Lamont-Doherty Earth Observatory
Office of Marine Affairs
61 Route 9W
Palisades, NY 10964

R/V Maurice Ewing Data Reduction Summary

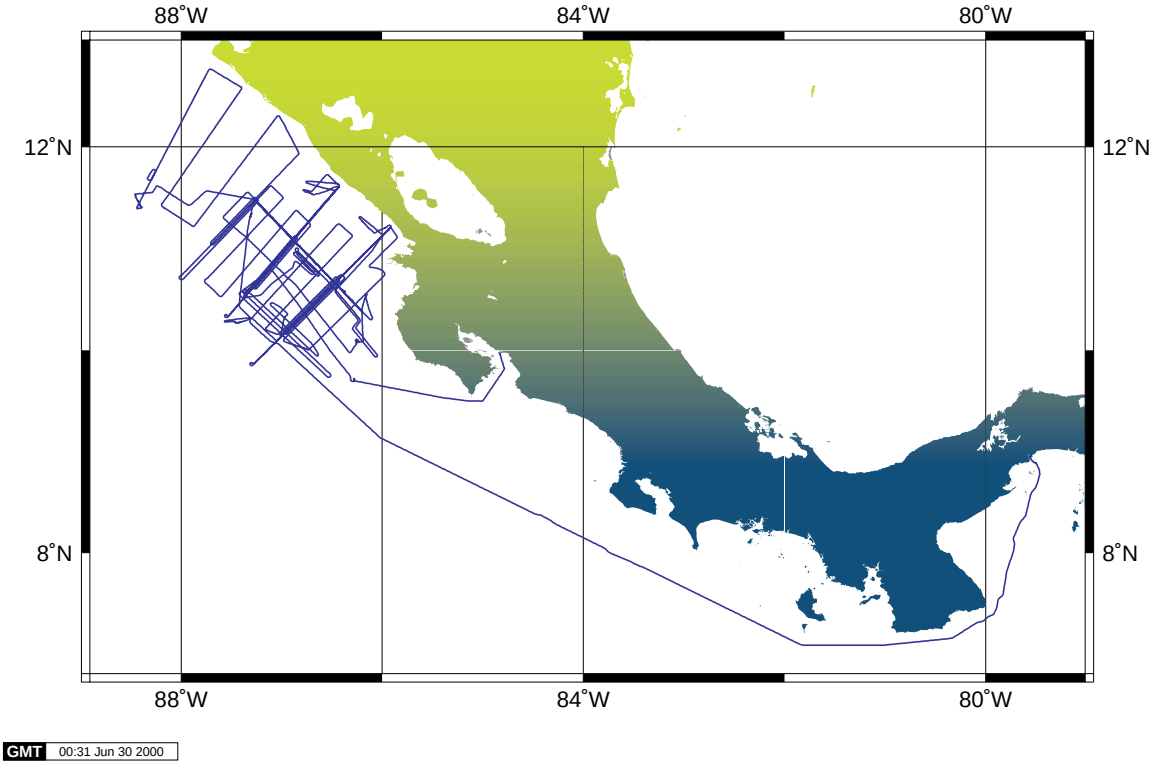
EW-0005 *Puntarenas, Costa Rica - Balboa, Panama*

Port Dates

Date	Julian	Time	Port
May 27	147	1720	Depart Puntarenas
June 27	179	1600	Arrive Balboa

Contents

Cruise Track



Project Summary

Structure of the Nicaragua/Costa Rica Subduction Zone:
A Framework for the Subduction Factory and Seismogenic Zone Initiatives

Around the world there is tremendous variation in seismogenic character of convergent margins and in the geochemical character of the associated volcanic arcs. This may be expected due to the wide range of upper and lower plate composition and thickness and variation of subduction parameters such as slab age and convergence rate. Because arc geochemistry and seismogenic patterns associated with the subduction system of Nicaragua and Costa Rica show along-strike variations comparable to those worldwide, we propose to investigate the nature of this variability along this margin with a single subducting plate and gradually changing subduction parameters. The Costa Rica segment of the margin has been well studied by seismic reflection and refraction techniques, swath bathymetry, and ODP drilling on Leg 170, but in contrast, the Nicaragua margin is poorly studied. Only one MCS profile is present on the Nicaraguan trench slope and a single block of swath bathymetry has been collected. The sparse data we presently have suggest that structural and stratigraphic differences are a significant reason why these two margins develop such different subduction processes. For example, fault block rotation on the subducting plate may lead to particularly efficient sediment subduction and may also enhance the tsunamigenic potential of the Nicaraguan margin segment. However the extent of this type of basement structure, as well as the importance other factors, is unknown due to lack of data. Thus, we propose to acquire, process, and interpret an extensive MCS survey supplemented with three selected refraction profiles and additional Hydrosweep swath bathymetry. We will use these data to document variations in the subducting Cocos plate structure and stratigraphy and the effects of these variations on the upper (Caribbean) plate. Ultimately these data will help identify how factors, such as Cocos plate fault block rotation, fault throw, and stratigraphy affect structural deformation styles in the upper plate that control sediment accretion, subduction, or erosion, processes which are critical to gradients in arc geochemistry and seismogenic characteristics.

This project will directly support many goals of the Subduction Factory Initiative of the MARGINS program in Central America. In particular, we will document sediment fluxes into the system, we have a good chance to identify accretionary or erosional processes at shallow depths, and we hope to identify factors influencing the efficiency of sediment subduction. Similarly, our investigation of the Cocos Plate, its interaction with the upper plate (especially the plate boundary fault zone), and determination of margin velocity structure will directly benefit the SEIZE Initiative (Seismogenic Zone Experiment). The science plans of both these initiatives picked Costa Rica/Nicaragua as a highest priority area and call for extensive seismic reflection and refraction surveying to provide the critical framework for subsequent interdisciplinary investigations.

