RV Langseth
Data Reduction Summary

MGL1407
Brooklyn, NY to Norfolk, VA

July 1 2014 08:00:00L

Date	Julian Date	Time	Port
2014-08-20	2014-232	1400 UTC, 0800L	Brooklyn, NY
2014-09-14	2014-257	1400 UTC, 0800L	Norfolk, VA

Prepared by:
David Martinson
Science Officer
dmartins@ldeo.columbia.edu

Table of Contents

I. Background and Scientific Objectives (taken from the Science Support Plan)
Cruise Overview
MGL1407 is a 2D multichannel seismic reflection survey in the Atlantic Ocean off the continental margin of North America between latitudes 31^oN to 40° N. The research aims to collect seismic data for two primary purposes: (a) to measure sediment thickness that will contribute to delineating the outer limits of the Extended Continental Shelf (ECS) beyond 200 nautical miles (nm); and (b) to image two entire landslide systems from near the continental slope to the runout on the lower continental rise and abyssal plain. This mission is part of the USGS ECS and Hazards programs. The proposed survey area is shown in Figure 1.4. The principal investigators (PIs) and science party objectives will drive this program on the *R/V Langseth* with the coordination and advisement of the technical staff headed by the Office of Marine Operations (OMO) at Lamont Doherty Earth Observatory (LDEO).

The proposed 2D acquisition survey requests 4 string source arrays, one 8 km streamer deployed running lines equaling ~ 3165 km. The survey program will be dynamic and varying dependent on the seabed conditions, weather conditions, and maximizing the science objectives. Total track lines for 2014 are ~3165 km (from the EA).

Other supporting equipment shall consist of a Kongsberg EM122 Multibeam Echosounder, Knudsen 3260 3.5 kHz Sub-bottom Profiler, Bell Aerospace BGM-3gravimeter, Sonobuoys, XBTs, the RDI 75 kHz Acoustic Doppler Current Profiler (ADCP), and the Geometrics 882 magnetometers. LDEO will ensure that the equipment in use meets the manufacturer's specifications, and also meets internal quality requirements. The technicians onboard are proficient in the operations of standard systems, but are not experts. If the investigation requires expertise in any of the acquisition, including data processing, the science party will provide appropriate staff and expertise (e.g., a data processor with the proper equipment to complete the science objectives, including software). Other science studies will be ongoing, per scientist request and shipboard specifications.

In addition to the operations of the air-sound-source array, a Multi-beam echosounder (MBES) and a Sub-Bottom Profiler (SBP) will also be operated from the Langseth continuously throughout the survey. All planned geophysical data acquisition activities would be conducted by LDEO with on-board assistance by the scientists who have proposed the study. The vessel would be self-contained, and the crew would live aboard the vessel for the entire cruise.

The principal investigator (PI) is Deborah Hutchinson (United States Geological Survey). She will be onboard for the survey operations, as well as 11other scientists/students (total of 12 scientists), 9 LDEO/contract technicians and 5 Protected Species Observers (PSOs), as well as 9student participants (including Team Leader) from Columbia University.

The cruise is expected to take 25 days to complete (inclusive of mob/demob days), currently scheduled for 14 August – 7 September 2014. The ship is scheduled to sail on 16 August out of Newark, NJ. Scientists will be permitted onboard the day before sailing. At the end of the cruise, the scientists must disembark the day after the ship arrives in port. Norfolk, Virginia is the planned port of call location, with an anticipated arrival date of 5 September.

Cruise Objectives
The primary objectives, i.e., those to achieve the purposes of the cruise, are to collect (a) multichannel seismic data; (b) multibeam echo-soundings; (c) marine magnetics; and (d) marine gravity. Secondary

objectives, i.e. the scientific measurements that are being collected on a non-interference basis, are (f) seismic oceanography (including xbt launches, to image water column masses); and (g) sonobuoy refraction measurements (for sediments, basement, crust, and upper mantle velocities; also including xbt launches for water column velocity to be used in offset calibration).

