R/V Marcus G. Langseth Data Reduction Summary

MGL2314 – Puerto Rico High Resolution MCS

Dr. Uri Ten Brink, USGS

San Juan, PR to Ponce, PR

Lamont-Doherty Earth Observatory, Columbia University

Sailing dates:

Date	Day of Year	Time	Port
2023-10-29	302	15:15 UTC	San Juan, Puerto Rico
2023-11-02	306	21:45 UTC	Offshore Ponce, PR

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I. Background and Scientific Objectives

The proposed survey is a follow-up to the USGS “rapid response” cruise from 2020 that investigated the 2019-2020 seismic swarm in southwestern Puerto Rico. This seismic activity may reflect the establishment of a new block boundary between Puerto Rico and Hispaniola, where Hispaniola is moving west relative to Puerto Rico. Most of the activity during this sequence occurred offshore, including the largest event, the Mw6.4 on January 7, 2020. The earthquake sequence caused extensive damage in coastal towns, creating anxiety among the island’s population.
The goal of the proposed survey is to improve detection of the faults with depth and map their spatial connections and relationships by collecting a denser grid of seismic lines at the desired orientation aboard a larger ship, and by using GI guns and a longer streamer.

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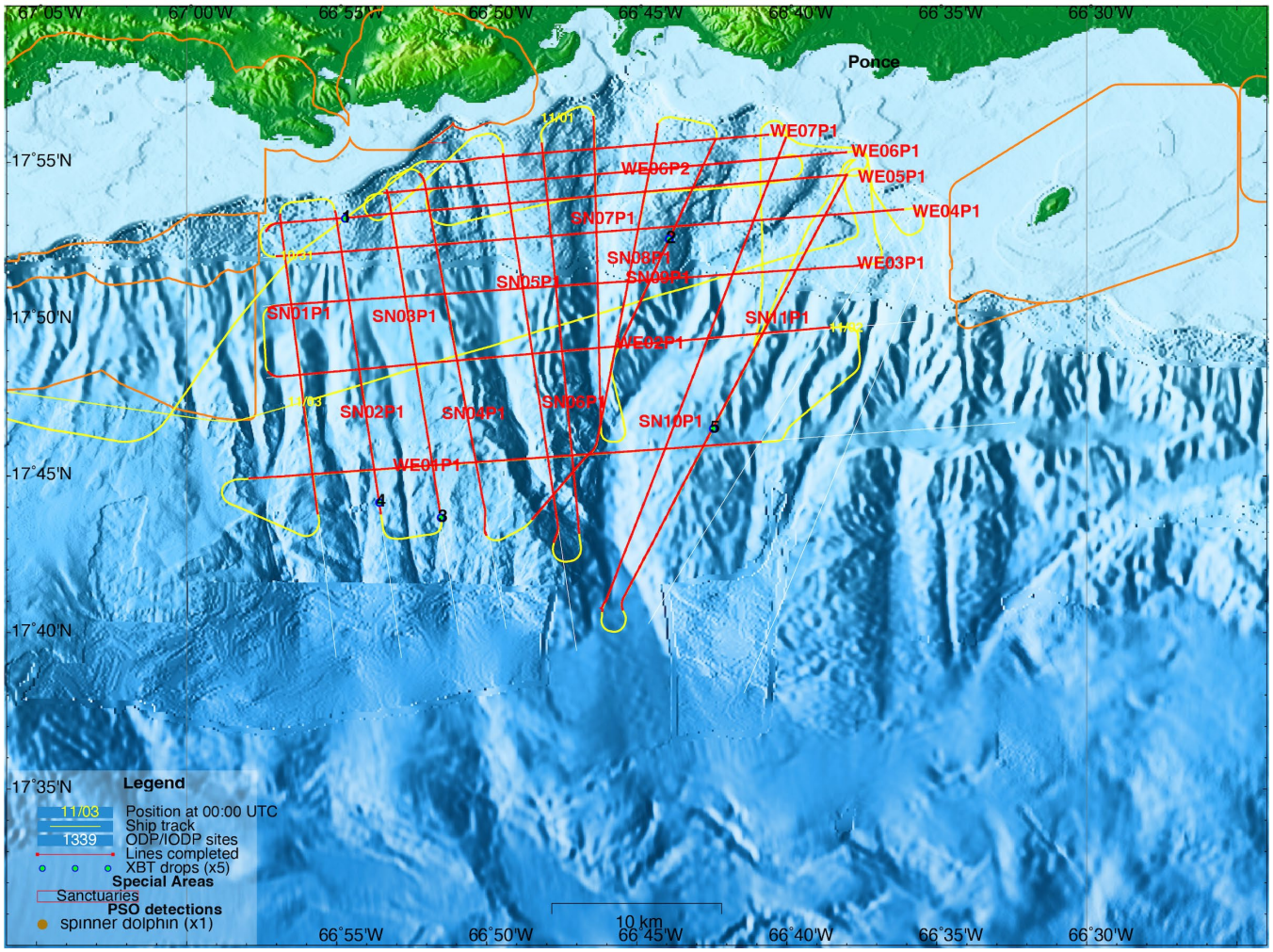