This project will involve international collaboration with scientists from Nicaragua and Germany and it will build on ongoing programs in the area. A German research vessel, R/V Sonne, was in this area in fall 1999 to investigate crustal thickness variations of the Cocos plate along the Costa Rica segment and crustal structure of the Nicaraguan forearc near the coast. Kirk McIntosh participated in that project and is working with a portion of the refraction data acquired. The work we propose here is complementary to this ongoing work, and, with the planned MCS and OBH data, provides the key elements for further interdisciplinary research.

Cruise Notes

More problems than usual this cruise:

1. Syntrak 3490 tape drive malfunctioning during portions of the cruise where only 20 shot records would be written. Chris removed the drive to clean/vacuum it and replaced it. Both times, this fixed the problem.
2. 3490 tape retensioner died.
3. Shooting algorithm problems:
   - Shoot-by-distance would cause the Syntrak to lose the first 10-100 bytes of the NAV header. This was fixed by adding a 2-second delay after the timebreak before writing the Navblock to the Syntron.
   - Shoot-by-time: shot time drifts over time.
   - Shottime problems would cause the guns to stop shooting. Problem was found in timing with miss-fires, and corrected.
4. Wind Speed: bird failed halfway through the cruise, replaced day 174.
5. Tailbuoy problems: During 2nd OBH line (day 160:2200) , the tailbuoy was rising at one specific location. Upon examination via the rescue boat, no obvious problems. Shortly after, an encounter with a fishing boat caused us to reel in the cable and more weight was affixed to the cable.
6. HS problems at beginning of cruise with excessive zero beams. Eventually cleared. Also a drop of several hours on day 172.
7. Truetime clock died. Problems shooting with Datum clock. Eventually got the Truetime clock in the Syntron working as the shot clock, and used the Datum clock as a CPU synchronizer once every half hour.
8. Gravity gyro died and need replacement.
9. Engine problems,compressor problems.