For recording marine seismic reflection data, we will use the full air-sound source of the R/V Marcus Langseth (4 air-sounds strings with a capacity of approximately 6,600 cubic inches) and an 8-km-long streamer. Both the air-sounds and streamer will be towed at approximately 9 m depth. Shot spacing is planned every 50 m on a grid of 2-D multichannel seismic reflection lines with a total length of ~3165 km. Some of the seismic lines will be dip lines from the continental shelf to the abyssal plain, while other seismic lines are oriented parallel to the coast.

Ports –

Brooklyn, NY

Norfolk, VA

Trackline and Bathymetry –

MGL1407
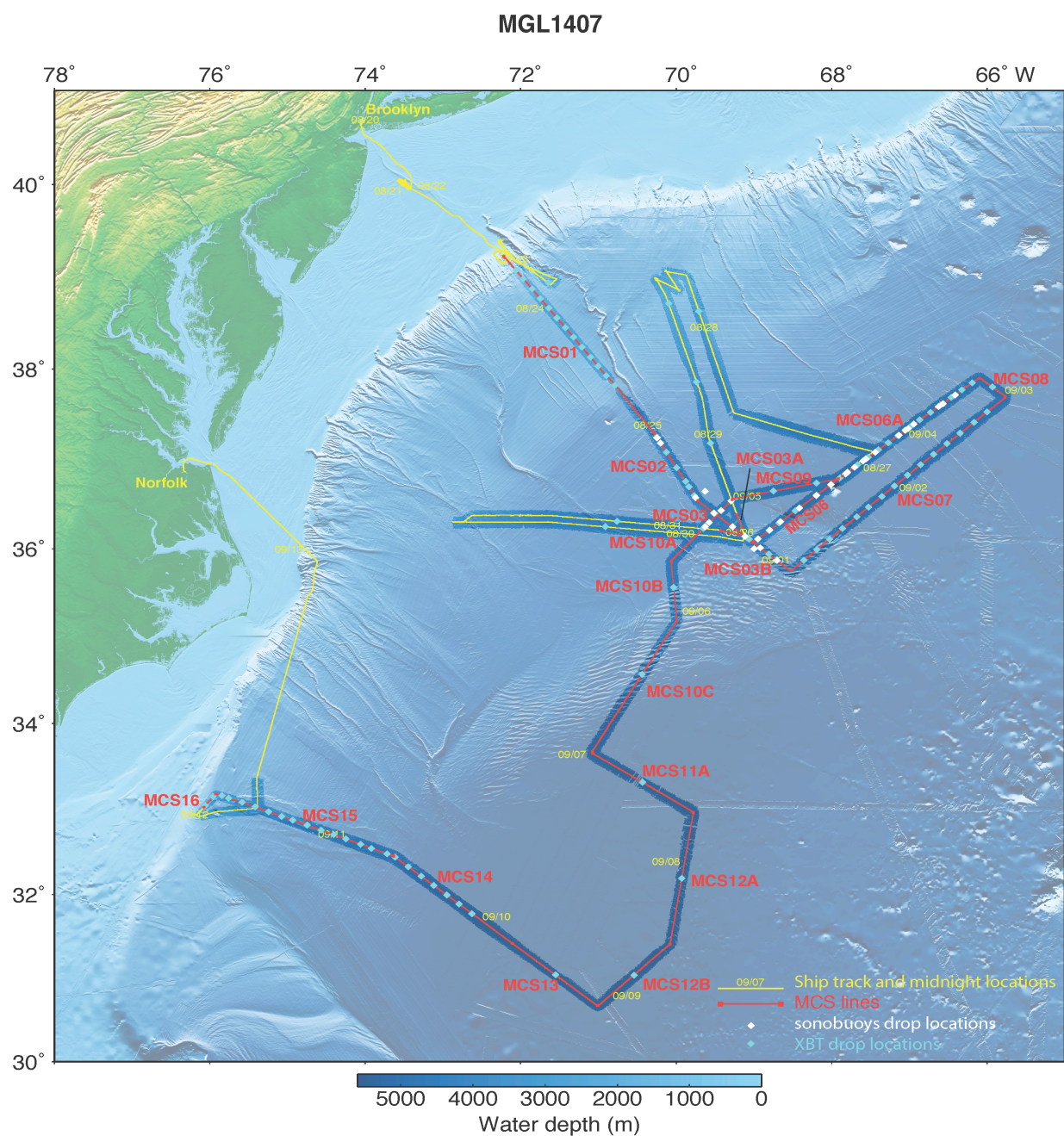
II. Personnel

Shipboard Technical Staff

1	David Martinson	Chief Science Officer
2	Michael Martello	Navigation
3	Alan Thompson	Navigation
4	Bobby Koprowski	Acquisition
5	Klayton Curtis	Acquisition
6	Carlos Gutierrez	Chief Sound Source Mechanic
7	Josh Kasinger	Sound Source Mechanic
8	Chad Rich	Sound Source Mechanic
9	Angela Slagle	Science Tech

Ship's Crew

1	Mark Landow	Captain
2	David Wolford	Chief Mate
3	Breckenridge Crum	2nd Mate
4	David Partikian	3rd Mate
5	Ricardo Redito	Bosun
6	Petronio Paragas	AB
7	George Cereno	AB
8	Marcus Nadler	AB
9	Anthony Orias	OS
10	Jocelyn White	Utility
11	Matthew Tucke	Chief Engineer
12	Michael Romero	1st Asst. Engineer
13	Ryan Smith	2nd Asst. Engineer
14	Joshua Visel	3rd Asst. Engineer
15	Jack Schwartz	Electrician
16	Guillermo Uribe	Oiler
17	Stephanie Pittman	Oiler
18	Rodolfo Florendo	Oiler
19	Saundra Leonard	Steward