II. Personnel

Science Party

Participant	Affiliation	Position
Uri Ten Brink	USGS	PI
Shuoshuo Han	UTIG	Co-PI
Hanchao Jian	WHOI	Scientist
Nick Harmon	WHOI	Scientist
Jose-Luis Granaha-Bruna	University of Madrid	Scientist
Wayne Baldwin	USGS	Scientist
William Danforth	USGS	Scientist
Sam Heller	USGS	Scientist
Eric Moore	USGS	Scientist
Seth Ackerman	USGS	Scientist
Charles Babendreier	UTIG	Student

Shipboard technical staff

Participant	Group/Affiliation	Position
Cody Bahlau	LDEO	Chief Science Officer
Gilles Guérin	LDEO	Marine Technician
Koray Ergun	LDEO	Marine Technician
Josh Kasinger	LDEO	Chief Source Mechanic
Brian Agee	LDEO	Source Mechanic
Aaron Martin	Contractor	Navigator
Ray Atton	Contractor	Mechanic
Mark Walker	Contractor	Mechanic
Jacob Greenberg	UNOLS	Marine Technician

Protected Species Observers

Participant	Group/Affiliation	Position
Amanda Dubuque	RPS	Lead PSO/PAM
Cassandra Frey	RPS	PSO/PAM
Elizabeth Breton	RPS	PSO/PAM
Maria Sandoval	RPS	PSO/PAM
Tiffany Ramdoo	RPS	PSO/PAM

Ship Crew

Participant	Position
Breck Crum	Master
Mark Stinziano	Chief Mate
Steve Uramato	2nd Mate
Sebastian Uriarte	3rd Mate
Ricardo Redito	Bosun
Robert Hammond	AB
William Robison	AB
Inocencio Rimando	AB
Billy Phillips	AB

Participant	Position
Butler, Gerald O.	Chief Engineer
Marlin Carpenter	1st A/E
Sara Wright	2nd A/E
Monica Martini	3rd A/E
Joe Walsh	Electrician/Oiler
Ryan Dries	Oiler
Christina DeLorenzi	Steward
Leoncio Martires	Cook
Madeline Ireland	OS Utility

III. Instrumentation Summary

All science instruments aboard the Langseth that were used and generated data during the cruise are listed below. File names and samples are in section IV, and details of serial formats in section VIII.

General Instrumentation

Instrument	Description	Data Set	Data Outputs	Files	Sampling rate
ADCP	Teledyne Ocean Surveyor 75 Doppler Current Profiler	Full	various	See below	variable
BGM	Bell Aerospace BGM-3 Gravimeter	Full	serial log	MGL-vc01.*	1s
CNAV	Oceaneering C-Nav3050 DGPS - Stern	Full	serial log	MGL-cnav.*	1s
CNAV3050	Oceaneering C-Nav3050 DGPS - Main	Full	serial log	MGL-cnav3050all.*	1s
DS80	Furuno DS-80 Doppler Speed log	Full	serial log	MGL-slog01.*	3s
EM122	Kongsberg EM122 Multibeam Sonar	Full	various	See below	variable
GYRO	Simrad GC80 Gyrocompass	Full	serial log	MGL-gy01.*	0.1s
KNUDSEN	Knudsen 3260 Sub-bottom Profiler	Full	kea, keb, segy, serial log	See below	variable
MAG01	Geometrics 882 Magnetometer	On deploy	serial log	MGL-mag01.*	0.1s
MICROSV	AML Oceanographic Micro-X SV Xchange velocity probe	Full	serial log	MGL-svuss01.*	1s
POSMV	Applanix POSMV Inertial Navigation System	Full	serial log	MGL-posmv*	0.5s
SEAPATH	Kongsberg Seapath 330+ Inertial Navigation System	Full	serial log	MGL-seapath.*	1s
TSG	SeaBird SBE45 MicroTSG Thermosalinograph	Full	serial log	MGL-tsgraw.*	10s
Vaisala	Vaisala WXT-520 Weather Station	Full	serial log	MGL-vaisala1*	1s
XBT	Lockheed Martin Sippican Expendable BathyThermographs	5 drops	Raw data	See below	n/a

