

RV Langseth Data Reduction Summary

MGL1206

Apra Harbor, Guam – Honolulu, HI

FINAL

V1.1, 2012-05-26

Lamont-Doherty Earth Observatory, Columbia University

Wednesday Apr 15 2012 08:00:00L

Date	Julian Date	Time	Port
2012-03-23	2012-083	2300 UTC, 0900L	Apra Harbor, Guam
2012-04-17	2012-108	1800 UTC, 0800L	Honolulu, HI

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Please refer to the Langseth Data Report Supplement for information regarding data formats.

I. Background and Scientific Objectives

R/V *Marcus G.Langseth* MGL-1206 formed the major data acquisition phase of the NSF-funded project, "Geophysical Constraints on Mechanisms of Ocean Plateau Formation from Shatsky Rise, Northwest Pacific" (OCE-0926611). Deciphering the origins of large oceanic plateaus is a critical element for understanding mantle dynamics and its relation to terrestrial magmatism, and Shatsky Rise was chosen as a high-priority target because it provides a unique tectonic setting to distinguish between various models proposed for the formation of oceanic plateaus. The purpose of this survey was to provide critical missing information on (1) the thickness, velocity structure, and composition of the Shatsky Rise crust, and (2) the history of magmatic emplacement and later tectonic development of the Rise. This was planned to be achieved by acquiring seismic data along two refraction lines over the TAMU massif, which represents the early, most voluminous phase of the Rise construction, and over 3,000 km of reflection lines covering both the TAMU and ORI massifs, the latter of which corresponds to the intermediate phase of the plateau evolution.

Figure 1 – Cruise Track

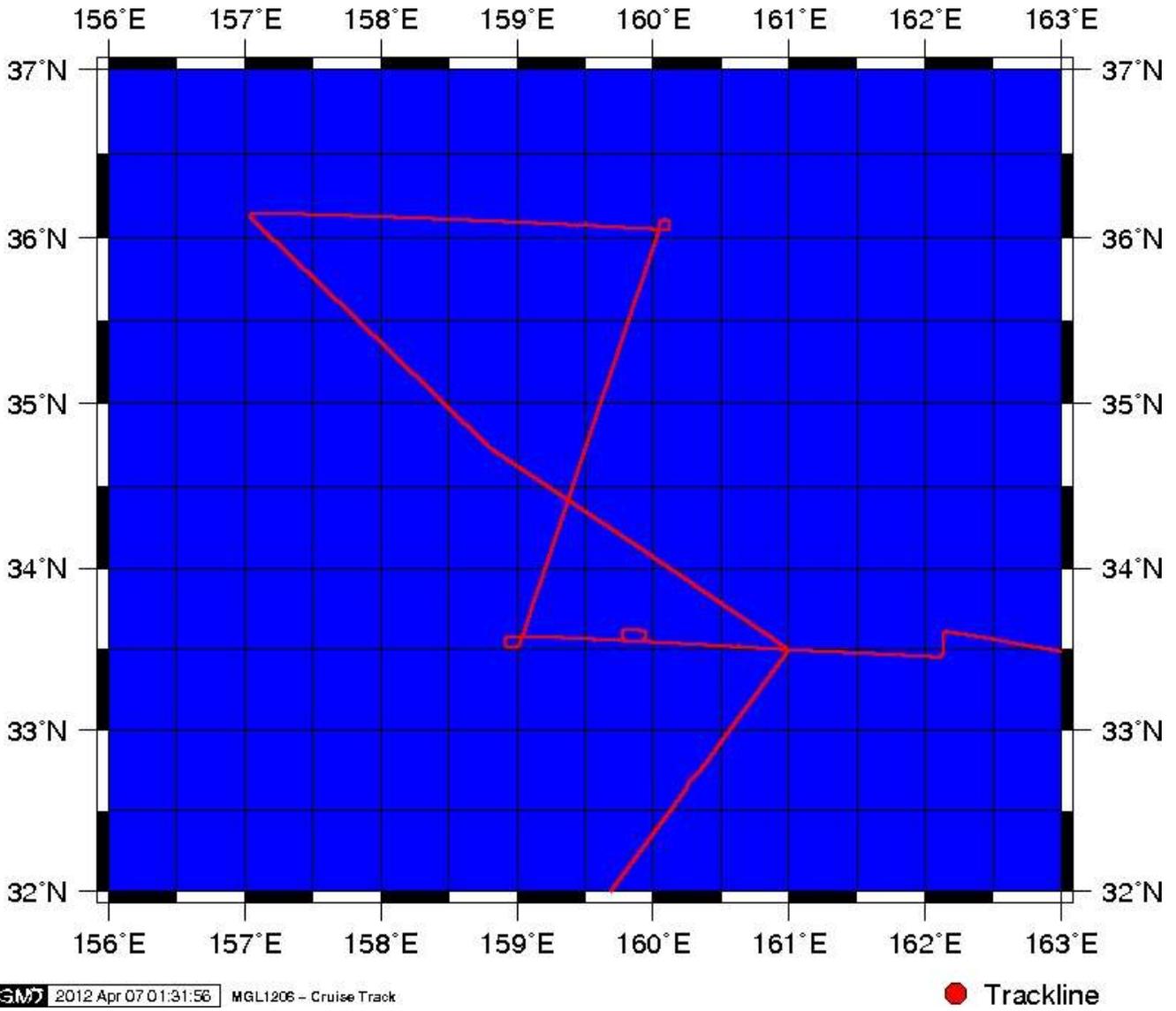
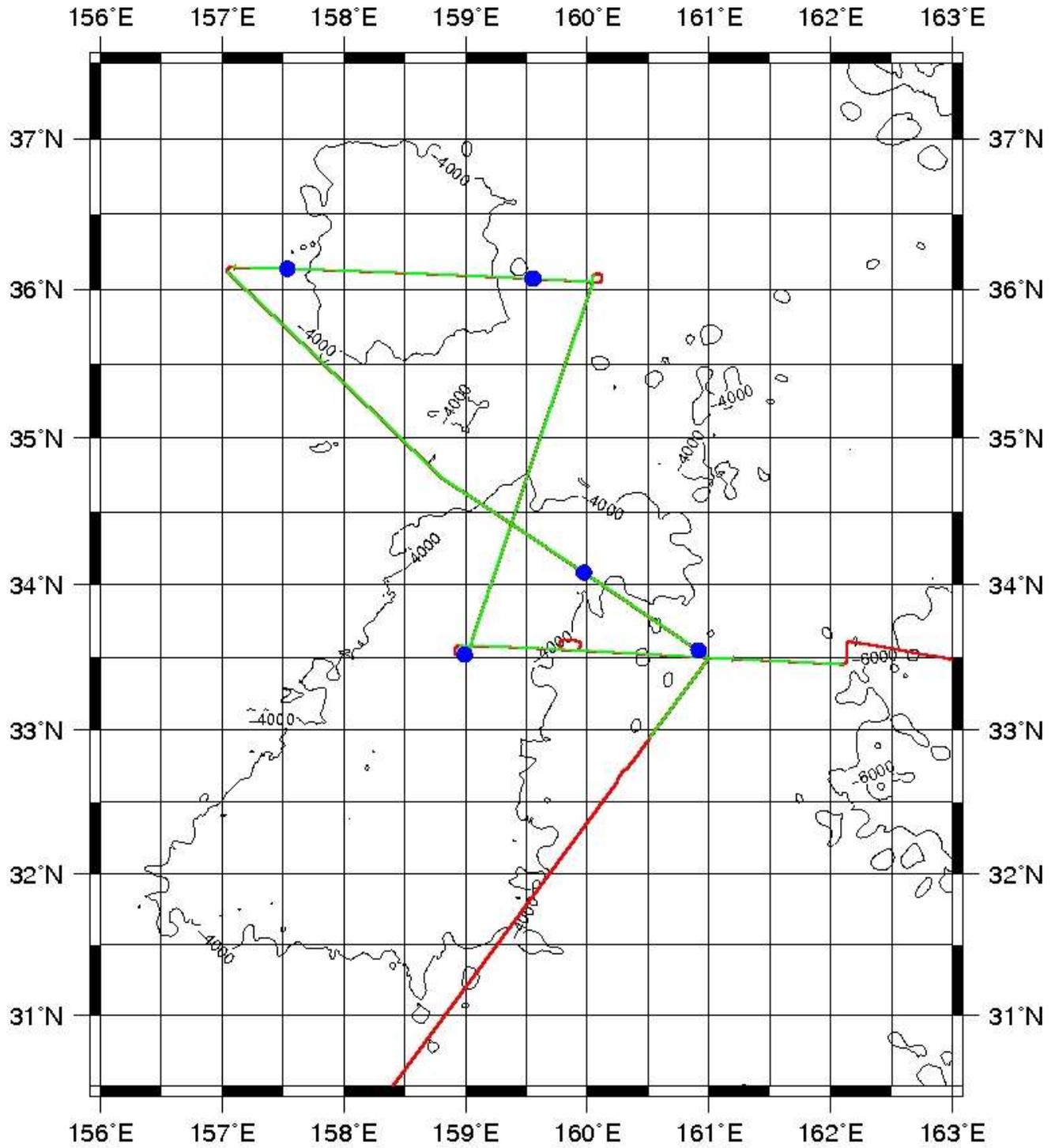
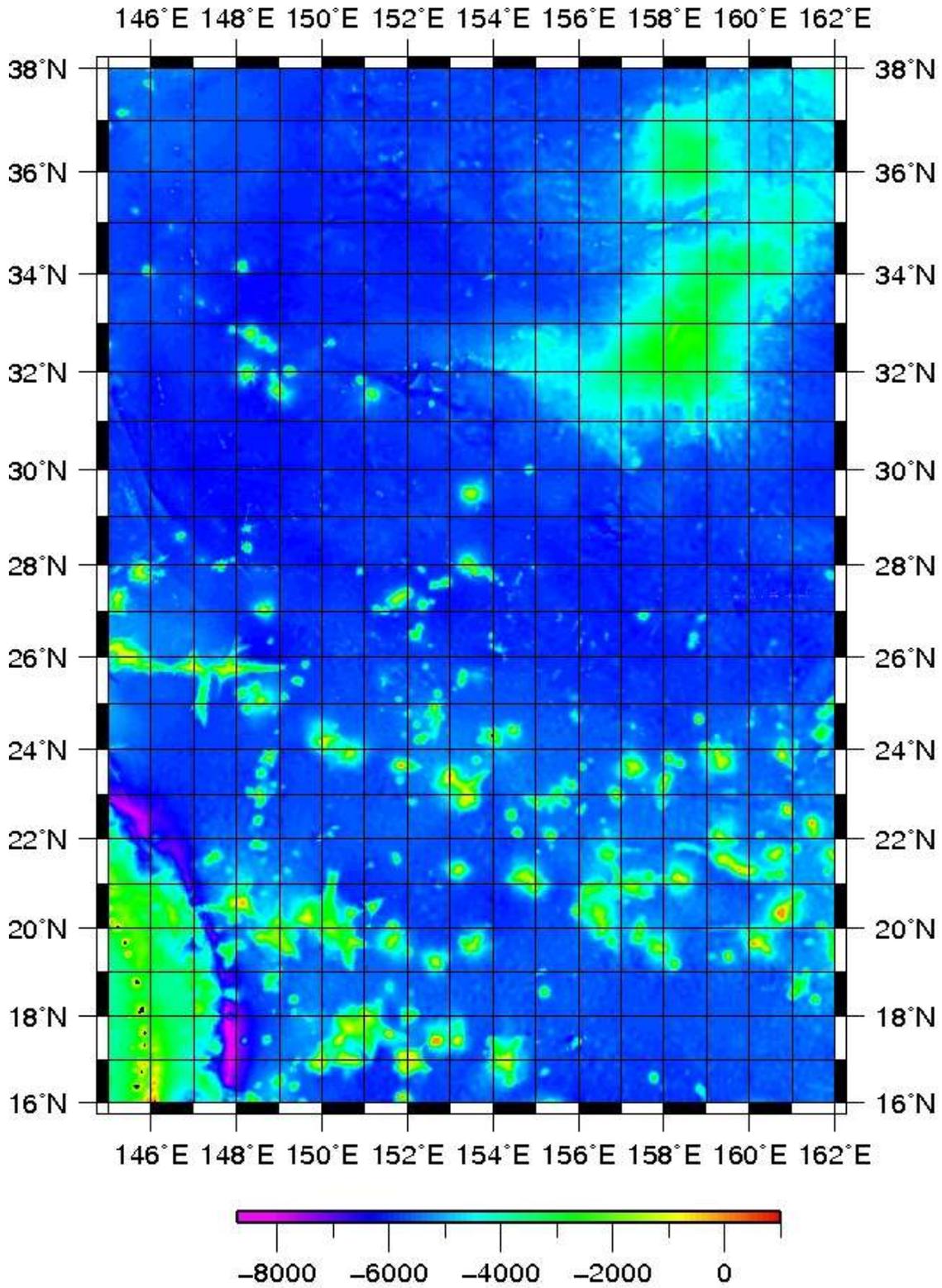