20	Ricardo Rios	Cook

MMO

1	Heidi Ingram	PSO
2	Laurie Dugan	PSO
3	Cassandra Frey	PSO
4	Leslie Curran	PSO
5	Laura Marcella	PSO

Science Party

1	Deborah Hutchinson	Chief Scientist	USGS
2	Nathan Miller	Co-chief Scientist	USGS
3	Thomas O'Brien	Scientist	USGS
4	Wayne Baldwin	Scientist	USGS
5	Brian Meyer	Scientist	USGS
6	Matthew Arsenault	Scientist	USGS
7	David Foster	Scientist	USGS
8	Eric Moore	Scientist	USGS
9	Brian Van Pay	Scientist	US State Department
10	Will Fortin	Scientist	U of Wyoming

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	Not used	serial logs	MGL-bath01.*	1s
EM122	Kongsberg EM122 Multibeam Sonar	Full	Center beam data	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/XCTD	Sippican MK21 XBT/XCTD Launcher	100 drops	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-	1s
CNAV	C&C Tech. CNAV 2000 DGPS Receiver	Full	serial logs	MGL-cnav.*	1s
CNAV3050	C&C Tech. CNAV 3050 DGPS Receiver	Full	raw serial logs	MGL-cnav3050all.*	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	POSMV Integrated Nav	Full	serial logs	MGL-posmv*	ls
SEAPATH	Kongsberg SeaPath Integrated Nav System	Full	serial logs	MGL-seapath.*	1s
STU	Syntrak Streamer Tension	Full	Serial logs	MGL-stu1*	15s

MICROSV	Applied Microsystems Sound Velocity USS Unit	Full	serial logs	MGL-svuss01.*	1s
SBE38	SeaBird SBE38 USS Thermometer USS Unit #1	Not used	serial logs	MGL-temppod01.*	1s
ADCP	RDI Current Profiler	Not used	serial logs	N/A	N/A
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 - Not in use on MGL1407

The FE700 was not in use on MGL1407.