Cruise Members

Ship Staff

Name	Position	Email
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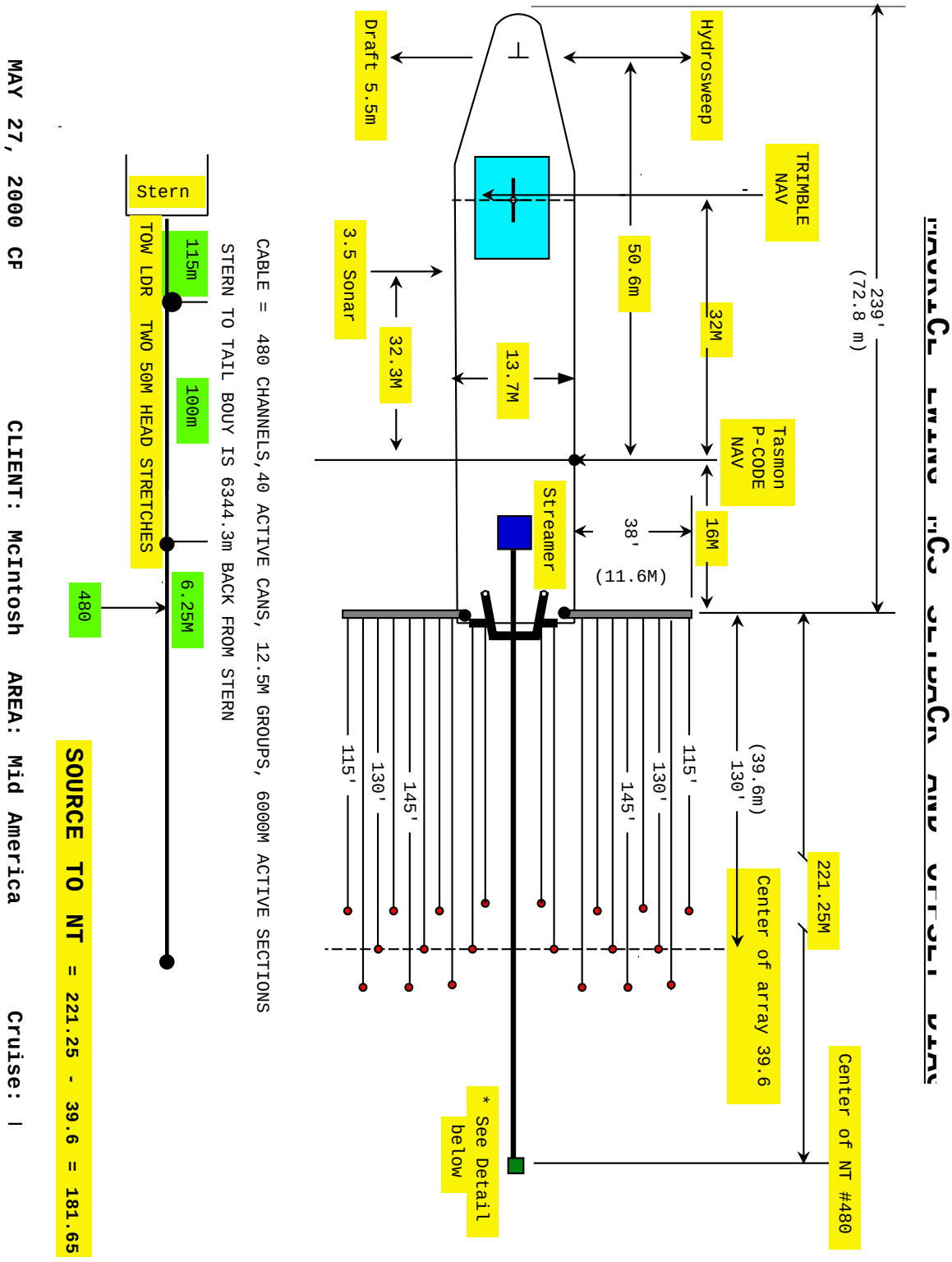
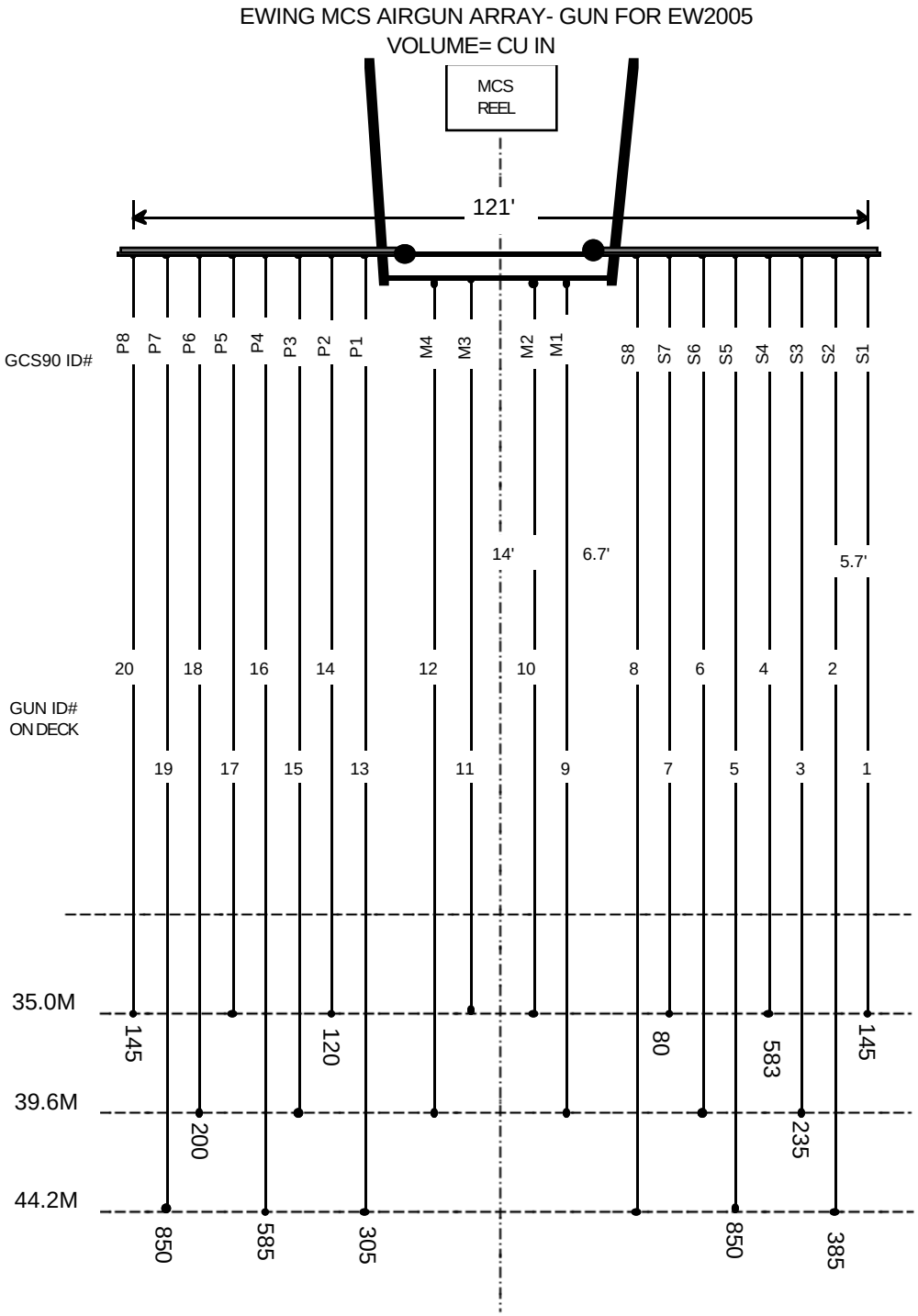
MCS Setback and Offset Diagram



20 Airgun Array



Streamer Configuration

MOD	SERIAL #	CAN#	SHIP OFFSET	CHANNELS	BIRD	COMMENTS
TB			6344.3M			TAIL BUOY AT 6345M
STIC	CABLE 25.3M		6319M TO 6344M			
1		2151				POWER MODULE 12151
HS	30120-HS	50M	6269M TO 6319M			
TS	0697-30284TS	50M	6219M TO 6269M			
AT	0498-30024	4M	6215M TO 6219M			
	0398-31433	RED	6140M TO 6215M	1 TO 3	1C	Bird at 6210M
2		3538				
	0298-31388	ORNG	6065M TO 6140M	4 TO 6		
	0298-31407	RED	5990M TO 6065M	7 TO 9	2	BIRD at 6060M
3		2734				
	0198-31319	ORNG	5915M TO 5990M	10 TO 12		
	0198-31333	RED	5840M TO 5915M	13 TO 15	3C	BIRD AT 5910M
4		2731				
	0298-31385	ORNG	5765M TO 5840M	16 TO 18		
	0298-31399	RED	5690M TO 5765M	19 TO 21	4	COMPASS Bird at 5760M
5		2731				
	0298-31386	ORNG	5615M TO 5690M	22 TO 24		REMOVED CAN 2759 CAUSED
	0996-30314	RED	5540M TO 5615M	25 TO 27	5C	A REVERSE POWER COND.
6		3607				BIRD AT 5610M
	0298-31402	ORNG	5465M TO 5540M	28 TO 30		
	0298-31337	RED	5390M TO 5465M	31 TO 33	6	BIRD at 5460M
7		3189				
	0298-31382	ORNG	5315M TO 5390M	34 TO 36		
	0298-31390	RED	5240M TO 5315M	37 TO 39		
8		3606				