Figure 2 – Cruise Track w/ XBT drops



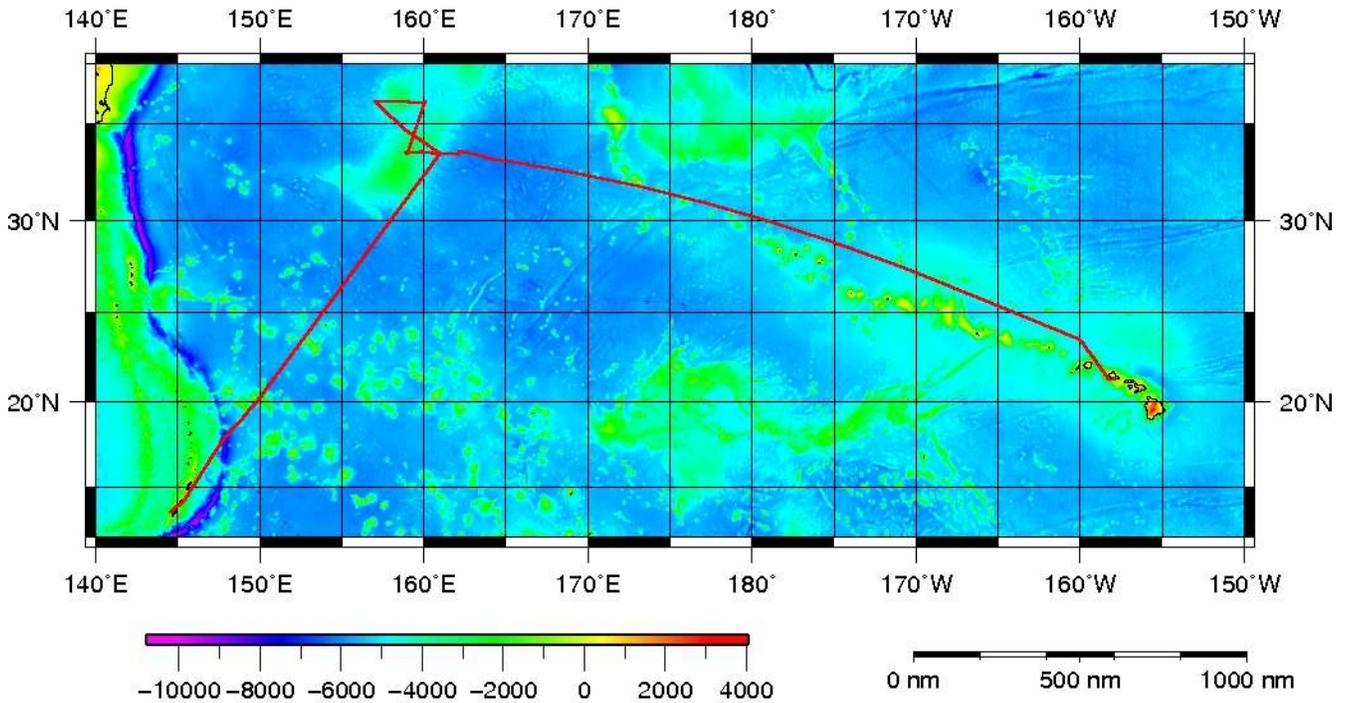
- Trackline
- Shot
- XBT/XCTD Drops

Figure 3 – Northern Marianas/Shatsky Rise bathymetry and topography



MGL1206 – Northern Marianas/Shatsky Rise Bathymetry & Topography

Figure 4 – Northern Marianas/Shatsky Rise/Hawaii bathymetry and topography incl. Track-line



MGL1206 – Northern Marianas/Shatsky Rise/Hawaii Bathymetry & Topography

II. Personnel

Shipboard Technical Staff

1	Robert Steinhaus	Chief Science Officer
2	Megan Meyer	Marine Tech
3	David Ng	Marine Tech
4	Bern McKiernan	Marine Tech
5	Mike Martello	Marine Tech
6	Chris Francis	Chief Sound Source Mechanic
7	Mike Tatro	Sound Source Mechanic
8	Carlos Gutierrez	Sound Source Mechanic
9	Weston Groves	Sound Source Mechanic

Ship's Crew

1	Jim O'Loughlin	Captain
2	Lee Dortzbach	Chief Mate
3	Breckenridge Crum	2 nd Mate
4	West Wilson	3 rd Mate
5	Ricky Redito	Bosun
6	Inocencio Rimando	AB
7	Ben Nadler	AB
8	Glenice James	AB
9	Joshua Schaffner	OS
10	Joselyn White	OS
11	Al Karlyn	Chief Engineer
12	Matt Tucke	1 st Asst. Engineer
13	Michael Romero	2 nd Asst. Engineer
14	Ross Himebauch	3 rd Asst. Engineer
15	Jack Schwartz	Electrician
16	Jack Billings	Oiler
17	Rudy Florendo	Oiler
18	Fernando Uribe	Oiler
19	Hervin Fuller	Steward
20	Leoncio Martires	Cook

MMO

1	Heidi Ingram	PSO
2	Meghan Piercy	PSO
3	Marina Olsen	PSO
4	Tatiana Moreno	PSO
5	Emily Ellis	PSO

Science Party

1	Jun Korenaga	Chief Scientist
2	Tanya Blacic	Scientist
3	Cecilia Cadio	Scientist
4	Adria Melendez Catalan	Scientist
5	William Durkin	Scientist
6	Yanming Huang	Scientist
7	Heidi Reiter	Scientist
8	Theodore Them	Scientist
9	Patrick Young	Scientist
10	Jinchang Zhang	Scientist

III. Instrumentation Summary

All science instruments aboard the Langseth are listed below with data formats in section VII. Summary notes on operation during this cruise are listed below. Seismic equipment is not listed here; refer to Part IV for the seismic summary. Other instruments not listed were not in operation.

Instrument Data Files

Instrument	Description	Data Set	Data Outputs	Files	Interval
FE700	Furuno FE700 Echosounder	N/A	serial logs	MGL-bath01.*	1s
EM122	Kongsberg EM122 Multibeam Sonar	Full	raw output to file	See below	variable
			centerbeam serial logs	MGL-bath02.*	variable
KNUDSEN	Knudsen Engineering 3260 Sub-bottom Profiler	Full	KEA, KEB, SEG-Y	See below	variable
DS50	Furuno DS50 Doppler Speedlog	Full	serial logs	MGL-slog01.*	1s
XBT/XCT	Sippican MK21 XBT/XCTD Launcher	1 per drop	raw output to file	See below	n/a
			converted output to file	See below	n/a
WX1	RM Young 5103 Weather Bird and	Full	serial logs	MGL-wx01.*	1s
			mwv conversion	MGL-mwv01.*	1s
TSG	SeaBird SBE45 Thermosalinograph	Full	raw serial logs	MGL-tsgraw.*	1s
CNAV	C&C Tech. CNAV 2000 DGPS Receiver	Full	serial logs	MGL-cnnav.*	1s
CNAV3050	C&C Tech. CNAV 3050 DGPS Receiver	Full	raw serial logs	MGL-cnnav3050all.*	1s
			converted data	MGL-cnnav3050.*	1s
MAG01	GeoMetrics 882 Magnetometer	On Deploy	serial logs	MGL-mag01.*	1s
BGM	Bell Aerospace BGM-3 Gravimeter	Full	serial logs	MGL-vc01.*	1s
GYRO	Simrad GC80 Gyrocompass/AD100	Full	serial logs	MGL-gy01.*	1s
POSMV	Applanix POSMV Integrated Nav System	Full	serial logs	MGL-posmv.*	1s
SEAPATH	Kongsberg SeaPath Integrated Nav System	Full	serial logs	MGL-seapath.*	1s
STU	Sercel Streamer Tension	Full	serial logs	MGL-stu1.*	15s
MICROSV	Applied Microsystems Sound Velocity Pod Unit #1	Full	serial logs	MGL-svpod01.*	1s
MICROSV	Applied Microsystems Sound Velocity Pod Unit #2	Full	serial logs	MGL-svpod02.*	1s
SBE38	SeaBird SBE38 Pod Thermometer Pod Unit #1	Full	serial logs	MGL-tempod01.*	1s
SBE38	SeaBird SBE38 Pod Thermometer Pod Unit #2	Full	serial logs	MGL-tempod02.*	1s
PCO2	LDEO PCO2 System	Full	serial logs	MGL-pco2.*	~180s

All timestamps in this report are presented using UTC time and day of year in order to avoid confusion with local time changes.

Science Navigation Instrumentation

FE700

Logging interval: 1 second

File id: bath01

The FE700 only operated up to 800m depth. The echosounder is normally switched off before the unit goes out of depth.

Interruptions greater than ten seconds are displayed in the following table.

Log Date	Event	Comment
2012:083:16:38:40.5855	Start	Logging officially started
2012:106:13:39:29.1695 - 2012:106:14:24:10.8810	Missing data	Secured for arrival in Honolulu
2012:106:18:19:48.1481	End	Logging officially ended

bath01 data sample:

bath01	2008:220:13:45:42.0681	\$SDDBT,,,,,,
bath01	2008:220:13:45:42.0690	\$SDDBS,,,,,,
bath01	2008:220:13:45:42.0691	\$SDDPT,,0006.6*49
bath01	2008:220:13:45:42.1482	\$PFEC,Alarm,0,0*6F
bath01	2008:220:13:45:42.1483	\$PFEC,xdr,FORE,050*79

EM-122 Mutibeam

The EM122 multibeam sonar was operated throughout the cruise. The system is designed for deeper water, and does not track ground well in less than 50m of water.

EM122 swath data is saved to the cruise archive under MGL1206/raw/multibeam. Center beam depth is recorded separately to serial log. The MicroSV (svpod01) probe in the pod supplied sound velocity to the EM122.