EM-122 Multibeam

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 MGL1407/raw/multibeam. Center beam depth is recorded separately to serial log. A daily built in self test (BIST) is done on the EM122 at which time logging of data is secured (see table below for date and time of data gaps), usually about 8-15 minutes.

File id: bath02
Logging interval: variable with water depth

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

Log Date		Event	Comment
2014:232:22:05:05.7358		start of data set	
2014:256:05:16:38.9736		end of data set	

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
```

Knudsen Engineering 3260 Sub-bottom Profiler

The Knudsen 3260 is a chirp echosounder/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. Data written in proprietary KEB, KEA, and SEGY format.

DS50 Speedlog

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

File id: slog01
Logging interval: 1 second

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

Log Date		Event	Comment
2014:232:00:00:01.4702		start of data set	
2014:256:00:00:00.7592		end of data set	

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

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.

File id: wx01
Logging interval: 1 second

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

Log Date		Event	Comment
2014:232:00:00:00.9244		start of data set	
2014:256:23:59:59.9570		end of data set	

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

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

Log Date		Event	Comment
2014:232:00:00:00.9244		start of data set	
2014:256:23:59:59.9570		end of data set	

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.

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

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.

File id: cnav
Logging interval: 1 second

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

Log Date		Event	Comment
2014:232:00:00:00.1482		start of data set	
2014:256:00:00:00.9010		end of data set	

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

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.

File id: cnav3050
Logging interval: 1 second

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

Log Date		Event	Comment
2014:232:00:00:01.5204		start of data set	
2014:256:00:00:00.1150		end of data set	

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 three hundred and one seconds are displayed in the following table.

Log Date		Event	Comment
2014:232:00:00:00.3144		start of data set	
2014:256:00:00:00.9070		end of data set	

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.

File id: posmv
Logging interval: 1 second

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

Log Date		Event	Comment
2014:232:00:00:00.4964		start of data set	
2014:256:00:00:00.9630		end of data set	

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 inertial navigation system. Operational for the duration of the cruise.

File id: seapath
Logging interval: 1 second

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

Log Date		Event	Comment
2014:232:00:00:00.6344		start of data set	
2014:256:00:00:00.3890		end of data set	

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.

Logging interval: 15 seconds

File id: stu1

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

Log Date		Event	Comment
2014:233:12:32:11.5124		start of data set	
2014:238:12:32:21.5012	2014:242:22:42:43.5766	gap	96 hours
2014:255:03:13:29.4946		end of data set	

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. Data collected only when Magnetometer is deployed. See the deployment/retrieval data gaps in the table below. For further information, see the elog files in docs/elog.

Logging interval: 1 second

File id: mag01
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. Output is also converted in real-time and recorded to the "tsgconv" data set.

File id: tsgraw
Logging interval: 1 second

Data intermittent interruptions greater than three hundred and one seconds are displayed in the following table.

Log Date		Event	Comment
2014:232:23:00:45.7950		start of data set	
2014:256:05:11:28.9590		end of data set	

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 three hundred and one seconds are displayed in the following table.

Log Date		Event	Comment
2014:232:00:00:00.0622		start of data set	
2014:256:23:59:59.7270		end of data set	

vc01 data format:
```
vc01  2011:130:00:00:08.2866  01:024436 00

