Fernando	Oiler	gato@ewing.ldeo.columbia.edu

Cruise Notes

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

Hydrosweep

There was a bad BE−6012−229 card in the 6012 cabinet that took most of the transit to troubleshoot. For the first several days after leaving port, the ship remained in water too shallow for the DS−2 to track, so it is difficult to determine when the card started to falter. I don't believe the data is of any value.

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 10 seconds to either the DATUM gps or JOETIME 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

JOETIME

logging interval: 10 seconds
file id: tr3

Used as the CPU synchronization clock. This clock is polled once every ten seconds 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
2004+051:00:00:00.701		Logging officially started
2004+051:13:26:10.021	2004+051:16:39:59.735	Data Interruption
2004+055:16:22:40.021	2004+055:17:00:30.443	Data Interruption
2004+057:20:21:20.041	2004+058:18:17:09.792	Data Interruption
2004+058:21:35:40.021		Logging officially ends

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 POS/MV with auxillary input from the C−Nav Global DPGS was the primary GPS for this cruise.

Trimble Tasmon P/Y Code Receiver

logging interval: 10 seconds
file id: gp1

The Tasmon GPS receiver's accuracy is around 15 meters.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	LogDate	Comment
2004+051:13:28:37.062		Logging officially started
2004+057:20:19:48.030		Logging officially ends

Trimble NT300D

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
2004+109:06:05:57.403		Logging officially started
2004+052:02:30:23.617	2004+052:02:50:30.299	Data Interruption
2004+052:03:14:10.668	2004+052:06:13:21.357	Data Interruption
2004+052:07:10:01.691	2004+052:15:51:47.421	Data Interruption
2004+052:16:40:39.273	2004+052:23:08:37.514	Data Interruption
2004+053:01:25:33.430	2004+053:02:11:06.290	Data Interruption
2004+053:02:55:06.995	2004+053:13:59:48.281	Data Interruption
2004+053:14:04:24.634	2004+053:14:45:06.290	Data Interruption
2004+152:07:56:31.542	2004+152:08:25:23.341	Data Interruption
2004+057:20:19:47.426		Logging Ends

C−Nav

logging interval: 2 seconds
file id: gp3

The C−Nav is a global satellite−based differential receiver. This is the best individual receiver currently on the ship.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	LogDate	Comment
2004+051:13:29:10.584		Logging officially started
2004+057:20:19:46.743		Logging Ends

POS/MV

logging interval: 1 second
file id: gp4

The POS/MV is a receiver which uses C−Nav input, its own antennae, an inertial sensor, and optional RTCM corrections (when available) and a kalman filter to produce a smooth nav output and very accurate heading. As of June 2003 it is used as the primary GPS for Hydrosweep, as an input to Spectra, and can be used as the gps for reduction processing. With the C−Nav auxiliary input, this is the most accurate receiver on the ship.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	LogDate	Comment
2004+051:13:36:20.495		Logging officially started
2004+051:17:04:45.596	2004+052:02:23:08.601	
2004+052:02:56:18.678	2004+052:03:06:35.520	
2004+052:07:15:27.396	2004+052:15:53:13.140	
2004+053:01:25:33.642	2004+053:02:10:50.980	
2004+053:02:55:07.816	2004+053:13:59:43.120	
2004+057:20:19:47.570		Logging Ends

Speed and Heading

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

logging interval: 3 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
2004+051:13:29:40.783		Official start date
2004+057:20:19:46.250		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: 0.175

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
2004+051:13:30:13.230		Official start date
2004+057:20:19:47.370		Official end time

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
2004+051:16:40:50		Official start logging
2004+155:12:30:35		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
2004+051:13:31:15.323		Official start logging
2004+057:20:19:00.679		Official end logging

LOCATION 1

EW0308 Bridgeport, Barbados

Pier/Ship	Latitude	Longitude
	13 06.07347N	59 37.75187W
Bridgeport Harbor		

Reference	Latitude	Longitude
No Lat/Lon available, (see map in gravity log).		

	Id	Julian	Date	Mistie	Drift/Day	Prev Mistie
Pre Cruise	EW0307	275	02. Oct 03	32.21	0.92	32.21
Post Cruise	EW0308	292	19. Oct 03	28.73	−0.205	0.00
Total Days			17.00	−3.48		

Time	Entry	Value	
16:10:00	CDeck Level BELOW Pier	0.30	
16:10:00	Pier 1 L&R Value	1966.10	L&R
15:50:00	Reference L&R Value	1967.58	L&R
16:30:00	Pier 2 L&R Value	1966.10	L&R
	Reference Gravity	978294.44	mGals
	Gravity Meter Value (BGM Reading)	978309.80	mGals
	Needs Potsdam Correction	1	1 if Potsdam referenced

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

Difference in meters between Gravity Meter and Pier: **5.80** meters

Height Cor = Pier Height* × FAA Constant

5.80	0.31			1.80 mGals/min

Difference in mGals between Pier and Gravity Meter

Pier (avg) − Reference *1.06 L&R/mGal = **Delta L&R**

1966.10	1967.58	1.06		−1.57 mGals

Gravity in mGals at Pierside

Reference + Delta mGals [+ Potsdam] = **IGSN−71 Referenced Pier**

978294.44	−1.57	−13.60		978279.27 mgals

Gravity in mGals at Meter

Pier Gravity + Height Correction = **Gravity@meter**

978279.27	1.80			978281.07 mGals

Current Mistie

BGM Reading − Calculated Gravity = **Current Mistie**

978309.80	978281.07			28.73 mGals

Gravity Ties

Location 2

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

EW0401/

EW0401.pdf	this document
ew0404.cdf	NetCDF database file of this cruise
ew0404.cdf_nav	NetCDF database file of this cruise' navigation
docs/	File Formats, Spectra manuals
mbsystem/	Latest on−board mbsystem source
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.
scripts/	Perl scripts and their friends