Logging interval: variable with water depth

File id: bath02

Interruptions greater than one hundred and twenty seconds are displayed in the following table.

Log Date	Event	Comment
2012:083:22:53:54.5366	Start	Logging officially started

2012:084:03:53:15.8880 - 2012:084:04:12:35.5967	Missing data	BIST Test
2012:084:04:12:35.5967 - 2012:084:04:14:56.7748	Missing data	Restarted d/t PU not online
2012:084:22:57:06.9725 - 2012:084:23:05:20.5783	Missing data	BIST Test
2012:085:22:31:35.5205 - 2012:085:22:34:31.4419	Missing data	Restarted d/t Seapath reboot
2012:085:22:52:26.3152 - 2012:085:23:00:16.1639	Missing data	BIST Test
2012:086:22:27:06.3154 - 2012:086:22:35:03.0626	Missing data	BIST Test
2012:087:23:01:53.7154 - 2012:087:23:09:51.8976	Missing data	BIST Test
2012:088:22:10:50.6286 - 2012:088:22:18:35.7923	Missing data	BIST Test
2012:089:21:53:42.8158 - 2012:089:22:02:05.3550	Missing data	BIST Test
2012:090:22:36:38.3517 - 2012:090:22:44:25.3485	Missing data	BIST Test
2012:091:20:58:18.4005 - 2012:091:21:07:52.5757	Missing data	BIST Test
2012:093:00:08:09.4000 - 2012:093:00:16:43.3177	Missing data	BIST Test
2012:094:00:10:20.0753 - 2012:094:00:19:14.5039	Missing data	BIST Test
2012:094:11:00:19.4996 - 2012:094:11:08:32.1743	Missing data	Restart d/t seapath reduced position/velocity
2012:095:00:07:58.8724 - 2012:095:00:15:51.1593	Missing data	BIST Test
2012:095:23:24:26.3464 - 2012:095:23:32:41.1675	Missing data	BIST Test
2012:096:22:38:03.8913 - 2012:096:22:45:37.6936	Missing data	BIST Test
2012:097:16:06:53.2282 - 2012:097:16:15:02.7320	Missing data	BIST Test
2012:098:16:58:50.1787 - 2012:098:17:06:50.9792	Missing data	BIST Test
2012:099:20:06:07.0842 - 2012:099:20:15:00.4918	Missing data	BIST Test
2012:100:21:19:10.4560 - 2012:100:21:26:55.4248	Missing data	BIST Test
2012:101:20:53:25.5982 - 2012:101:21:02:09.6374	Missing data	BIST Test
2012:102:23:16:20.1921 - 2012:102:23:24:34.4092	Missing data	BIST Test
2012:103:19:59:02.0963 - 2012:103:20:09:04.2028	Missing data	Restart to reset transceivers
2012:103:21:22:58.1165 - 2012:103:21:30:44.0954	Missing data	BIST Test
2012:104:19:45:01.1792 - 2012:104:19:52:51.2332	Missing data	BIST Test
2012:105:18:09:59.7020 - 2012:105:18:17:54.4162	Missing data	BIST Test
2012:106:16:53:34.3180	End	Logging officially ended

bath02 data format:

bath02	2008:192:00:00:12.6663	\$KGDPT,2938.25,0.0,12000.0*4a
bath02	2008:192:00:00:30.3301	\$KGDPT,2954.08,0.0,12000.0*4f

bath02	2008:192:00:00:46.5831	\$KGDPT,2958.32,0.0,12000.0*4a
bath02	2008:192:00:01:03.0606	\$KGDPT,2954.18,0.0,12000.0*4e

Knudsen Engineering 3260 Sub-bottom Profiler

File id: n/a

Logging interval: Variable with water depth

The Knudsen 3260 is a chirp echosounder/sub-bottom profiler. It was in operation for the length of the cruise.

There are two sets of segy data recorded/processed this cruise. The segy set in the /raw/knudsen directory are generated by the knudsen software. The segy set in the /processed/knudsen directory are post-processed in the SEG-Y-Rev0 format.

DS50 Speedlog

File id: slog01

Logging interval: 1 second

The Furuno DS-50 is a Doppler speed log. It was in operation for the length of the cruise.

Interruptions greater than ten seconds are displayed in the following table.

Log Date	Event	Comment
2012:083:00:00:01.6390	Start	Logging officially started
2012:106:18:39:15.9038	End	Logging officially ended

slog01 data format:

slog01	2008:231:00:00:00.0744	\$VDVHW,,T,,M,09.68,N,17.93,K*4C
slog01	2008:231:00:00:00.1906	\$VDVBW,009.68,000.09,A,009.68,000.09,V*46
slog01	2008:231:00:00:00.1908	\$VDVLW,0005960.30,N,0005960.30,N*5F

RMYoung Integrated Weather

File id: wx01

Logging interval: 1 second

The weather station is used to log wind speed, direction, air temperature, and barometric pressure. The unit was functioning during the cruise. See also mwv01 below.

Interruptions greater than ten seconds are displayed in the following table.

Log Date	Event	Comment
2012:083:00:00:00.6749	Start	Logging officially started
2012:106:18:39:16.5528	End	Logging officially ended

wx01 data format:

wx01	2011:130:00:00:00.3553	19.0	18.6	19.3	22.5	328	328	2	16.6	17.1	3.7	
	21.1	355	355	0	28.2	31.1	28.0	31.2	96	85	97	1006
wx01	2011:130:00:00:01.2983	18.8	18.6	19.3	22.5	331	328	2	16.2	17.1	3.7	
	21.1	355	355	0	28.2	31.1	28.0	31.2	96	85	97	1006

File id: mwv01

Logging interval: 1 second

The weather station is used to log wind speed, direction, air temperature, and barometric pressure. The wx01 strings are converted in real-time to produce mwv strings for the DP. The mwv output is strictly a derivative of the w01 output. See also the wx01 description above.

Interruptions greater than ten seconds are displayed in the following table.

Log Date	Event	Comment
2012:083:00:00:00.6749	Start	Logging officially started
2012:106:18:39:16.5528	End	Logging officially ended

mwv01 data sample:

mwv01	2008:231:00:00:00.5173	6.1	6.6	6.6	8.8	354	321	5	0.0	0.0	0.0	
	0.0	355	355	0	*****	*****	*****	*****	8	8	8	1009.7
mwv01	2008:231:00:00:01.5172	5.9	6.6	6.6	8.8	353	321	5	0.0	0.0	0.0	
	0.0	355	355	0	*****	*****	*****	*****	8	8	8	1009.6
mwv01	2008:231:00:00:02.5190	6.3	6.6	6.6	8.8	354	321	5	0.0	0.0	0.0	
	0.0	355	355	0	*****	*****	*****	*****	8	8	8	1009.8

CNAV2000

File id: cnav

Logging interval: 1 second

The C-NAV is a global satellite-based differential receiver. This was used as a secondary GPS system on the ship. This system was operational during the cruise.

Interruptions greater than ten seconds are displayed in the following table.

Log Date	Event	Comment
----------	-------	---------

2012:083:00:00:00.0259	Start	Logging officially started
2012:106:18:39:16.0928	End	Logging officially ended

cnav data format:

```
cnav 2008:231:00:00:00.6936
$GPGGA,000000.00,1434.94372,N,10444.85748,W,2,8,1.1,15.52,M,-20.60,M,9,0108*65
cnav 2008:231:00:00:00.7137 $GPVTG,006.5,T,,M,9.64,N,17.85,K*53
```

CNAV3050

File id: cnav3050

Logging interval: 1 second

The C-NAV 3050 is a global satellite-based differential receiver. This is the best individual receiver currently on the ship. This system was operational during the cruise.

Interruptions greater than ten seconds are displayed in the following table.

Log Date	Event	Comment
2012:083:00:00:00.6329	Start	Logging officially started
2012:106:18:39:16.0288	End	Logging officially ended

cnav3050 data format:

```
cnav3050 2011:132:00:00:00.0717
$GNGGA,000000.00,0842.538264,N,08427.839561,W,2,16,0.9,28.395,M,0.0,M,9.0,035
8*48
cnav3050 2011:132:00:00:00.0877 $GNVTG,338.4,T,,M,5.78,N,10.71,K,D*27
```

GC80 Gyrocompass

The GC80 gyrocompass is installed on the bridge and used for ship and seismic navigation.

File id: gy01

Logging interval: 1 second

Interruptions greater than ten seconds are displayed in the following table.

Log Date	Event	Comment
2012:083:00:00:00.0239	Start	Logging officially started
2012:106:18:39:16.7769	End	Logging officially ended

gy01 data format:

```
gy01 2008:231:00:00:00.4110 $PTKM,HEALM,0000,0,G1*09
```

gy01	2008:231:00:00:00.6395	\$HEHDT,005.8,T*22
gy01	2008:231:00:00:00.6396	\$HEROT,-005.25,A*34
gy01	2008:231:00:00:01.6394	\$HEHDT,005.7,T*2D
gy01	2008:231:00:00:01.6395	\$HEROT,-004.53,A*34

POSMV Integrated Nav

The POS/MV is a receiver that uses CNAV input in addition to its own antennae, an inertial sensor and optional RTG, WTC, or WAAS corrections and a Kalman filter to produce a smooth navigation output and very accurate heading.

Note that the PosMV was not operational (on but not outputting any good data) throughout the entire cruise and stopped functioning completely on Julian day 85.

File id: posmv

Logging interval: 1 second

Interruptions greater than ten seconds are displayed in the following table.

Log Date	Event	Comment
2012:083:00:00:00.6979	Start	Logging officially started
2012:084:18:32:11.6757 - 2012:084:18:34:00.5543	Missing data	Instrument failure
2012:085:17:29:45.0239	End	Logging officially ended

posmv data format:

posmv	2008:231:00:00:00.0885	\$INGGA,235959.842,1434.95002,N,10444.85734,W,2,,1.1,12.71,M,,,9.0,0108*2E
posmv	2008:231:00:00:00.0889	\$INHDT,15.0,T*11
posmv	2008:231:00:00:00.2047	\$INVTG,7.0,T,,M,9.7,N,17.9,K*46
posmv	2008:231:00:00:00.3208	\$INGST,235959.842,,0.9,0.9,0.0,0.9,0.9,2.5*51
posmv	2008:231:00:00:00.4411	\$PASHR,235959.842,15.05,T,-0.58,0.48,0.15,0.069,0.069,0.045,2,0*05
posmv	2008:231:00:00:00.4412	\$INZDA,235959.0000,17,08,2008,,*73

SeaPath Integrated Nav

The Kongsberg Seapath is an integrated navigation system. It was in operation for the length of the cruise.

Logging interval: 1 second

File id: seapath

Interruptions greater than ten seconds are displayed in the following table.

Log Date	Event	Comment
2012:083:00:00:00.3939	Start	Logging officially started
2012:085:22:32:00.7151 - 2012:085:22:32:42.7728	Missing data	Restart d/t reduced readings
2012:094:10:59:22.6767 - 2012:094:11:00:07.3386	Missing data	Restart d/t reduced readings
2012:106:18:39:16.9444	End	Logging officially ended

seapath data format:

seapath	2008:231:00:00:00.0504	\$INZDA,235959.99,17,08,2008,,*73
seapath	2008:231:00:00:00.1686	\$INGGA,235959.99,1434.953109,N,10444.859147,W,2,08,1.1,-
		16.30,M,,M,1.0,0291*70
seapath	2008:231:00:00:00.1687	\$INVTG,5.97,T,,M,9.7,N,,K,D*03
seapath	2008:231:00:00:00.1688	\$INHDT,5.82,T*1A

Sercel Streamer Tension Unit

The Sercel Streamer Tension Unit measures streamer tension in pounds. It was in operation while streamers were deployed.