vc01  2011:130:00:00:09.2926  01:024548 00
```

Seabird SBE38 Temperature Probe USS Unit #1 – Not in use on MGL1407

The Seabird SBE38 temperature probe USS Unit #1 was NOT functional during the length of the cruise.

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 **threehundred and one seconds** are displayed in the following table.*

Log Date		Event	Comment
2014:232:21:01:00.9502		start of data set	
2014:256:05:09:39.7138		end of data set	

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              0
Equil

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

XBT and XCTD drops were made during this cruise. The data set(s) are saved to the raw/XBT directory in the cruise archive. Refer to the MGL1407 Expendable Drops.xls spreadsheet in the docs/operations directory of the cruise archive for more information.

Sonobuoy System

Files: *.SEG, *.SEGY

34 Sonobuoy launches were done during this cruise. The dataset(s) are saved to the raw/sonobuoy directory in the cruise archive. Please refer to the sonobuoy_log.xls in the raw/sonobuoy directory of the cruise archive for more information.

IV. Seismic Summary

A. Acquisition Parameter Table

Acquisition Parameter Table 1	
FieldActivityID	MGL1407
Acquisition_sequence(s)	Seqs 1 - 20
ReceiverType	Sentry Solid Streamer
SourceType	Airgun
Acquisition System Name	Syntrak 960
Acquisition System Type	MCS
Seismic_Nav_System	C-Nav 3050 primary
Survey_datum	WGS84
Navigation Reference Point (primary GPS antenna)	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
Antenna(NRP)_to_source	213 m
Source_to_Near_Channel	225 m
Number _of_channels_recorded	**Ref: MGL1407_configuration_by_sequence.xls**
Number _of_cables	1
Number_of_channels_each_cable	**Ref: MGL1407_configuration_by_sequence.xls**
Channel_length	12.5 m
Cable_length	**Ref: MGL1407_configuration_by_sequence.xls**
Cable_spacing	N/A
Near_Channel_Number	**Ref: MGL1407_configuration_by_sequence.xls**
Cable_depth	**Ref: MGL1407_configuration_by_sequence.xls**
Number_sources	1
Sub-arrays_per_source	4
Flipflop_shooting (dual source alternating)	False
Source_separation	Applicable to flipflop (dual source alternating) only
Sub-array_separation	6.0 m
Source_volume	6600 cu in
Source_pressure	2000 psi nominal
Source_make,model	Bolt 1500LL & 1900LL
Source_element_number	36 + 4 spare
Source_depth	**Ref: MGL1407_configuration_by_sequence.xls**
Shot_control	Distance
Shot_Interval	**Ref: MGL1407_configuration_by_sequence.xls**
Sample_interval	**Ref: MGL1407_configuration_by_sequence.xls**
Record_length	**Ref: MGL1407_configuration_by_sequence.xls**
Compass_birds	30
Recording_delay	False
Active_tail_buoy	True
Multiple_ships	False

Physical Configuration

The towing configuration for the air guns and streamers is detailed in the document titled ***MGL1407_Offsets.xls***.

Offsets

All antenna and in-water offset drawings are in the file ***MGL1407_Offsets.xls***.

Spectra

Spectra was used for all timing and navigation during the cruise. Spectra generated UKOOA P294 and P190 files for each MCS line acquired.

Sprint

Sprint was used for post processing of Spectra UKOOA P294 files to produce UKOOA P190 files with improved positioning.

V. RV Langseth Gravity Tie Information

Date / Time	Ship Location	Reference Location	Mistie
2014-08-15T09.54	Brooklyn, NY	Brooklyn Navy Yard	Brooklyn, NY
2014-09-13T11:07	Norfolk, VA	NOAA Facility	Norfolk, VA

Please refer to the documents located under MGL1407/docs/gravity_tie for detailed records.

VI. Archive Contents

Key files are bolded.

MGL1407/docs	Cruise documents and logs
MGL1407/docs/config	Configuration archive
MGL1407/docs/elog	Cruise elog
MGL1407/docs/gravity_tie	Gravity Tie information
MGL1407/docs/map	Cruise maps, track map
MGL1407/docs/offsets	Vessel/sensor offsets
MGL1407/docs/operations/	Operations documents
MGL1407/docs/operations/Daily_Reports	Cruise Daily Reports from Chief Science Officer
MGL1407/docs/operations/NavLogs	Seismic navigation logs (spectra)
MGL1407/docs/operations/ObsLogs	Seismic acquisition logs (gun controller)
MGL1407/docs/operations/MGL1407_B15_line_log_multi_channel_seismics	**Master line log table**
MGL1407/docs/operations/MGL1407_configuration_by_sequence.xls	**Acquisition configuration**