Seismic Instrumentation

Instrument	Description	Data Set	Data Formats	Files
Gunlink	Seamap Gunlink 2000 source controlling system	Full	SEGD	See below
Orca	Sercel Orca Seismic navigation system	Full	various	See below
Seal	Sercel Seal 428 Seismic acquisition system	Full	SEGD	See below

IV. Data Files and Data Strings

The outputs of all the science instruments listed in the previous section are described below, in the same alphabetical order for instrument names as the previous table.
For all serial data, the files are named MGL-*inst*.y*YYYY*d*jjj*, after the code or ID of the instrument (*inst*), the year (*YYYY*) and the julian day (*jjj*) when they are recorded, with a new file created every day. Each data sentence is preceded by its ID and a UTC time stamp, added by the Lamont Data System (LDS). The description of the sentence formats is in section VIII.
See **docs/elog/MGL2314_r2relog.csv** for information on any data gaps or degraded operation.

General Instrumentation

ADCP: Teledyne Doppler Current Profiler

ADCP data were collected during the entire cruise, starting shortly after leaving port.
Data are delivered as a replication of its acquisition directory structure, including raw and processed data, reports, figures and binary data in clearly labeled folders.

BGM: Bell Aerospace BGM-3 Gravimeter

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

Serial file id: vc01
Logging interval: 1 second
vc01 data sample:

```
vc01   2023:305:00:00:00.4375  04:025125 00
```

CNAV: C-Nav3050 DGNSS Receiver

The C-Nav3050 is a global satellite-based differential receiver. Two units are used: the unit located on the ship tower is used as the primary reference, while the unit at the stern is used as a secondary system. Both units were operational during the entire cruise.

Primary unit (tower)
Serial file id: cnav3050all
Logging interval: 1 second
cnav3050all data sample:

```
cnav3050all   2023:305:00:00:02.1687  $GNGGA,000002.00,1756.4449,N,06647.6247,W,2,16,0.6,-22.5,M,0.0,M,7.0,0446*6B
cnav3050all   2023:305:00:00:02.1689  $PNCTGGA,000002.00,1756.444941,N,06647.624694,W,2,16,0.6,-22.549,M,0.000,M,7.0,
0536*69
cnav3050all   2023:305:00:00:02.2280  $GNGLL,1756.444941,N,06647.624694,W,000002.00,A,D*67
cnav3050all   2023:305:00:00:02.2845  $GNRMC,000002.00,A,1756.444941,N,06647.624694,W,4.24,59.6,011123,,,P,S*33
cnav3050all   2023:305:00:00:02.2846  $GNVTG,59.6,T,,M,4.24,N,7.85,K,P*30
cnav3050all   2023:305:00:00:02.2847  $GNZDA,000002.00,01,11,2023,00,00*78
cnav3050all   2023:305:00:00:02.3339  $GNGSA,A,3,02,04,07,08,09,16,21,26,27,31,,,1.4,0.6,1.3,1*37
cnav3050all   2023:305:00:00:02.3340  $GNGSA,A,3,66,67,76,77,86,87,,,,,,,1.4,0.6,1.3,2*32
cnav3050all   2023:305:00:00:03.1119  $GNDTM,999,,,,,,,999*54
cnav3050all   2023:305:00:00:03.1120  $PNCTDTM,ITR,,,,,,,ITR*54
```

Secondary unit (stern)
Serial file id: cnav
Logging interval: 1 second
cnav data sample:

```
cnav   2023:305:00:00:09.2456 $GPGGA,000009.00,1756.4420,N,06647.6332,W,2,18,0.6,18.0,M,-43.7,M,4.0,0446*43
cnav   2023:305:00:00:09.3167 $GPVTG,66.2,T,,M,4.16,N,7.70,K,P*2D
cnav   2023:305:00:00:10.2457 $GPDTM,999,,,,,,,999*4A
```

DS80: Furuno DS-80 Doppler Speed log

The Furuno DS-80 is a Doppler speed log. It was in operation for the duration of the cruise.