Logging interval: 15 seconds

File id: stu1

Data intermittent interruptions greater than thirty seconds are displayed in the following table.

Log Date	Event	Comment
2012:089:20:03:44.1402	Start	Logging officially started
2012:100:00:08:02.8965 - 2012:100:00:08:42.9692	Missing data	Reason not specified
2012:106:16:53:53.6708	End	Logging officially ended

stu1 data format:

stu1	2011:130:00:02:12.8968	111	129	22	0	49	1	0	3360	3472	-179
33	1	1	3643	3643	-157	31	1	2	3964	3994	-157
34	1	3	3487	3584	-157	32					
stu1	2011:130:00:02:27.8994	111	129	22	1	4	1	0	3375	3487	-164
33	1	1	3643	3793	-157	31	1	2	3950	4002	-164
34	1	3	3509	3606	-179	32					

Geometrics 882 Magnetometer

The Geometrics 882 magnetometer is towed behind the ship. Raw serial output is logged using LDS. Deployment is dependent upon seismic operations. See the deployment notes below. For further information, see the elog files in docs/elog.

Magnetometer Deployment Notes

Time	Event
2012:089:18:55:00.0000	Power up maggie and begin deployment
2012:089:19:04:00.0000	Maggie deployed and in position
2012:090:08:56:00.0000	Maggie stopped communicating and powered off
2012:090:08:58:00.0000	Recovering maggie
2012:090:09:03:00.0000	Maggie onboard
2012:090:09:09:00.0000	Powered maggie on; no comms
2012:090:10:28:00.0000	Maggie powered on; tow lead changed to new one; deploying maggie
2012:090:10:32:00.0000	Maggie in position
2012:091:21:44:00.0000	Begin retrieval
2012:091:21:48:00.0000	Maggie onboard
2012:092:19:22:00.0000	Begining deployment
2012:092:19:25:00.0000	Maggie in position and logging
2012:094:10:47:00.0000	Begin recovering maggie
2012:094:10:50:00.0000	Maggie onboard
2012:094:13:14:00.0000	Begin deploying maggie
2012:094:13:17:00.0000	Maggie in position
2012:095:09:04:00.0000	Power off maggie for retrieval d/t weather
2012:095:09:07:00.0000	Begin recovering maggie
2012:095:09:10:00.0000	Maggie onboard
2012:095:19:35:00.0000	Start deploying maggie
2012:095:19:39:00.0000	Maggie in position
2012:096:12:30:00.0000	Begin recovering maggie
2012:096:12:35:00.0000	Maggie on deck
2012:096:14:50:00.0000	Deploying maggie
2012:096:14:53:00.0000	Maggie in position
2012:097:15:31:00.0000	Begin recovering maggie
2012:097:15:36:00.0000	Maggie onboard

Logging interval: 1 second

File id: mag01

Interruptions greater than ten seconds are displayed in the following table.

Log Date	Event	Comment
2012:089:18:56:36.6669	Start	Logging officially started
2012:090:08:52:14.7671 - 2012:090:08:52:25.4075	Missing data	Tow leader failed
2012:090:08:52:40.6082 - 2012:090:08:53:37.9256	Missing data	Tow leader failed
2012:090:08:53:43.2198 - 2012:090:08:54:19.1183	Missing data	Tow leader failed
2012:090:08:54:26.3787 - 2012:090:08:55:01.2961	Missing data	Tow leader failed
2012:090:08:55:01.2961 - 2012:090:08:55:13.7127	Missing data	Tow leader failed
2012:090:08:55:21.1821 - 2012:090:09:39:40.5166	Missing data	Powered off unit to switch out failed tow leader
2012:090:09:43:14.5077 - 2012:090:10:27:37.5634	Missing data	Powered off unit to switch out failed tow leader
2012:095:09:04:28.3773 – 2012:095:19:32:14.8878	Missing data	Secure for retrieval d/t weather
2012:097:15:42:31.7956	End	Logging officially ended

mag01 data sample:

mag01	2008:185:09:45:58.1820	\$107714.673,0042,0024,0110,3533,1143
mag01	2008:185:09:46:01.0333	\$ 63703.933,0042,0024,0110,3533,1143
mag01	2008:185:09:46:04.0330	\$ 44031.029,0042,0027,0110,3533,1143

SBE-45 Thermosalinograph

The Seabird TSG output is logged by LDS to the “tsg” set.

File id: tsgraw

Logging interval: 1 second

Data intermittent interruptions greater than ten seconds are displayed in the following table.

Log Date	Event	Comment
2012:084:01:19:27.7541	Start	Logging officially started

2012:088:08:59:50.2200 - 2012:088:12:32:46.4645	Missing data	USS pump failure
2012:106:15:53:14.5345	End	Logging officially ended

tsgraw data sample:

tsgraw	2012:050:05:59:11.0312	27.3455,	5.52201,	34.7764
tsgraw	2012:050:05:59:21.0406	27.3435,	5.52175,	34.7760
tsgraw	2012:050:05:59:31.0341	27.3304,	5.52027,	34.7753

BGM-3 Gravimeter

The Bell Aerospace BGM-3 Gravimeter operated normally during the length of this cruise.

File id: vc01

Logging interval: 1 second

Interruptions greater than ten seconds are displayed in the following table.

Log Date	Event	Comment
2012:083:00:00:00.9419	Start	Logging officially started
2012:106:18:39:16.8808	End	Logging officially ended

vc01 data format:

vc01	2011:130:00:00:08.2866	01:024436	00
vc01	2011:130:00:00:09.2926	01:024548	00

Applied Microsystems MicroSV Pod Unit #1

The Applied Microsystems MicroSV probe #1 in the pod was functional and logging during the length of the cruise.

File id: svpod01

Logging interval: 1 second

Interruptions greater than ten seconds are displayed in the following table.

Log Date	Event	Comment
2012:083:00:00:00.3469	Start	Logging officially started
2012:106:18:39:17.1709	End	Logging officially ended

svpod01 data format:

svpod01	2011:130:00:00:08.6626	1540.52
svpod01	2011:130:00:00:09.6527	1540.53

Applied Microsystems MicroSV Pod Unit #2

The Applied Microsystems MicroSV probe #2 in the pod was functional and logging during the length of the cruise.

File id: svpod02

Logging interval: 1 second

Interruptions greater than ten seconds are displayed in the following table.

Log Date	Event	Comment
2012:083:00:00:00.4629	Start	Logging officially started
2012:106:18:39:17.3029	End	Logging officially ended

svpod02 data format:

svpod02	2011:130:00:00:08.0686	1541.87
svpod02	2011:130:00:00:09.0746	1541.88

Seabird SBE38 Temperature Probe Pod Unit #1

The Seabird SBE38 temperature probe #1 in the pod was functional and logging during the length of the cruise.

File id: temppod01

Logging interval: 1 second

Interruptions greater than ten seconds are displayed in the following table.

Log Date	Event	Comment
2012:083:00:00:00.2439	Start	Logging officially started
2012:106:18:39:17.1129	End	Logging officially ended

temppod01 data format:

temppod01	2011:130:00:00:07.0855	29.4851
temppod01	2011:130:00:00:07.9476	29.4850

Seabird SBE38 Temperature Probe Pod Unit #2

The Seabird SBE38 temperature probe #2 in the pod was functional and logging during the length of the cruise.

File id: temppod02

Logging interval: 1 second

Interruptions greater than ten seconds are displayed in the following table.

Log Date	Event	Comment
2012:083:00:00:00.8179	Start	Logging officially started
2012:106:18:39:16.8119	End	Logging officially ended

temppod02 data format:

temppod02	2011:130:00:00:07.2015	29.4884
temppod02	2011:130:00:00:08.0786	29.4883

LDEO PCO2 System

The LDEO PCO2 system output is logged by LDS to the “pco2” set.

See below for more information.

File id: pco2

Logging interval: ~180 seconds

Interruptions greater than three hundred seconds are displayed in the following table.

Log Date	Event	Comment
2012:088:02:20:50.6694	Start	Logging officially started
2012:088:02:20:50.6694 - 2012:088:02:27:35.9564	Missing data	Reason not specified
2012:088:09:02:13.0141 - 2012:088:12:40:24.2720	Missing data	USS pump failure
2012:091:08:16:47.6809 - 2012:091:08:30:51.6197	Missing data	No serial data output
2012:091:08:30:51.6197 - 2012:091:08:37:34.4209	Missing data	Restart instrument's laptop
2012:106:15:51:08.0021	End	Logging officially ended

pco2 data format:

pco2	2011:130:00:27:11.9162	2011130.02002	2370.39	37.54	1007.07
	404.51	28.42	386.9	5000.00	19
Equil					0

pco2	2011:130:00:30:00.5374	2011130.02198	2370.02	37.53	1007.14	
	404.42	28.46	386.8	5000.00	19	0
Equil						

Mk21 XBT System

Files: *.RDF,*.EDF

Nineteen XBT drops (9x T-5 and 10x T-7) were made during this cruise. The data set is saved to the raw/XBT directory in the cruise archive. Refer to the MGL1206_Expendable_Drops.xls spreadsheet in the docs/operations directory of the cruise archive for more information.

IV. Seismic Summary

A. Acquisition Parameter Table

Acquisition Parameter Table	
AcquisitionParameterID	MGL1206_ACQ01
FieldActivityID	MGL1206
ReceiverType	Sentry Solid Streamer
SourceType	Airgun
Acquisition System Name	Sercel Syntrak 960
Acquisition System Type	MCS
Seismic_Nav_System	C-Nav 3050 primary
Survey_datum	WGS84
Navigation Reference Point	Fore/Aft+29.5 m, Stb/pt +0.00 m, vertical +16.9 m Keel, centerline, ~frame 42 (Seapath 200 calculated center of gravity) waterline
NRP to source	232.00 m
Source_to_Near_Channel	152.70 m
Number_of_channels_recorded	468
Number_of_cables	1
Number_of_channels_each_cable	468
Channel_length	12.5 m
Cable_length	6.0 km
Cable_spacing	N/A
Near_Channel_Number	N/A
Cable_depth	9.0 m
Number_sources	1
Sub-arrays_per_source	4
Alternate_Shooting	No
Source_separation	N/A
Sub-array_separation	8.0 m
Source_volume	6600 cu in
Source_pressure	2000 psi nominal
Source_make,model	Bolt 1500LL & 1900LL
Source_number	36 + 4 spare
Source_depth	9.0 m
Shot_control	Distance
Shot_Interval	50 m
Sample_interval	2ms
Record_length	16s
Compass_birds	22 Digicourse 5011
Recording_delay	N/A

Acquisition Parameter Table	
AcquisitionParameterID	MGL1206_ACQ02
FieldActivityID	MGL1206

ReceiverType	Sentry Solid Streamer
SourceType	Airgun
Acquisition System Name	Sercel Syntrak 960
Acquisition System Type	MCS
Seismic_Nav_System	C-Nav 3050 primary
Survey_datum	WGS84
Navigation Reference Point	Fore/Aft+29.5 m, Stb/pt +0.00 m, vertical +16.9 m Keel, centerline, ~frame 42 (Seapath 200 calculated center of gravity) waterline
NRP to source	232.00 m
Source_to_Near_Channel	152.70 m
Number_of_channels_recorded	468
Number_of_cables	1
Number_of_channels_each_cable	468
Channel_length	12.5 m
Cable_length	6.0 km
Cable_spacing	N/A
Near_Channel_Number	N/A
Cable_depth	12.0 m
Number_sources	1
Sub-arrays_per_source	4
Alternate_Shooting	No
Source_separation	N/A
Sub-array_separation	8.0 m
Source_volume	6600 cu in
Source_pressure	2000 psi nominal
Source_make,model	Bolt 1500LL & 1900LL
Source_number	36 + 4 spare
Source_depth	9.0 m
Shot_control	Distance
Shot_Interval	50 m
Sample_interval	2ms
Record_length	16s
Compass_birds	22 Digicourse 5011
Recording_delay	N/A

See the “MGL1206 Seismic Configuration by Sequence Acquired.xls” file in the MGL1206/docs/offsets directory for more information.