MOD	SERIAL #	CAN#	SHIP OFFSET	CHANNELS	BIRD	COMMENTS
	0298-31346	ORNG	5165M TO 5240M	40 TO 42		
	0298-31381	RED	5090M TO 5165M	43 TO 45	7C	Bird at 5160M
9		3107				
	0298-31391	ORNG	5015M TO 5090M	46 TO 48		
	0298-31336	RED	4940M TO 5015M	49 TO 51		
10		3395				
	0298-31384	ORNG	4865M TO 4940M	52 TO 54		
	0198-31341	RED	4790M TO 4865M	55 TO 57	8	BIRD at 4860M
11		3599				
	0198-31398	ORNG	4715M TO 4790M	58 TO 60		
	0298-31387	RED	4640M TO 4715M	61 TO 63		
12		3597				
	0298-31378	ORNG	4565M TO 4640M	64 TO 66		
	0298-31369	RED	4490M TO 4565M	67 TO 69	9C	Bird at 4560M
13		3604				
	0298-31396	ORNG	4415M TO 4490M	70 TO 72		
	0198-31335	RED	4340M TO 4415M	73 TO 75		
14		2965				
	0198-31362	ORNG	4265M TO 4340M	76 TO 78		
	0298-31373	RED	4190M TO 4265M	79 TO 81	10	BIRD at 4260M
15		2714				
	0198-31334	ORNG	4115M TO 4190M	82 TO 84		
MOD	SERIAL #	CAN#	SHIP OFF-SET	CHANNELS	BIRD	COMMENTS
	0298-31405	RED	4040M TO 4115M	85 TO 87		
16		2757				
	0198-31348	ORNG	3965M TO 4040M	88 TO 90		

MOD	SERIAL #	CAN#	SHIP OFFSET	CHANNELS	BIRD	COMMENTS
	0397-31119	RED	3890M TO 3965M	91 TO 93	11C	Bird at 3960M
17		3031				
	0198-31318	ORNG	3815M TO 3890M	94 TO 96		
	0198-31343	RED	3740M TO 3815M	97 TO 99		
18		3602				
	1296-30808	ORNG	3665M TO 3740M	100 TO 102		
	0996-30302	RED	3590M TO 3665M	103 TO 105	12	BIRD at 3660M
19		2940				
	30804	ORNG	3515M TO 3590M	106 TO 108		
	0996-30327	RED	3440M TO 3515M	109 TO 111		
20		2935				
	0197-31058	ORNG	3365M TO 3440M	112 TO 114		
	0298-31389	RED	3290M TO 3365M	115 TO 117	13C	
21		2704				Bird at 3360M ***LEAK!!!!
	31329	ORNG	3215M TO 3290M	118 TO 120		REMOVED SECTION 31375
	0996-30279	RED	3140M TO 3215M	121 TO 123		
22		2563				
	0297-31082	ORNG	3065M TO 3140M	124 TO 126		
	1096-30330	RED	2990M TO 3065M	127 TO 129	14	BIRD at 3060M
23		2507				
	31350	ORNG	2915M TO 2990M	130 TO 132		
	31363	RED	2840M TO 2915M	133 TO 135		
24		2567				
	0996-30300	ORNG	2765M TO 2840M	136 TO 138		
	0696-31347	RED	2690M TO 2765M	139 TO 141	15C	Bird at 2760M
25		2717				
	0697-31351	ORNG	2615M TO 2690M	142 TO 144		

MOD	SERIAL #	CAN#	SHIP OFFSET	CHANNELS	BIRD	COMMENTS
	31383	RED	2540M TO 2615M	145 TO 147		
26		2523				
	0996-30304	ORNG	2465M TO 2540M	148 TO 150		
	0996-30283	RED	2390M TO 2465M	151 TO 153	16	BIRD at 2460M
27		3163				
	298 31372	ORNG	2315M TO 2390M	154 TO 156		
	0996-30301	RED	2240M TO 2315M	157 TO 159		
28		2511				
	1096-30332	ORNG	2165M TO 2240M	160 TO 162		
	????	RED	2090M TO 2165M	163 TO 165	17C	Bird at 2160M
29		2570				
	0597-31248	ORNG	2015M TO 2090M	166 TO 168		30311 noisey channels
	0597-31269	RED	1940M TO 2015M	169 TO 171		REMOVED
30		3172				
	0597-31268	ORNG	1865M TO 1940M	172 TO 174		
	0996-30281	RED	1790M TO 1865M	175 TO 177	18	BIRD at 1860M
31		2505				
	???	ORNG	1715M TO 1790M	178 TO 180		SS1-0696-0138 had a leak at conn.
	0996-30303	RED	1640M TO 1715M	181 TO 183		
32		2554				
	1096-30346	ORNG	1565M TO 1640M	184 TO 186		
	30313	RED	1490M TO 1565M	187 TO 189	19C	Bird at 1560M
33		3182				
	0696-10388	ORNG	1415M TO 1490M	190 TO 192		
	0697-31277	RED	1340M TO 1415M	193 TO 195		
34		2506				
	0696-31280	ORNG	1265M TO 1340M	196 TO 198		