Serial file id: slog01
Logging interval: 3 seconds
slog01 data sample:

```
slog01 2023:305:00:00:49.7911 $VDVLW,165074.96,N,317.75,N*66
slog01 2023:305:00:00:50.5123 $VDVBW,4.6,,A,,,V*6A
```

EM122: Kongsberg EM122 Multibeam Sonar

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 **raw/multibeam**. Data in Kongsberg raw formats (*.all, *.wcd, *.asvp, *.abs) are replicated in the original directory structure, named by time stamps and sorted by day of acquisition. Center beam depth is recorded separately to serial log.
See **docs/elog/MGL2314_r2relog.csv** for times and durations of any interruption.

Serial file id: bath02
Logging interval: variable with water depth
bath02 data sample:

```
bath02 2023:305:00:00:45.1831 $KIDPT,269.54,6.76,12000.0*48
```

GYRO: Simrad GC80 Gyrocompass

The GC80 gyrocompass is installed on the bridge and is used for ship and seismic navigation. It was in operation for the duration of the cruise.

Serial file id: gy01
Logging interval: 0.1s
gy01 data sample:

```
gy01   2023:305:00:00:02.1937 $HEROT,-009.45,A*3E
gy01   2023:305:00:00:02.2906 $HEHDT,064.5,T*28
gy01   2023:305:00:00:02.4917 $HEHDT,064.5,T*28
gy01   2023:305:00:00:02.4918 $PTKM,HEALM,0000,0,G1*09
```

KNUDSEN: Knudsen Engineering 3260 Sub-bottom Profiler

The Knudsen 3260 is a chirp echosounder/sub-bottom profiler. Its 3.5kHz channel was in operation for the length of the cruise. Data are written in proprietary KEB, KEA, and in SEGY format. The depth is also broadcast as UDP and recorded as a serial log.

Serial file id: bath01
Logging interval: variable with water depth
bath01 data sample:

```
bath01 2023:230:00:00:03.3951 $SDDPT,0812.63,000.00,0200.00*69
```

MAG01: Geometrics 882 Magnetometer

The Geometrics 882 magnetometer is towed behind the ship. Deployment Data are collected only when the Magnetometer is deployed, which is dependent upon seismic operations and sea state. See **docs/elog/MGL2314_r2relog.csv** for when it was deployed.

Serial file id: mag01
Logging interval: 0.1 second
mag01 data sample:

```
mag01  2023:305:00:00:03.1258 $ 36537.021,0681,0803
```

MICROSV: AML Oceanographic Micro-X SV Xchange velocity probe

Because of issues with the uncontaminated sea water pump at the beginning of the cruise, the AML Micro SV probe started operating only at 17:22 UTC, Oct 30, ~24hrs after sailing from San Juan. It operated normally through the rest of the cruise.

Serial file id: svuss01
Logging interval: 1 second
svuss01 data sample:

```
svuss01   2023:305:00:00:27.9319   1546.458
```

POSMV: Applanix POS-MV Inertial Navigation System

The POS/MV is an inertial navigation system using two antennas and an IMU to produce full six degrees-of-freedom position and orientation solutions for the vessel. It was operational during the entire cruise.

Serial file id: posmv
Logging interval: 0.5-1 second, depending on sentence
posmv data sample:

```
posmv  2023:305:00:00:01.8317 $INGGA,000001.581,1756.45210,N,06647.62104,W,2,18,0.9,14.96,M,,,4,0134*3E
posmv  2023:305:00:00:01.8878 $INHDT,63.2,T*12
posmv  2023:305:00:00:01.8879 $INVTG,59.1,T,,M,4.2,N,7.7,K,D*23
posmv  2023:305:00:00:02.0534 $INZDA,000002.0045,01,11,2023,,*77
posmv  2023:305:00:00:02.2134 $PASHR,000002.081,63.12,T,-2.43,-0.01,0.29,0.041,0.041,0.013,2,1*23
posmv  2023:305:00:00:02.2135 $PRDID,-0.01,-2.43,63.12*4B
posmv  2023:305:00:00:02.3333 $INGST,000002.081,,0.4,0.4,75.5,0.4,0.4,0.8*6D
```

SEAPATH: Kongsberg SeaPath 330 Inertial Navigation System

The Kongsberg Seapath 330 is an other inertial navigation system using two antennas and an IMU to produce full six degrees-of-freedom position and orientation solutions for the vessel. It was operational for the duration of the cruise.