B. Seismic Overview

Physical Configuration

The towing configuration for the air guns and streamers is detailed in the document titled *MGL1206_Offsets.xls*.

Offsets

All antenna and in-water offset drawings are in the file *MGL1206_Offsets.xls*

Spectra

Spectra was used for all timing and navigation during the cruise. Shotlogs were generated from spectra header logs, P190 and P294 files using shotlog processing code contained on the archive in /supplemental/code/shotlog.

V. RV Langseth Gravity Tie Information

The Gravimeter was tied before and after the cruise at the tie point located at the pier in Kodiak.

Date / Time	Ship Location	Reference Location	Mistie
2012-03-184T02:26	Apar Harbor, Guam, Pierside Guam Naval Base Sierra Pier 13 25.9127 N 144 39.6346 E	Apar Harbor, Guam, Pierside Guam Naval Base Sierra Pier 500 marker 13 26.076 N 144 39.145 E	Apar Harbor, Guam, Pierside Guam Naval Base Sierra Pier 13 25.907 N 144 39.660 E
2012-04-15T19:32	Honolulu, HI, UH Marine Center 21 18.9737 N 157 53.1742 W	Honolulu, HI, UH Marine Center UH Marine Center Pierside Tiepoint 21 18.962 N 157 53.180 W	Honolulu, HI, UH Marine Center 21 18.972 N 157 53.181 W

Please refer to the documents located under [MGL1206/docs/gravity_tie](#) for detailed records.

VI. Archive Contents

Key files are bolded.

MGL1206/docs	Cruise documents and logs
MGL1206/docs/config	Configuration archive
MGL1206/docs/elog	Cruise elog
MGL1206/docs/gravity_tie	Gravity Tie information
MGL1206/docs/map	Cruise maps, track map
MGL1206/docs/offsets	Vessel/sensor offsets
MGL1206/docs/operations/	Operations documents
MGL1206/docs/operations/Daily_Reports	Cruise Daily Reports from Chief Science Officer
MGL1206/docs/operations/NavLogs	Seismic navigation logs (spectra)
MGL1206/docs/operations/ObsLogs	Seismic acquisition logs (gun controller)
MGL1206/docs/operations/MGL1206_B15_line_log_multi_channel_seismics.xls	Master line log table
MGL1206/docs/permits	Clearance Documents
MGL1206/docs/waypoints	Waypoint files
MGL1206/docs/personnel	Personnel rosters, org chart, bunk and phone lists
MGL1206/docs/reports	Cruise Report and supplemental docs
MGL1206/docs/reports/MGL1206_DataReport_v1.0.doc	This file
MGL1206/docs/offsets/MGL1206_Offsets.xls	Vessel/sensor offsets
MGL1206/docs/screencaps	Screen captures
MGL1206/processed	Processed data
MGL1206/processed/reflex (3D data-sets only, not applicable to OBS and 2D)	Spectra reflex files
MGL1206/processed/shotlogs	Shot log files
MGL1206/processed/sprint	Sprint files
MGL1206/processed/svp	Sound velocity profiles
MGL1206/raw	Raw data
MGL1206/raw/adcp	Raw ADCP data
MGL1206/raw/knudsen	Raw Knudsen sub-bottom profiler data
MGL1206/raw/multibeam	Raw EM122 data
MGL1206/raw/serial	Underway serial data: gps, tsg, weather, etc.
MGL1206/raw/spectra/P1	Spectra p190
MGL1206/raw/spectra/P2	Spectra p294
MGL1206/raw/XBT	Raw XBT data

VII. Data Formats

Gravimeter data

The gravimeter serial data is output in the following format:

01:025610 01

01:xxxxxx ff

Item	Definition	Units
01	output frequency	Hz
xxxxxx	raw counts	n/a
ff	sensor status	n/a

CNAV GPS receiver data

CNAV outputs data in NMEA 0183 compatible format. Currently* the following sentence types are enabled:

- \$GPVTG-GPS Velocity, Track made good and Ground speed data (computed by the CNAV GPS receiver).
- \$GPGGA-Global Positioning System Fix data (computed by the CNAV GPS receiver).

*Note: there are other sentence types available from CNAV. Please consult the software manual for more options.

\$GPVTG, xxx.x, T,, M, m.mm, N, n.nn, K*hh

\$GPVTG Sentence Fields

Item	Definition	Units
xxx.x	Course over ground (COG)	Degrees from True North
T	Indicates course relative to True North	n/a
M	COG	Degrees from Magnetic North
m.mm	Speed over ground (SOG)	Nautical miles per hour (knots)
N	Indicates that the speed over ground is in knots	n/a
n.nn	SOG	km/h
K	Indicates that the SOG is in km/h	n/a
*hh	Checksum (hexadecimal representation)	n/a

\$GPGGA,hhmmss.ss, ddmm.mmmmm, a, ddmm.mmmmm, a, x, xx, x.x, xx.xx, M, xx.xx, M, x.x, xyy*hh

\$GPGGA Sentence Fields

Item	Definition	Units
hhmmss.ss	UTC time of position	Hours/Minutes/Seconds
ddmm.mmmmm	Latitude	Degrees/Minutes/Seconds
a	Direction of Latitude N = North S = South	n/a
ddmm.mmmmm	Longitude	Degrees/Minutes/Seconds
a	Direction of Longitude E = East W = West	n/a
x	GPS Quality indicator 0 = fix not valid 1 = GPS Autonomous fix 2 = GcGPS Corrected Fix	n/a
xx	Number of GPS satellites used in solution fix	n/a
x.x	Horizontal Dilution of Precision (HDOP)	n/a
xx.xx	C-NAV GPS receiver antenna altitude reference to Mean Sea Level (MSL)	n/a
M	Altitude units--M indicates meters	n/a
xx.xx	WGS-84 Geoidal separation distance from MSL based on the NIMA/NASA EGM96 15-minute (Earth Gravity Model)	Meters

M	Geosoidal separation units--M indicates meters	n/a
x.x	Age of GcGPS corrections used in solution fix	n/a
xyy	C-NAV GPS receiver reference identification	x is downlink satellite beam in use yy is the GPS correction mode/type being used
*hh	Checksum (hexadecimal representation) followed by CRLF terminator pair	n/a

CNAV 3050 GPS receiver data

CNAV 3050 outputs data in NMEA 0183 compatible format. Currently* the following sentence types are enabled:

- \$GPVTG-GPS Velocity, Track made good and Ground speed data (computed by the CNAV GPS receiver).
- \$GPGGA-Global Positioning System Fix data (computed by the CNAV GPS receiver).

*Note: there are other sentence types available from CNAV. Please consult the software manual for more options.

\$GPVTG, xxx.x, T,, M, m.mm, N, n.nn, K*hh

\$GPVTG Sentence Fields

Item	Definition	Units
xxx.x	Course over ground (COG)	Degrees from True North
T	Indicates course relative to True North	n/a
M	COG	Degrees from Magnetic North
m.mm	Speed over ground (SOG)	Nautical miles per hour (knots)
N	Indicates that the speed over ground is in knots	n/a
n.nn	SOG	km/h
K	Indicates that the SOG is in km/h	n/a
*hh	Checksum (hexadecimal representation)	n/a

\$GPGGA,hhmmss.ss, ddm. mmmmm, a, ddm. mmmmm, a, x, xx, x.x, xx.xx, M, xx.xx, M, x.x, xyy*hh

\$GPGGA Sentence Fields

Item	Definition	Units
hhmmss.ss	UTC time of position	Hours/Minutes/Seconds
ddmm.mmmmm	Latitude	Degrees/Minutes/Seconds
a	Direction of Latitude N = North S = South	n/a
ddmm.mmmmm	Longitude	Degrees/Minutes/Seconds
a	Direction of Longitude E = East W = West	n/a
x	GPS Quality indicator 0 = fix not valid 1 = GPS Autonomous fix 2 = GeGPS Corrected Fix	n/a
xx	Number of GPS satellites used in solution fix	n/a
x.x	Horizontal Dilution of Precision (HDOP)	n/a
xx.xx	C-NAV GPS receiver antenna altitude reference to Mean Sea Level (MSL)	n/a
M	Altitude units--M indicates meters	n/a
xx.xx	WGS-84 Geoidal separation distance from MSL based on the NIMA/NASA	Meters

	EGM96 15-minute (Earth Gravity Model)	
M	Geosoidal separation units--M indicates meters	n/a
x.x	Age of GcGPS corrections used in solution fix	n/a
xyy	C-NAV GPS receiver reference identification	x is downlink satellite beam in use yy is the GPS correction mode/type being used
*hh	Checksum (hexadecimal representation) followed by CRLF terminator pair	n/a

EM122 Center Beam Depth

This page describes the EM122 centerbeam depth serial output, used for real-time depth display. For full multibeam data, please see the [multibeam](#) page.