MOD	SERIAL #	CAN#	SHIP OFFSET	CHANNELS	BIRD	COMMENTS
	SS1-0696-10057	RED	1190M TO 1265M	199 TO 201	20	BIRD at 1260M
35		2462				
	1096-30320	ORNG	1115M TO 1190M	202 TO 204		
	0996-31349	RED	1040M TO 1115M	205 TO 207		
36		2747				
	0697-31282	ORNG	965M TO 1040M	208 TO 210		
	1096-30337	RED	890M TO 965M	211 TO 213	21C	Bird at 960M
37		3192				
	SS1-0696-0140	ORNG	815M TO 890M	214 TO 216		
	31400	RED	740M TO 815M	217 TO 219		
38		3162				
	0298-31410	ORNG	665M TO 740M	220 TO 222		
	0298-31365	RED	590M TO 665M	223 TO 225	22	Bird at 660M
39		2728				
	31346	ORNG	515M TO 590M	226 TO 228		
	0298-31377	RED	440M TO 515M	229 TO 231	23C	
40		2485				
	0198-31321	ORNG	365M TO 440M	232 TO 234		
	0298-31357	RED	290M TO 365M	235 TO 237	24	BIRD AT 469M
41		2970				
	0298-31360	ORNG	215M TO 290M	238 TO 240		CAN # 3084 WAS BAD
42		10284				PASSIVE CAN 10284
	30128HS		165M TO 215M	STRETCH		
	30134HS		115M TO 165M	STRETCH		
LDR	0498-30025		STERN TO 115M	LEADER		FIBER OPTIC

Data Instruments

The following tables describe the times data was logged for all instruments. Unless otherwise noted, the tables will show the start of logging through the end of logging, with only the data interruptions described in the tables.

Time Reference

Datum StarTime 9390-1000

Normally the alternate reference UTC clock due to its unreliability, it became necessary during this cruise to use it as a CPU Time synchronizer as well as an IRIG input to tag the shot times. It appears that the CPU clock will lose about 17 msecs per hour if left unsynchronized. The highlighted sections below show several times where the CPU clock cannot be trusted. The logged times for most of the instruments are incorrect during these periods. This will not affect those items that contain their own fix times: shot times and GPS fixes.

Date	Comment
147:02:00	Datum CPU Synchronization starts (updates @ 1x/minute)
147:22:51 - 149:03:28	Datum not logging, CPU lost 600 msecs.
150:22:53:30.071 - 23:09:30.071	**Datum out of sync**
154:19:10:29.983 - 19:24:30.071	**Datum out of sync**
155:05:02:29.989 - 05:16:31.812	**Datum out of sync**
155:05:27:30.151 - 14:02:30.191	no log, CPU lost 150 msecs
155:14:13:30.142 - 156:20:00:30.074	no log, CPU lost 500 msecs
157:01:00:30.150 - 14:29:30.113	no log, CPU lost 230 msecs
157:18:25:30.077 - 158:14:57:30.068	no log, CPU lost 350 msecs
158:19:14:30.069	Switched to updates 1x/30 minutes
159:02:14:30.112 - 159:02:14:30.112	no log, CPU lost 350 msecs
164:13:01:30.119 - 165:00:33:30.079	no log, CPU lost 240 msecs
165:19:03:30.118 - 166:04:42:30.065	no log, CPU lost 160 msecs
179:16:00	Cruise ends

Speed and Heading

Furuno CI-30 Dual Axis Speed Log, Sperry MK-27 Gyro

Logged at 3 second intervals.

Date	Comment
144:16:54	Furuno logging started
179:16:00	Cruise ends

GPS Receivers

gp1 = Trimble Tasman Y-Code **gp2 = Trimble NT200D** **tb1 = Tailbuoy**

GPS receivers were logged at 10 second intervals. Navigation is processed and reduced to 60 second intervals which is then applied to the magnetics, gravity, bathymetry, and shot data. All data for this cruise was processed with the Tasman (gp1). Only gp1 outages are accounted for in this log as gp2 goes out frequently due to email connections, and the tailbuoy is erratic, at best.Fix times are based on the GPS fix time, not the CPU time.

Date	Comment
144:16:54	GPS1 Started Logging
147:16:19:47 - 147:16:23:46	Lost GPS1 for 239 seconds
150:23:00:00 - 150:23:03:38	Lost GPS1 for 218 seconds
155:01:17:26 - 155:01:29:54	Lost GPS1 for 748 seconds
179:16:00	End of Cruise

Gravimeter

The **Bell BGM-3 Gravimeter** is logged at 1-second intervals. The gravimeter went out for 13 hours on day 153 - 154 due to a gyro replacement..

Date	Comment
144:16:54	Gravity logging begins
153:13:00 - 154: 02:10	Gravity gyro out, needed replacement.
179:16:00	Cruise ends

Magnetometer

The **Geometrics G-886 Marine Magnetometer** was logged at 12 second intervals throughout the cruise. Dropouts are due to OBS dropoffs/recoveries and streamer deployments and recoveries.

Date	Comment
148:16:29	Magnetics logging begins
149:21:24:08 - 150:17:47:38	no logging
157:08:25:27 - 158:10:57:24	no logging
159:15:37:56 - 160:12:26:29	no logging
162:16:48:54 - 163:22:48:52	no logging
170:20:16:36 - 170:20:40:35	no logging
172:00:38:50 - 173:10:14:42	no logging, OBH drops
173:10:14:42 - 175:15:11:15	Last of Magnetics Logging

Hydrosweep Bathymetry

The **Krupp Atlas Hydrosweep-DS** full swath data is logged for each ping, and the centerbeam data is extracted and processed separately. The hydrosweep operates at varying intervals based on water depth.

The full swath data can be read and processed using the MB-System software which can be downloaded from the web site: http://www.ldeo.columbia.edu/MB-System

MB-System 4.6.10 is necessary to process data after Jan 1, 2000.