MGL1407/docs/permits	Clearance Documents
MGL1407/docs/waypoints	Waypoint files
MGL1407/docs/personnel	Personnel rosters, org chart, bunk and phone lists
MGL1407/docs/reports	Cruise Report and supplemental docs
MGL1407/docs/reports/MGL1407_DataReport_v1.0.doc	**This file**
MGL1407/docs/offsets/MGL1407_Offsets.xls	**Vessel/sensor offsets**
MGL1407/docs/screencaps	Screen captures
MGL1407/processed	Processed data
MGL1407/processed/reflex (3D data-sets only, not applicable to OBS and 2D)	Spectra reflex files
MGL1407/processed/obsip	shot log files
MGL1407/processed/sprint	Sprint UKOOA P190s
MGL1407/processed/svp	Sound velocity profiles
MGL1407/raw	Raw data
MGL1407/raw/adcp	Raw ADCP data
MGL1407/raw/knudsen	Raw Knudsen sub-bottom profiler data
MGL1407/raw/multibeam	Raw EM122 data
MGL1407/raw/serial	Underway serial data: gps, tsg, weather, etc.
MGL1407/raw/sonobuoy	Raw sonobuoy data
MGL1407/raw/spectra/P1	Spectra underway p190
MGL1407/raw/spectra/P2	Raw seismic navigation, p294
MGL1407/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-Gobal 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 /td>
*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
hhmms.ss	UTC time of position	Hours/Minutes/Seconds.decimal.
ddmm.mmmmm	Latitude	Degrees/Minutes.decimal.
a	Direction of Latitude N = North S = South	n/a
ddmm.mmmmm	Longitude	Degrees/Minutes.decimal
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 communication beam in use yy is the GPS correction signal 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-Gobal 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 /td>
*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
hhmms.ss	UTC time of position	Hours/Minutes/Seconds.decimal.
ddmm.mmmmm	Latitude	Degrees/Minutes.decimal.
a	Direction of Latitude N = North S = South	n/a
ddmm.mmmmm	Longitude	Degrees/Minutes.decimal
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 communication beam in use yy is the GPS correction signal 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 fulll multibeam data, please see the [multibeam](#) page.

The EM122 outputs serial data in the following formats:

- KIDPT - Depth below transducer

$KIDBT,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 -129.212118 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 -129.212118 48.479293 -129.213152 2516.1
MGL0910_05
sssssss yyyy-mm-dd hh:mm:ss.ssssss xx.xxxxxx yyy.yyyyyy vv.vvvvvv www.wwwwww dddd.d llllllllllllllll

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
dddd.d	depth	meters
llllllllllllllll	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	Units
yyyyjjj.jjj	pco2 Computer Date/Time	n/a	Year/Julian Day.decimal Four fixed digits of year. Three fixed digits of julian day. Five fixed digits for decimal fractions of 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

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.llllllm, 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	Units
yyyyjjj.jjj	pco2 Computer Date/Time	n/a	Year/Julian Day.decimal Four fixed digits of year. Three fixed digits of julian day. Five fixed digits for decimal fractions of 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, C15551, or CC63668	alphanumeric
llll.llllllm	CNav Latitude	0 to 90, N/S	degrees/minutes.decimal/direction
nnnnn.nnnnnno	CNav Longitude	0 to 180, E/W	degrees/minutes.decimal/direction
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, hhmmss.sss, llll.lllll, 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.lllll	Latitude	-90 to +90	DegreeslMinutes.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	n/a	Metres

	mean sea level. A negative value 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	o 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 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 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, hhmmss.sss, llll.lllll, 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.lllll	Latitude	-90 to +90	DegreeslMinutes.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	o 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

<u>Speed log data</u>

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 iiii 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

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