The EM122 outputs serial data in the following formats:

- KIDPT - Depth below transducer

SKIDBT,x.x,x.x,x.x,*hh

SDDBT sentence format

Item	Definition	Units
x.x	Water depth	feet
x.x	Water depth	meters
x.x	Water depth	fathoms
*hh	Checksum	n/a

FE700 Navigational Echosounder data

The FE700 Navigational Echosounder outputs data in the following formats

- \$PFEC - unspecified
- \$SDDBT - Depth Below Transducer
- \$SDDBS - Depth Below Surface

\$PFEC ,aaaa,x,x*hF

PFEC sentence format

Item	Definition	Units
aaaa	unspecified	unspecified
x	unspecified	unspecified
x	unspecified	unspecified
*hF	unspecified	unspecified

\$DBT,x.x,f,x.x,M,x.x,F*hh

SDDBT sentence format

Item	Definition	Units
x.x	Water depth	feet
f	f = feet	n/a
x.x	Water depth	meters
M	M = meters	n/a
x.x	Water depth	fathoms
F	F = fathoms	n/a
*hh	Checksum	n/a

\$DBS,x.x,f,x.x,M,x.x,F*hh

SDDBS sentence format

Item	Definition	Units
x.x	Water depth	feet
f	f = feet	n/a
x.x	Water depth	meters
M	M = meters	n/a
x.x	Water depth	fathoms
F	F = fathoms	n/a
*hh	Checksum	n/a

Gyroscope data

The gyroscope serial data is output in the following sentence formats:

- PTKM,HEALM -- Unspecified
- HEHDT -- Heading - True
- HEROT -- Rate Of Turn

\$PCICM,HEALM,xxxx,x,xx*hh

ALM sentence format

Item	Definition	Units
xxxx	unspecified	n/a
x	unspecified	n/a
*hh	unspecified	n/a

\$HEHDT,xxx.x,T*hh

HDT sentence format

Item	Definition	Units
xxx.x	Heading true	degrees
T	T = true	n/a
*hh	Checksum	n/a

\$HEROT,-xxx.x,A*hh

HEROT sentence format

Item	Definition	Units
xxxx.x	Rate of turn	Degrees per minute, Note: "-" means bow turns to port
A	A = data valid	n/a
*hh	Checksum	n/a

Geometrics 882 Magnetometer Data

The magnetometer serial data is output in the following format:

\$ 53863.927,0652

\$ xxxxx.xxx,vvvv

Item	Definition	Units
xxxxx.xxx	Magnetic field intensity	nT
vvvv	Reserved for future use	n/a

RM Young Meteorological Station Data

The meteorological data from the RMYoung integrated weather station is output in the following sentence format:

12.6 13.2 12.6 16.9 1 335 2 0.0 0.0 0.0 0.0 355 355 0 -11.9 -23.8 ***** 7.3 8 4 9 1006.9
 aaa.a bbb.b ccc.c dd.d eee fff ggg hhh.h iii.i jjj.j kkk.k lll mmm nnn -oo.o -pp.p -qq.q -rr.r ss tt uu vvvv.v

Langseth WX station sentence format

Item	Definition	Units
aaa.a	bird 1 speed, instantaneous	knots
bbb.b	bird 1 speed, 60 second average	knots
ccc.c	bird 1 speed, 60 minute average	knots
ddd.d	bird 1 speed, 60 second peak	knots
eee	bird 1 direction, instantaneous	knots
fff	bird 1 direction, 60 second average	knots
ggg	bird 1 direction, 60 minute average	knots
hhh.h	bird 2 speed, instantaneous	knots
iii.i	bird 2 speed, 60 second average	knots
jjj.j	bird 2 speed, 60 minute average	knots
kkk.k	bird 2 speed, 60 second peak	knots
lll	bird 2 direction, instantaneous	knots
mmm	bird 2 direction, 60 second average	knots
nnn	bird 2 direction, 60 minute average	knots
ooo.o	temperature, instantaneous	Degrees C
ppp.p	temperature, 60 minute average	Degrees C
qqq.q	temperature, 60 minute low	Degrees C
rrr.r	temperature, 60 minute high	Degrees C
ss	relative humidity, instantaneous	%
tt	relative humidity, 60 minute low	%
uu	relative humidity, 60 minute high	%
vvvv.v	Baromoeter, instantaneous	knots

OBSIP Shotlog Format

Each OBSIP shotlog contains a header followed by shot records:

```
#obsipshotfile v1.0
#shotnumber date time sourceLat sourceLon shipLat shipLon waterDepth sciTag
0001280 2009-08-27 05:08:49.807873 48.495334 -129.201444 48.494097 -129.203017 2530.6 MGL0910_05
0001279 2009-08-27 05:12:33.961869 48.491860 -129.204474 48.490060 -129.205425 2526.4 MGL0910_05
0001278 2009-08-27 05:16:36.302883 48.488608 -129.206115 48.486807 -129.206944 2530.3 MGL0910_05
0001277 2009-08-27 05:19:51.053880 48.485157 -129.209212 48.483406 -129.209755 2526.1 MGL0910_05
0001276 2009-08-27 05:24:01.863875 48.480813 -129.212088 48.479293 -129.213152 2516.1 MGL0910_05
```

Shot records are in the following format:

```
0001276 2009-08-27 05:24:01.863875 48.480813 -129.212088 48.479293 -129.213152 2516.1 MGL0910_05
sssssss yyyy-mm-dd hh:mm:ss.ssssss xx.xxxxxx yy.yyyyyy vv.vvvvvv ww.wwwwww dddd.d llllllllllll
```

OBSIP record format

Item	Definition	Units
sssssss	shot number	n/a
yyyy-mm-dd	date	ISO8601 format
hh:mm:ss.ssssss	time	ISO8601 format
xx.xxxxxx	source lat	degrees, WGS84
yy.yyyyyy	source lon	degrees, WGS84
vv.vvvvvv	vessel lat	degrees, WGS84
ww.wwwwww	vessel lon	degrees, WGS84
ddd.d	depth	meters
llllllllllll	linename	n/a

LDEO PCO2 System

PCO2 outputs data in the following sentence format:

yyyyjjj.jjj aaaa.aa bb.bb cccc.cc ddd.dd e.ee fff.f gggg.gg hh i k

PCO2 Data

Item	Definition	Value	Unit
yyyyjjj.jjj	pco2 Computer Date/Time	n/a	Year/Julian Day.dec Four fixed digits of year Three fixed digits of month Five fixed digits for julian day.
aaaa.aa	CO2 Raw Signal	n/a	mVolts
bb.bb	CO2 Analyzer Cell Temperature	n/a	Celcius
cccc.cc	PCO2 Barometer	n/a	mbar
ddd.dd	VCO2	n/a	ppm
e.ee	Equilibrator Water Temp	n/a	Celcius
fff.f	pCO2	n/a	uatm
gggg.gg	Flow Controller	n/a	mVolts
hh	Flow Meter	n/a	cc/min
i	Sample ID #	0 to 16	integer
k	Sample ID	Equil, Atmos, Nitrogen, CC18798, CA07163, CC15551, or CC63668	alphanumeric

LDEO PCO2 + CNav + TSG + WX01 + SBE38 Systems

PCO2 merge is a combination of outputs of various serial data in the following sentence format:

yyyyjjj.jjj aaaa.aa bb.bb cccc.cc ddd.dd e.ee fff.f gggg.gg hh i k, llll.lllllm, nnnnn.nnnnnno, pppp.pp, q.qq, r.rr, s.ss, tt.tt, uu.u, vvv, w.w, xxx.x, y.yy, zzz.z, @@.@@@@

PCO2 Data

Item	Definition	Value	
yyyyjjj.jjj	pco2 Computer Date/Time	n/a	Year/Julian Day. Four fixed digits Three fixed digits Five fixed digits a julian day.
aaaa.aa	CO2 Raw Signal	n/a	mVolts
bb.bb	CO2 Analyzer Cell Temperature	n/a	Celcius
cccc.cc	PCO2 Barometer	n/a	mbar
ddd.dd	VCO2	n/a	ppm
e.ee	Equilibrator Water Temp	n/a	Celcius
fff.f	pCO2	n/a	uatm
gggg.gg	Flow Controller	n/a	mVolts
hh	Flow Meter	n/a	cc/min
i	Sample ID #	0 to 16	integer
k	Sample ID	Equil, Atmos, Nitrogen, CC18798, CA07163, CC15551, or CC63668	alphanumeric
llll.lllllm	CNav Latitude	0 to 90, N/S	degrees/minutes
nnnnn.nnnnnno	CNav Longitude	0 to 180, E/W	degrees/minutes
pppp.pp	TSG Speed of Sound	n/a	m/s
q.qq	TSG Internal Temperature	n/a	Celcius
r.rr	TSG External Temperature	n/a	Celcius
s.ss	TSG Conductivity	n/a	S/m
tt.tt	TSG Salinity	25 to 40	ppm
uu.u	WX01 Bird 1 Wind Speed 60 sec avg	n/a	knots
vvv	WX01 Bird 1 Wind Direction 60 sec avg	0 to 360	degrees
w.w	WX01 Temperature Instantaneous	n/a	Celcius
xxx.x	WX01 Ship Barometer Instantaneous	n/a	mbar
y.yy	CNav Speed Over Ground / Speed Made Good	0 to 15	knots
zzz.z	CNav Course Made Good	0 to 360	degrees
@@.@@@@	SBE38 Temperature Probe	n/a	Celcius

POS/MV Position and Orientation System for Marine Vessels

POS/MV outputs data using the NMEA 0183 format at rates of up to fifty sentences per second. The following seven different sentence formats are available.

- 1. \$INGGA-Global System Position Fix Data
- 2. \$INHDT-Heading - True data
- 3. \$INVTG-Course over ground and Ground speed data
- 4. \$INGST-GPS pseudorange noise statistics
- 6. \$PRDID-Attitude data
- 7. \$INZDA-Time and date

\$INGGA, hmmmss.sss, llll.llll, a, yyyyy.yyyyy, b, t, nn, v.v, x.x, M,,c.c,rrrr*hh

\$INGGA-Global System Position Fix Data

Item	Definition	Value	Units
\$INGGA	Header	\$INGGA	Hours/Minutes/Seconds.decimal. Two fixed digits of hours.
hmmmss.sss	UTC time of position	n/a	Two fixed digits of minutes. Two fixed digits of seconds. Three digits for decimal fractions of a second.
llll.llll	Latitude	-90 to +90	Degrees Minutes.decimal. Two fixed digits of degrees Two fixed digits of minutes Five digits for decimal minutes.
a	N (north) or S (south)	N or S	Degrees/Minutes.decimal. Three fixed digits of degrees. Two fixed digits of minutes. Five digits for decimal minutes.
yyyyy.yyyyy	Longitude	-180 to +180	Degrees/Minutes.decimal. Three fixed digits of degrees. Two fixed digits of minutes. Five digits for decimal minutes.
b	E (east) or W (west)	E or W 0 = Fix not available or invalid 1 = CIA standard GPS; fix valid. 2 = DGS mode; fix valid. 3 = PPP mode; fix valid. 4 = RTK fixed 5 = RTK float 6 = free inertial	
t	GPS Quality Indicator		
nn	Number of satellites used in fix	0 to 32	
v.v	Horizontal dilution of precision		
x.x	Altitude of the IMU above or below the mean sea level. A negative value	n/a	Metres

	indicates below sea level.		
M	Units of measure = metres		M
Null	Null		
Null	Null		
c.c	Age of differential corrections in records since last RTCM-104 message.	0 to 99.9	Seconds
rrr	DGPS reference station identity	0000 to 1023	
*hh	Checksum	00 - FF	
/CR/LF	Carriage return and line feed	/CR/LF	

Note that, in the case of the HDOP, IMU altitude and age of differential connections, POS/MV adds leading digits as required (i.e. if the value exceeds 9.9). Also, note that commas separate all items, including null fields. The information is valid at the location of the vessel frame.

\$INHDT, x.x, T*hh

\$INHDT-Heading - True data

Item	Definition	Value	Units
\$INHDT	Header	\$INHDT	
x.x	True vessel heading in the vessel frame	0 to 359.99	degrees
*hh	Checksum	n/a	
/CR/LF	Carriage return and line feed	/CR/LF	

\$INVTG, x.x, T,, M, n.n, N, k.k, K*hh

\$INVTG-Course over ground and Ground speed data

Item	Definition	Value	Units
%INVTG	Header	\$INVTG	
x.x	True vessel track in the vessel frame	0 to 359.99	degrees
T	True	T	
null	Not supported	null	
M		M	
n.n	Speed in the vessel frame	n/a	Knots
N	Knots	N	
k.k	Kilometres	K	
*hh	Checksum	n/a	
/CR/LF	Carriage return and line feed	/CR/LF	

Note that, in the case of the track and the speed fields, POS/MV adds the leading digits as required (i.e. if the value exceeds 9.9). Also, note that commas separate all items in the including null fields.