Hydrosweep data was logged continuously throughout the cruise. One XBT was performed on

Date	Comment
147:17:46	Hydrosweep logging starts
148	High percentage of Zero beams: 18.3%
149	High percentage of Zero beams: 18.25%
148:04:45 - 148:08:01	No HS logging
149:02:22 - 149:02:22	No HS logging
157:18:47 - 158:10:12	No HS logging
162:13:19 - 162:13:30	No HS logging
170:03:21 - 170:03:26	No HS logging, OBH drops?
172:16:20 - 172:16:24	No HS logging, OBH drops ?
172:17:58 - 172:19:55	No HS logging, system crash
176:17:03 - 176:19:17	Turned off for Dredging
179:13:30	Anchored, HS off

Sea Temperature

The sea temperature was logged during the entire cruise with no interruptions.

Weather Station

The **R.M. Young Precision Meteorological Instruments; 26700 series** is used to log a variety of weather conditions at 1-minute intervals. The weather station bird was lost

Date	Comment
144:16:54:56	Start logging weather
163:10:46	Wind speed indicator lost
174:00:28	Wind speed replaced
179:16:00	End of Cruise

Shot Logs

The shot logs represent the times that data was logged for shooting lines. These tables represent the shots and shot times recorded by the system and should account for every shot on tape. Any data we have for shooting problems will be represented in these tables. Missing shots usually mean a gun misfire for some reason. Shot times were logged via the Datum

Shot Times

Line	Shots	Times	Comments
NIC20H	1 .- 1582	150:21:33:42 - 152:23:59:50	Missing shots: 79..82, 84, 112, 1563..1565
NIC20	1 - 3829	152:02:43:43 - 153:01:55:50.156	Missing shots: 228
NIC15	4177 - 4415	153:01:57:12 - 153:03:16:32	Missing shots: 4226..4233, 4249..4250, 4254, 4271, 4278, 4298..4302
NIC14	1 .. 860	153:03:23:09 - 153:09:06:45	
NIC10	1..2837	153:11:54:00 - 154:03:57:45	Missing shots: 2808
NIC22	1 .. 1965	154:04:15:57 - 154:15:16:30	
NIC26	1..1793	154:15:32:25 - 155:01:15:24	Missing shots: 640, 643..653, 657, 1389..1393, 1698..1700, 1705..1706, 1711..1712, 1717..1718
NIC24	1 .. 1602	155:01:56:28 - 155:10:49:42	Missing Shots: 568..569, 571, 584, 586..588, 590
NIC28	1 .. 1785	155:11:43:34 - 155:21:38:14	
NIC30	1 .. 2723	155:23:24:17 - 156:14:31:37	
NIC31	1 .. 275	156:15:10:19 - 156:16:41:39	
NIC40	1 .. 2647	156:17:47:44 - 157:08:29:44	
NIC50H	1 .. 1451	160:13:30:48 - 161:13:46:47	Missing Shots: 408, 553, 774, 830..843
NIC50	1 .. 3733	161:15:00:28 - 162:11:55:12	Missing Shots: 1543, 2361, 2777, 3250, 3330
NIC60	1 .. 415	162:14:00:40 - 21:21:43	Missing Shots: 2, 247, 294..299,

Line	Shots	Times	Comments
NIC54	1 .. 1443	163:23:23:31 - 164:07:24:11	
NIC56	1445 .. 1370	164:07:24:56 - 164:15:03:21	
NIC52	1382 ..3564	164:16:41:27 - 165:04:48:47	Missing Shots: 2314
NIC60	1 .. 2488	165:04:50:58 - 165:18:39:58	
NIC60C	1 .. 422	165:18:43:21 - 165:21:03:41	
NIC70	1 ..2491	165:21:09:20 - 166:11:07:25	Missing Shots: 29
NIC70C	1 .. 318	166:11:11:12 - 166:12:57:49	
NIC84	1 .. 1757	166:13:06:32 - 166:22:51:22	
NIC86	1 .. 1292	166:22:56:00 - 167:07:07:46	
NIC82	1 .. 2321	167:08:01:22 - 167:20:49:46	
NIC80	1 .. 3688	167:21:41:00 - 168:19:09:19	Missing Shots: 3004, 3186
NIC80C	1 .. 937	168:19:12:09 - 169:01:31:12	
NIC90	1 .. 2994	169:01:35:48 - 169:19:48:03	Missing Shots: 947..952
NIC90C	3000 .. 3826	169:19:52:44 - 170:00:22:24	
NIC100	1 .. 3039	170:00:25:13 - 170:19:31:03	Missing Shots: 2105
NIC100C	1 .. 638	170:20:36:01 - 171:00:10:58	
NIC110	1 .. 2667	171:00:24:34 - 171:17:24:49	Missing Shots: 1227..1234
NIC110X	1 .. 837	171:19:53:00 - 172:00:34:54	
NIC125H	1 .. 1528	173:10:19:01 - 174:10:30:02	
NIC125C	1540 .. 1811	174:10:35:59 - 174:12:10:00	
NIC125D	1 .. 373	174:12:26:48 - 174:14:32:19	
NIC115	1 .. 4003	174:14:42:42 - 175:15:06:48	Missing Shots: 1527

Suva, Fiji

EW0002 Suva, Fiji

Pier/Ship	Latitude	Longitude
	S 18 08.121	E 178 25.382

Reference	Latitude	Longitude

ACIC 0352-1

	Id	Julian	Date	Mistie	Drift/Day	Prev Mistie
Pre Cruise	EW0001	29	1/29/00	1.26	0.020	1.26
Post Cruise	EW0002	62	3/2/00	3.58	0.070	1.26
Total			33.00	2.32		

Time	Entry	Value	
3/2/00 7:15	CDeck Level BELOW Pier	1.00	
	Pier 1 L&R Value	0.00	L&R
	Reference L&R Value	0.00	L&R
	Pier 2 L&R Value	0.00	L&R
	Reference Gravity	978622.50	mGals
	Gravity Meter Value (BGM Reading)	978628.10	mGals
	Potsdam Corrected	0	1 if corrected