\$INGST, hhmmss,sss,,smjr.smjr,smnr.smnr, o.o, l.l, y.y, a.a *hh

\$INGST-GPS pseudorange noise statistics

Item	Definition	Value	Units
\$INGST	Header	\$INGST	
hhmmss.sss	UTC time of position	n/a	Hours/Minutes/Seconds.decimal.

			2 fixed digits of hours. 2 fixed digits of minutes. 2 fixed digits of seconds. Three digits for decimal fractions of a second.
null	Not supported	null	
smjr.smjr	Standard Deviation of semi-major axis of error ellipse	n/a	Metres
smnr.smnr	Standard deviation of semi-minor axis of error ellipse	n/a	Metres
o.o	Orientaion of semi-major axis ellipse	0 to 359.9	Degrees from true north
l.l	Standard deviation of latitude	n/a	Metres
y.y	Standard deviation of longitude	n/a	Metres
a.a	Standard deviation of Altitude	n/a	Metres
*hh	Checksum	n/a	
/CR/LF	Carriage return and line feed	/CR/LF	

Note that, in the case of all fields POS/MV adds leading digits as required (i.e. if the value exceeds 9.9). Also, note that commas separate all items, including null fields. The information is valid at the location of the vessel frame.

Note that commas separate all items

Two attitude data strings are available. The strings are identical except for the definition of roll and pitch angles. One string uses Tate-Bryant angles and the

other uses TSS angles. Use the POS/MV Controller program to set the required angle convention.

\$PRDID, PPP.PP, RRR.RR, xxx.xx*hh

\$PRDID-Attitude data

Item	Definition	Value	Units
\$PRDID	Header	\$PRDID	
PPP.PP	Pitch	-90.00 to +90.00	Degrees
RRR.RR	Roll	-90.00 to +90.00	Degrees
xxx.xx	Sensor heading	0 to 359.99	Degrees
*hh	Checksum	n/a	
/CR/LF	Carriage return and line feed	/CR/LF	

Note that commas separate all items

Two attitude data strings are available. The strings are identical except for the definition of roll and pitch angles. One string uses Tate-Bryant angles and the

other uses TSS angles. Use the POS/MV Controller program to set the required angle convention.

\$INZDA, hhmmss.ss, DD, MM, YYYY,, *hh

\$INZDA-Time and date

Item	Definition	Value	Units
\$INZDA	Header	\$INZDA	

hhmmss.sss	UTC time	n/a	Hours/Minutes/Seconds.decimal. 2 fixed digits of hours 2 fixed digits of minutes 2 fixed digits of seconds Three digits for decimal fractions of a second
DD	Day of month	01 to 31	
MM	Month of year	01 to 12	
YYYY	Year		
Null	Null		
Null	Null		
*hh	Checksum	n/a	/CR/LF

RM Young Rain Gauge & Eppley PSP data

RM Young Rain Gauge & Eppley PSP data is formatted in the following sentences:

x.xxxxxx,y.y

Sentence field

Instrument	Item	definition	units
Eppley PSP	x.xxxxxx	voltage	mV
RM Young Rain Gauge	y.y	amount of rain	mm

Seabird Thermosalinograph, Converted

Data from the Seabird TSG is output in the following format:

2008:199:02:23:43.0914 AE9FC8F927F34AA7DAC1 1527.40 27.94 23.47 5.17 31.90

yyyy:ddd:hh:mm:ss.ssss tttccccxxxxxvvvvv aaaa.aa bb.bb cc.cc d.dd ee.ee

Item	Definition	Units
yyyy	LDS Timestamp	year
ddd	LDS Timestamp	day of year
hh	LDS Timestamp	hour
mm	LDS Timestamp	minute
ss.ssss	LDS Timestamp	second
ttt	Raw internal temperature sensor data	n/a
cccc	Raw conductivity sensor data	n/a
xxxxxx	Raw external temperature sensor data	n/a
aaaa.aa	Speed of sound	m/s
bb.bb	Internal temperature	Degrees C
cc.cc	External temperature	Degrees C
d.dd	Conductivity	S/m
ee.ee	Salinity	ppm

Seabird SBE-45 Thermosalinograph Data

Data from the SBE-45 TSG is output in the following format:

2012:050:06:02:01.0294 27.2958, 5.51684, 34.7768

yyyy:ddd:hh:mm:ss.ssss tttt, cccc, xxxx

Item	Definition	Units
yyyy	year	n/a
ddd	day of year	n/a
hh	hours	n/a
mm	minutes	n/a
ss.ssss	seconds	n/a
tttt	Raw internal temperature sensor data	n/a
cccc	Raw conductivity sensor data	n/a
xxxx	Raw salinity sensor data	n/a

SEAPATH 200 Inertial Navigation System

SEAPATH outputs data in NMEA format using the following sentence formats:

- 1. \$INGGA-Global System Position Fix Data
- 2. \$INHDT-Heading - True data
- 3. \$INVTG-Course over ground and Ground speed data
- 4. \$INZDA-Time and date

\$INGGA, hhhmss.sss, llll.llll, a, yyyyy.yyyyy, b, t, nn, v.v, x.x, M,,c.c,rrrr*hh

\$INGGA-Global System Position Fix Data

Item	Definition	Value	Units
\$INGGA	Header	\$INGGA	
hhmmss.sss	UTC time of position	n/a	Hours/Minutes/Seconds.decimal. Two fixed digits of hours. Two fixed digits of minutes. Two fixed digits of seconds. Three digits for decimal fractions of a second.
llll.llll	Latitude	-90 to +90	Degrees Minutes.decimal. Two fixed digits of degrees Two fixed digits of minutes Five digits for decimal minutes.
a	N (north) or S (south)	N or S	
yyyyy.yyyyy	Longitude	-180 to +180	Degrees/Minutes.decimal. Three fixed digits of degrees. Two fixed digits of minutes. Five digits for decimal minutes.
b	E (east) or W (west)	E or W	
t	GPS Quality Indicator	0 = Fix not available or invalid 1 = CIA standard GPS; fix valid. 2 = DGS mode; fix valid. 3 = PPP mode; fix valid. 4 = RTK fixed 5 = RTK float 6 = free inertial	
nn	Number of satellites used in fix	0 to 32	
v.v	Horizontal dilution of precision		
x.x	Altitude of the IMU above or below the mean sea level. A negative value indicates below sea level.	n/a	Metres
M	Units of measure = metres	M	
Null	Null		
Null	Null		
c.c	Age of differential corrections in records since last RTCM-104 message.	0 to 99.9	Seconds

rrr	DGPS reference station identity	0000 to 1023	
*hh	Checksum		
/CR/LF	Carriage return and line feed	/CR/LF	

\$INHDT, x.x, T*hh

\$INHDT-Heading - True data

Item	Definition	Value	Units
\$INHDT	Header	\$INHDT	
x.x	True vessel heading in the vessel frame	0 to 359.99	degrees
*hh	Checksum	n/a	
/CR/LF	Carriage return and line feed	/CR/LF	

\$INVTG, x.x, T,, M, n.n, N, k.k, K*hh

\$INVTG-Course over ground and Ground speed data

Item	Definition	Value	Units
\$INVTG	Header	\$INVTG	
x.x	True vessel track in the vessel frame	0 to 359.99	degrees
T	True	T	
null	Not supported	null	
M		M	
n.n	Speed in the vessel frame	n/a	Knots
N	Knots	N	
k.k	Kilometres	K	
*hh	Checksum	n/a	
/CR/LF	Carriage return and line feed	/CR/LF	

\$INZDA, hhmmss.ss, DD, MM, YYYY,, *hh

\$INZDA-Time and date

Item	Definition	Value	Units
\$INZDA	Header	\$INZDA	
hhmmss.sss	UTC time	n/a	Hours/Minutes/Seconds.decimal. 2 fixed digits of hours 2 fixed digits of minutes 2 fixed digits of seconds Three digits for decimal fractions of a second
DD	Day of month	01 to 31	
MM	Month of year	01 to 12	
YYYY	Year		
Null	Null		
Null	Null		
*hh	Checksum	n/a	

/CR/LF | Carriage return and line feed | /CR/LF

Langseth Shotlog Format

Each Langseth shotlog contains shot records in the following format:

MGL1204MCS01 00924 2011:159:15:28:10.8208 152810.8208670 4059.5 565908.12N 1464326.41N
 565906.79N 1464338.85N
 ||||| sssss yyyy:mm:dd:hh:mm:ss.ssss hhmmss.ssssss dddd.d vv.vvvvvv www.wwwwww xx.xxxxxx yyy.yyyyyy

Langseth shotlog format

Item	Definition	Units
	linename	n/a
ssssss	shot number	n/a
yyyy:mm:dd:hh:mm:ss.ssss	date/time	ISO8601 format
hhmmss.ssssss	time	hh = hour mm = minutes ss = seconds .ssssss = decimal seconds
ddd.d	depth	meters
vv.vvvvvv	vessel lat	degrees, WGS84
www.wwwwww	vessel lon	degrees, WGS84
xx.xxxxxx	source lat	degrees, WGS84
yyy.yyyyyy	source lon	degrees, WGS84

Speed log data

Speed log data is formatted in the following sentences:

- VHW - Water speed and heading
- VBW - Dual Ground/Water Speed

\$VHW,x.x,T,x.x,M,x.x,N,x.x,K*hh

VHW sentence fields

Item	definition	units
x.x	degrees true	?
T	T=true	n/a
x.x	degrees Magnetic	?
M	M = Magnetic	n/a
x.x	Speed of vessel relative to water	Knots/hour
N	N = Nots	n/a
x.x	Speed of vessel relative to water	Km/hour
K	K = Kilometers	n/a
*hh	Checksum	n/a

\$VBW,x.x,x.x,A,x.x,x.x,A*hh

VBW sentence fields

Item	Definition	Units
x.x	Longitudinal water speed, "-" means astern	?
x.x	Transverse water speed, "-" means port	?
A	A = Data Valid	n/a
x.x	Longitudinal ground speed, "-" means astern	?
x.x	Transverse ground speed, "-" means port	?
A	A = data valid, V = data invalid	n/a
*hh	Checksum	n/a

Streamer Tension Unit Data

STU outputs data in the following sentence format:

**aaa bbb cc dd ee f g hhhh iiiii jjjj kkkk l m nnnn oooo pppp qqqq r s tttt uuuu
vvvv wwww x y zzzz !!!! @@@@ #####**

STU Data

Item	Definition	Value	Units
aaa	na	n/a	n/a
bbb	Julian Day	1 to 366	day
cc	Hour	0 to 24	integer
dd	Minutes	0 to 60	integer
ee	Seconds	0 to 60	integer
f	# 1 ID	1	integer
g	# 1 Channel #	0	integer
hhhh	# 1 Peak Tension	n/a	lbs
iiii	# 1 Average Tension	n/a	lbs
jjjj	# 1 Delta Tension	n/a	n/a
kkkk	# 1 Temperature	n/a	Celcius
l	# 2 ID	1	integer
m	# 2 Channel #	1	integer
nnnn	# 2 Peak Tension	n/a	lbs
oooo	# 2 Average Tension	n/a	lbs
pppp	# 2 Delta Tension	n/a	n/a
qqqq	# 2 Temperature	n/a	Celcius
r	# 3 ID	1	integer
s	# 3 Channel #	2	integer
tttt	# 3 Peak Tension	n/a	lbs
uuuu	# 3 Average Tension	n/a	lbs
vvvv	# 3 Delta Tension	n/a	n/a
wwww	# 3 Temperature	n/a	Celcius
x	# 4 ID	1	integer
y	# 4 Channel #	3	integer
zzzz	# 4 Peak Tension	n/a	lbs
!!!!	# 4 Average Tension	n/a	lbs
@@@@	# 4 Delta Tension	n/a	n/a
#####	# 4 Temperature	n/a	Celcius

Applied Microsystems Sound Velocity Probe Data

The sound velocity probe serial data is output in the following format:

1479.35

xxxx.xx

Item	Definition	Units
xxxx.xx	Sound Velocity	m/s

Seabird SBE38 Thermometer Probe Data

The sound velocity probe serial data is output in the following format:

8.2221

xx.xxxx

Item	Definition	Units
xx.xxxx	Temperature	Celcius

Spectrum TM-4 time and frequency system data

The TM-4 is used as an event logger to log shot times from digishot. The 'tagger' data set includes all output from the TM-4. The 'shot' data set includes only the event messages (message #62)

Spectra provides primary shot timing aboard Langseth. The TM-4 is used for qc and backup purposes.

Message descriptions

Message #	Type	Form	Explanation
50	ACKNOWLEDGE	CRLF	
51	DATE AND TIME	MMDDYYYY,HHMMSSCRLF	MMDDYYYY is UTC month, day, and year HHMMSS is UTC hours, minutes and seconds
52	POSITION	WWW.WW,X,YYYY.YY,Z,A,NCRLF	W = latitude in DDMM.MM X = hemisphere N or S Y = longitude in DDDMM.MM Z = hemisphere E or W A = GPS availability (0 = not available, 1 = available) N = number of satellites used (0-9, A[10], B[11], C[12])
53	ALTITUDE	SXXXXX,MCRLF	S = sign (+ or -) X = altitude (5 digits) M = altitude units (meters)
55	MASK ANGLE AND MAP DATUM SETTING	X,47CRLF	X = 0 for 5 degrees X = 1 for 15 degrees X = 2 for 20 degrees 47 = two digit map datum code (fixed at WGS84)
56	USER TIME BIAS	SXXXXXCRLF	S = sign (+ or -) X = bias value (5 digits)
57	TIMING MODE	XCRLF	X = 0 for Dynamic Timing Mode X = 1 for Static Timing Mode X = 3 for Auto Survey Mode
59	GEOMETRIC QUALITY AND ALMANAC STATUS	X,YCRLF	X = GQ (0-9) Y = 0 (Almanac OK) Y = 1 (no Almanac) Y = 2 (Almanac is old)
60	TIME PORT DATA RATE AND MULTIPLEXER #1 STATUS	X,YCRLF	X = 0 (1200 baud) Y = 0 for 10 MHz output X = 1 (2400 baud) Y = 1 for 5 MHz output X = 2 (4800 baud) Y = 2 for 1 MHz output X = 3 (9600 baud) Y = 3 for 100 kHz output X = 4 (19200 baud) Y = 4 for 10 kHz output X = 5 (38400 baud) Y = 5 for 1 kHz output X = 6 (57600 baud) Y = 6 for IRIG output (if installed) X = 7 (115200 baud) Y = 7 for PPS output Y = 8 for OFF (newer TM-4's only)

61	TIMING STATUS	W,CRLF	W = 0 (time not valid) W = 1 (Time Valid)
62	EVENT TIME-TAG	MMDDYYYY,HHMMSS.SSS SSSSCRLF	MMDDYYYY = UTC date of event HHMMSS.SSSSSSS = UTC time of event
63	POP/ETT STATUS	X,P,MMDDYYYY,HHMMSS. SSSSSSS,RRRRRRRRCRLF	X = 0 for ETT/POP OFF X = 1 for POP One-Shot X = 2 for POP Repeat X = 3 for ETT P = + for positive polarity P = - for negative polarity P = 0 when POP/ETT Mode is OFF MMDDYYYY is the POP date (UTC) HHMMSS.SSSSSSS is the POP time (UTC) RRRRRRRR is the POP repeat interval
64	OSCILLATOR TUNING MODE	XCRLF	X = 1 for Mode 1 (oscillator warm-up) X = 2 for Mode 2 (course adjust) X = 3 for Mode 3 (course adjust standby) X = 4 for Mode 4 (fine adjust) X = 5 for Mode 5 (fine adjust hold) Note: See OSCILLATOR MODES on page 11 of the Spectrum manual for an explanation of these Oscillator Tuning Modes.
65	ALARM STATUS	X,Y,ZCRLF	X = 0 for No Coast condition X = 1 for Coast Alarm condition See Message #79 for Coast Timer. Y = 0 for Antenna Good Y = 1 for Antenna Current Sense Fault condition Z = 0 for 10 MHz Frequency Output Good Z = 1 for 10 MHz Frequency Output Fault condition See HARDWARE FAULT MONITORING on page 14 of Spectrum manual for an explanation of Antenna Alarm.
68	MULTIPLEXER #2 STATUS	XCRLF	X = 0 for 10 MHz output X = 1 for Mux1 mirror X = 2 for PPS X = 3 for output option 1 X = 4 for output option 2 X = 5 for output option 3 X = 6 for baseband IRIG (if installed) X = 7 for baseband NASA-36 (if installed) X = 8 for OFF (newer TM-4's only)
69	TRACKING CHANNEL STATUS	VV,W,X,Y,.... VV,W,X,Y,ZCRLF	VV = PRN of satellite being tracked W = constellation status: 0 = not included in current constellation 1 = included in current constellation X = tracking status:

			<p>A = acquisition/reacquisition S = searching 0-9 = SQ Y = Ephemeris status: 0 = not collected 1 = collected Z = receiver status: 2 = search the sky 3 = Almanac collect 4 = Ephemeris collect 5 = acquisition 6 = position NOTE: VV,W,X,Y repeats twelve times, corresponding to each of the twelve channels.</p>
70	SERIAL TIME MESSAGE FORMAT	XCRLF	<p>X = 0 for standard output X = 1 for NTP output (optional) X = 2 for NMEA output</p>
71	SERIAL TIME CODE FORMAT	XCRLF	<p>X = 0 for IRIG B output X = 1 for NASA-36 output</p>
72	ETT PARAMETERS	X,PCRLF	<p>X = 0 (ETT off) X = 1 (ETT on)</p>
74	POP PARAMETERS (Simultaneous ETT/POP units)	X,P,MMDDYYYY,HHMMSS.SSSSSSS,RRRRRRRR,WCRRLF	<p>X = 0 for POP Off X = 1 for POP One-Shot X = 2 for POP Repeat P = + for positive polarity P = - for negative polarity MMDDYYYY is the POP date (UTC) HHMMSS.SSSSSSS is the POP time (UTC) RRRRRRRR is the POP repeat interval in milliseconds W = 0 for 1 μs pulse width W = 1 for 10 μs pulse width W = 2 for 100 μs pulse width W = 3 for 1 ms pulse width W = 4 for 10 ms pulse width W = 5 for 50 ms pulse width W = 6 for 100 ms pulse width W = 7 for 250 ms pulse width W = 8 for Level Hold</p>
75	SPEED OVER LAND and HEADING	SSS.SS,HHH.HCRLF	<p>SSS.SS indicates speed over land in meters/sec HHH.H indicates course in degrees decimal</p>
76	ADDITIONAL NMEA INFORMATION	DDMM.MMMM,N,DDDMM.MMMM,W,SAAAAA.A,M,G,UU,PP.P,ZZZ.ZZ,YYY.YCRLF	<p>DDMM.MMMM is latitude in degrees and decimal minutes N is north or south (N, S) DDDMM.MMMM is longitude in degrees and decimal minutes W is west or east (W, E)</p>

			<p>S is sign of altitude above or below sea level (+,-) AAAAA.A is altitude (in meters) (0-18000) M is altitude units (meters) G is GPS status (0= fix not valid, 1= fix valid) UU is number of satellites used in navigation solution (0-12) PP.P is estimated horizontal dilution of precision (0-99.9) ZZZ.ZZ is speed over ground in knots YYY.Y is course over ground in degrees</p>
77	PHASE LOCK STATUS	X,CRLF	.
78	ADDITIONAL USER OPTION SETTINGS	A,B,C,D,E,FCRLF	<p>A = 0 for Antenna Alarm Disabled A = 1 for Antenna Alarm Enabled (default) B = 0 for PPS Source 0 (See Message #24 for definitions) B = 1 for PPS Source 1 B = 2 for PPS Source 2 B = 3 for PPS Source 3 Fields C-F are reserved.</p>
79	COAT TIMER	HHHHMMSSCRLF	HHHHMMSS = Amount of time (Hours, Minutes, Seconds) that the unit has been in Coast (Mode 3 or Mode 5)
80	PHASE LOCK STATUS	X, CRLF	.
81	LEAP SECONDS?GPS TIME	X,Y,Â±ZZCRLF	<p>X = 0 for TM-4 operation in GPS Time (reserved for future feature, currently disabled) X = 1 for TM-4 operation in UTC Time (default) Y = 0 for Leap Second data not valid Y = 1 for Leap Second data valid Â±ZZ = UTC/GPS Time Offset, in whole seconds The difference between UTC Time and GPS Time is the number of Leap Seconds that have been introduced to UTC Time since the beginning of GPS Time. (GPS Time is never adjusted for Leap Seconds.) The Â±UTC OffsetÂ± from GPS Time is in the information data stream broadcast by the GPS satellites. The TM-4 stores the previously known value, but until the TM-4 makes contact with satellites and downloads the current "UTC Offset", the data cannot be considered to be valid.</p>

RM Young Meteorological Station Data

The meteorological data from the RMYoung integrated weather station is output in the following sentence format:

12.6 13.2 12.6 16.9 1 335 2 0.0 0.0 0.0 0.0 355 355 0 -11.9 -23.8 ***** 7.3 8 4 9 1006.9
 aaa.a bbb.b ccc.c dd.d eee fff ggg hhh.h iii.i jjj.j kkk.k lll mmm nnn -oo.o -pp.p -qq.q -rr.r ss tt uu vvvv.v

Langseth WX station sentence format

Item	Definition	Units
aaa.a	bird 1 speed, instantaneous	knots
bbb.b	bird 1 speed, 60 second average	knots
ccc.c	bird 1 speed, 60 minute average	knots
ddd.d	bird 1 speed, 60 second peak	knots
eee	bird 1 direction, instantaneous	knots
fff	bird 1 direction, 60 second average	knots
ggg	bird 1 direction, 60 minute average	knots
hhh.h	bird 2 speed, instantaneous	knots
iii.i	bird 2 speed, 60 second average	knots
jjj.j	bird 2 speed, 60 minute average	knots
kkk.k	bird 2 speed, 60 second peak	knots
lll	bird 2 direction, instantaneous	knots
mmm	bird 2 direction, 60 second average	knots
nnn	bird 2 direction, 60 minute average	knots
ooo.o	temperature, instantaneous	Degrees C
ppp.p	temperature, 60 minute average	Degrees C
qqq.q	temperature, 60 minute low	Degrees C
rrr.r	temperature, 60 minute high	Degrees C
ss	relative humidity, instantaneous	%
tt	relative humidity, 60 minute low	%
uu	relative humidity, 60 minute high	%
vvvv.v	Baromoeter, instantaneous	knots