*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

0.00	0.00	1.06		0.00 mGals

Gravity in mGals at Pierside

Reference + Delta mGals [+ Potsdam] = Pier Gravity

978622.50	0.00	0.00		978622.50 mgals

Gravity in mGals at Meter

Pier Gravity + Height Correction = Gravity@meter

978622.50	2.02			978624.52 mGals

Current Mistie

BGM Reading − Calculated Gravity = Current Mistie

978628.10	978624.52			3.58 mGals

Balboa, Panama

EW0005 Balboa, Panama

Pier/Ship	Latitude	Longitude
	N 08 57.2277	W 79 34.0239

3rd Bollard from end of pier

Reference	Latitude	Longitude
	N 08 57.60	W 079 33.81

Port Captain Office, under awning in front of building on sidewalk
WH 1013

	Id	Julian	Date	Mistie	Drift/Day	Prev Mistie
Pre Cruise	EW0002	62	3/2/00	1.26	0.07	1.26
Post Cruise	EW0005	179	6/27/00	2.63	0.012	1.26
Total Days			117.00	1.37		

Time	Entry	Value	
18:40	CDeck Level BELOW Pier	2.00	
18:40	Pier 1 L&R Value	1915.55	L&R
19:07	Reference L&R Value	1915.45	L&R
19:39	Pier 2 L&R Value	1915.50	L&R
11/1/71 0:00	Reference Gravity	978224.17	mGals
18:40	Gravity Meter Value (BGM Reading)	978242.80	mGals
	Potsdam Corrected	1	1 if corrected

*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	
1915.53	1915.45	1.06		0.08	mGals

Gravity in mGals at Pierside

Reference + Delta mGals [+ Potsdam]				Pier Gravity	
978224.17	0.08	13.60		978237.85	mgals

Gravity in mGals at Meter

Pier Gravity+	Height Correction			Gravity@meter	
978237.85	2.33			978240.17	mGals

Current Mistie

BGM Reading-	Calculated Gravity			Current Mistie	
978242.80	978240.17			2.63	mGals

Data Processing

GPS Processing

Navigation data is post-processed in order to accurately determine the position and remove GPS accuracy errors. We perform slightly different processing depending on the type of receiver.

1. Check data for mutant records and non-sequential times.
2. If we have speed and/or DOP information, remove records that have excessive speed or too high of a DOP[1]
3. Convert from NMEA or proprietary format to a standard format
   2000+009:00:28:50.091 N 42 14.1536 W 063 25.5897 P-trimble
4. If we are processing known differential data, remove non-differential fixes from the file.
5. Interpolate and reduce data. Fixes are reduced to 30 second fixes and any minor gaps (< 3 minutes) are linearly interpolated.
6. Smooth data using a 9 point running average algorithm and further reduce data to 60 second fixes.
7. Perform dead reckoning using the smoothed Furuno speed and heading to fill in major gaps (> 3 minutes) and to insure the accuracy of the GPS data

Furuno Processing

Furuno speed and heading is processed by smoothing the data using a vector summing algorithm. Data is reduced and output at 60 second intervals by taking the smoothed values and calculating the mean value for the 30 seconds before and after the whole minute.

Hydrosweep Processing

Center Beam Processing

1. Remove all survey and calibration records from the raw data and all 0 level depths
2. Reduce data to one minute intervals on 00 seconds of the minute by computing the median values from the raw values that lie between +-30 seconds of 00 seconds of the minute.
3. Merge the data with the processed navigation to end up with one minute hydrosweep centerbeam fixes with navigation.

Full Swath Processing

Hydrosweep swath data is processed using the MB-System software, and consists primarily of hand-editing the beam data. Source code and documentation for MB-System may be found at the Web site: http://www.ldeo.columbia.edu/MB-System.

1. Dilution of Precision, a term used to measure the accuracy of the fix based on the number of Satellites the GPS receiver is tracking, and the position of the satellites.

bias	*= 852645.3;*	*Dec 5, 1997*
scale	*= 5.0940744*	*July 9, 1992*
mGals	*= raw_gravity_count * scale + bias;*	

Logging

- Raw gravity is logged to disk at a rate of 1 sample/second.

Reduction

1. Raw gravity is filtered using a 6 minute gaussian filter and mGals are output. The raw mGals are represented by, outputting a gravity count once every 6 seconds.
   `mGals = gravitycount * scale + bias;`
2. A second filter is then applied; an 8 minute Gaussian filter using the GMT system:
   `filter1D -G480 -R -E`
3. The filtered output is then reduced to 1 minute intervals by using sample1d to tie the gravity values to the processed navigation.
4. The results from step 3 are used to calculate the velocities between Nav fixes, which are smoothed using a 9-minute averaging window. The smoothed velocities are used to calculate the Eotvos correction. At this point, the drift corrections are applied and the the final faa value calculated using the 1980 theoretical gravity formula.

```
corrected_grv = raw_grv + eotvos_corr - drift - dc_shift
faa = corrected_grv - theoretical_grv
```

Gravity Tie

It is usual practice to have a gravity "tie" to a gravity reference base station during the port stay. A portable gravity meter, e.g. the Lacoste Model G #70, is used to make 1) a pier-side reading; 2) a reading at the base station; 3) an additional pier-side reading. The pier-side gravity value, adjusted in value to correspond to the height of the BGM gravity meter, is compared to the real-time BGM Gravity Reading discussed previously.

The practice is not to adjust the BGM-3 so that its reading agrees with the pier-side gravity value, but to establish a *bgm-offset*, which represents a constant correction to be applied to all gravity values on the next cruise.

For example, suppose the pier-side value equaled 980274.7 mGal and the BGM reading was 980279.9, the *bgm-offset* would be 5.2 mGal. In other words, the BGM is 5.2 mGal high. This value is subtracted from observed values of gravity following the cruise as a constant correction. The "drift" of the Bell gravity meter is determined from the two in-port gravity station ties. In the pre-cruise tie the BGM might have been found to be 5.3 mGal high and during the post-cruise tie it is 8.4 mGal high. The drift during the cruise is therefore equal to 3.2 mGal (8.4 - 5.2). The amount of drift per day is then calculated and gravity data is processed with the drift values corrected for the length of the cruise.

Thus, for daily reduction at sea the drift correction option cannot be used. However, the drift rate of the Bell gravimeter is very low, usually much less than 0.1 mGals/day; thus useful analysis of the FAA values while at sea.

Raw Compass Block — cb1.d*jjj*

Official Shot Time	Line	Shot	GPS1 Position	
2000+009:00:01:29.572	LAU1	021144	S 19 26.4331	W 176 16.3491

GPS2 Position *Trimble*		Tailbuoy Position		Gyro	Compass#	Position
S 19 26.4393	W 176 16.3198	S 19 25.2864	W 176 19.7897	107.0	C01	97.8...

No processing is performed on compass block data.

Raw Furuno Log — fu.d*jjj*

CPU Time Stamp	Track	Speed	Heading	Gyro
2000+009:00:01:53.091	-	4.4	140.5	148.3

Hydrosweep Center Beam merged w/ Navigation — hb.n*jjj*

CPU Time Stamp	Position				Depth
2000+009:09:55:00.000	N 13	6.6206	W	59 39.3908	3409.1

Hydrosweep is median filtered at 1 minute intervals, then merged with navigation at 1 minute intervals.

Merged Data — m.*jjj*

CPU Time Stamp	Position				GPS	Set	Drift	Depth
2000+009:14:08:00.000	N 13	54.3859	W	59 43.5175	gp1	0.0	0.0	732.9

Magnetic Total Intensity	Gravity Anomaly	FAA	GRV	EOTVOS	Drift	Shift
0.01	0.0	31.3	978370.7	-3.9	0.0	4.5

Temperature	Salinity	Conductivity
0.0	0.0	0.0

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

Temp, salinity and conductivity are only valid when the thermosalnograph is being logged.

Navigation File — n.*jjj*

CPU Time Stamp	Position				Used	Set	Drift
2000+009:00:03:00.000	N 13	6.2214	W	59 37.9399	gp1	0.0	0.0

Time Shot File — ts.n*jjj*

Official Shot Time	Shot #	Shot Position		Line Name
2000+009:00:15:00.000	000295	N 16 11.8600	W 59 48.0157	strike1

Navblock File (processing file) — nb.r*jjj*

Official Shot Time	Shot Number	CPU Time Stamp	Official Shot Position	
2000+103:00:00:05.150	012016	2000+103:00:00:05.138	N 02 33.4911	W 094 16.3357

Depth	Sea Temp	Wind Speed	Wind Direction	Tailbuoy Position	Tailbuoy Distance	Tailbuoy Bearing
2444.2	27.7	2.5	52	N 02 33.8605 W 094 19.7385	6338.9	96.2

Line Name	Speed	Course
gsc-AA2	4.9	100.0

Gravity File merged with navigation — vt.n*jjj*

```
eotvos_corr = 7.5038 * vel_east * cos(lat) + .004154 * vel*vel
faa = corrected_grv - theoretical_grv
```

CPU Time Stamp	Position		Model	FAA	Raw
2000+009:00:15:00.000	N 16 11.8600	W 59 48.0157	1980	-175.9	978253.6

Eotvos Smooth	Drift Total	DC Shift	Raw Velocity North	Raw Velocity East	Smooth Velocity North	Smooth Velocity East
9.7	0.0	4.5	-4.350	1.282	-4.333	1.329

Raw Weather File Format — wx.d*jjj*

CPU Time Stamp	True Speed	True Dir	Bird 1 Wind Speed Instant	60secAvg	60minAvg	60secMax
2000+175:01:49:00.288	17.5	62	19.6	21.3	24.6	29.3

Bird1 Wind Direction Current	60secAvg	60minAvg
303	302	2

Bird2 Wind Speed Instant	60secAvg	60minAvg	Max	Bird2 Wind Direction Current	60secAvg	60minAvg
0.0	0.0	0.0	0.0	0	0	0

Temperature Current	60minAvg	60minMin	60minMax
28.7	28.7	28.6	28.8

Humidity Current	60minMin	60minMax	Barometric Pressure
69	67	75	1011.3

Bird 2 is deactivated.

True wind speed and direction are calculated based on the heading and speed of the ship.

Tape Contents

- *EW0005.pdf*
  this cruise report (Adobe Acrobat 3 PDF file)
- *ew0005.cdf*
  final one-minute processed data tied to navigation (NetCDF files) for LDEO MG&G database
- *ew0005.cdf_nav*
  final one-minute processed navigation (NetCDF files) for LDEO MG&G database
- *docs/*
  FileFormats for all the files included on tape, hydrosweep info, etc.
- *scripts/*
  scripts used for custom data reduction.
- *processed/*
  final processed data tied to navigation (daily files) plus trackplots, scripts, summary files
- *raw/*
  original logged data (daily files)
- *reduction/*
  intermediate processed data (daily files), including daily PS plots of various reduction parameters: gravity plots, magnetics plots, hydrosweep centerbeam, etc. These postscript plots can be found for each day in the directories ***djjj****.ps/*, where ***jjj*** is the julian day.
- *hydrosweep/*
  - *raw/*
  - *xbt/*