Serial file id: seapath
Logging interval: 1 second
seapath data sample:

```
seapath   2023:305:00:00:04.3778 $INGGA,000004.14,1756.445958,N,06647.622140,W,2,10,0.9,-1.86,M,-40.74,M,0.0,0001*47
seapath   2023:305:00:00:04.6095 $INGLL,1756.445958,N,06647.622140,W,000004.14,A,D*6B
seapath   2023:305:00:00:04.6096 $INVTG,60.04,T,,M,4.1,N,7.7,K,D*1F
seapath   2023:305:00:00:04.6097 $INHDT,62.85,T*2C
seapath   2023:305:00:00:04.6097 $PSXN,20,0,0,0,0*3B
seapath   2023:305:00:00:04.6726 $PSXN,23,-2.25,0.03,62.85,0.17*2C
```

TSG: SBE-45 Thermosalinograph

Because of issues with the uncontaminated sea water pump at the beginning of the cruise, the Seabird TSG started operating only at 17:22 UTC, Oct 30, ~24hrs after sailing from San Juan. It operated normally through the rest of the cruise.

Serial file id: tsgraw
Logging interval: 10 seconds
tsgraw data sample:

```
tsgraw 2023:305:00:05:05.3366 t1= 30.4796, c1= 5.80410, s= 34.4447, sv=1545.670, t2= 30.3087
```

Vaisala: Vaisala Meteorological Ultrasonic Integrated Weather Station

One weather station was used to log wind speed, direction, air temperature, relative humidity, precipitation, dew point, and barometric pressure. The station is located on top of the tower and was operational during the entire cruise.

Serial file id: vaisala1
Logging interval: 1 second
vaisala data sample:

```
vaisala1  2023:305:00:00:00.0676 $WIMWV,019,R,14.8,N,A*08
vaisala1  2023:305:00:00:00.8647 $WIXDR,C,28.7,C,0,C,28.7,C,1,H,76.6,P,0,P,1008.5,H,0*5A
```

XBT: Lockheed Martin Sippican eXpendable BathyThermographs

5 XBT drops were made during this cruise. The data sets produced by the MK21 Oceanographic Data Acquisition System were saved to the raw/XBT directory in the cruise archive and were imported into the EM122 acquisition software when reaching sufficient depth to provide reliable velocity profiles through the water column. See the **docs/MGL2314_Expendable_Drops.xls** spreadsheet for more information.

Files: *.RDF,*.EDF

Seismic Instrumentation

Gunlink

Seamap Gunlink 2000 was used to control the sources used during seismic acquisition. For each shot point, it generated a segd file including the signatures of the hydrophones active on the source arrays. Files are named with the associated shotpoint number, sorted in separate folders for each sequence, under **raw/gunlink.**

Files: *ShotPoint*.segd

Orca

Sercel's Orca software was used for all timing and navigation during the cruise. Orca generated UKOOA P294 and P211 files for each sequence. File names are made of the cruise name (MGL2314), the sequence number (*Seq*), the name of the line (*Line*), and an additional identifier (*Pid*) for pass number, reshoot or segmented lines.

Files: MGL2314*SeqLinePid*.p294, MGL2314*SeqLinePid*.p211

Serial file id: orcahdr
For each shot point, Orca outputs to UDP a general navigation header combined with the Gun Controller String for the shot:

```
orcahdr   2023:305:00:22:17.6400 $10259000303002216.31201320231101UTC001016MGL2314008SN07P1  17.936631 -66.773532
576.5  17.939299 -66.77384 7179.6181.54.9001*GCS90014008SN07P1000000101601E23/11/01:00:22:16110202000000000030030000.0
0 0.000    1921!,+&192101AP1N 000177496-0403202AP1N 000173499-01032
```

Navigation Post Processing

Onboard navigation post processing of the P294 files was performed with Iris, as part of the Orca suite, to produce UKOOA P190 files with improved positioning. Naming convention is the same as for the raw p294 data: File names are made of the cruise name (MGL2314), the sequence number (*Seq*), the name of the line (*Line*), and an additional identifier (*Pid*) for pass number, reshoot or segmented lines.

Files: MGL2314*SeqLinePid*.p190

Seal

Sercel's Seal 428 system was used to acquire, retrieve and record the data from the streamer. All channels were recorded to two types of SEGD files:

- The continuous recording creates new files every 5 seconds at a 1ms sampling rate, with 1 sample overlap between files. These files are controlled by a high precision GPS clock, independently of any trigger from navigation. The file names are based on the raw Field File Identification Numbers (*FFID*), reset to 1 at the beginning of the cruise, and files are sorted in separate folders named for the year, month and day of acquisition (*YYYYMMDD*)

Files: *YYYYMMDD/FFID*.segd

- 'Processed' files are generated from the continuous data, under the control of the navigation triggers sent by Orca, with a record length and sampling interval adjusted to the scientific objectives of the acquisition. File names are based on the processed FFID, reset to 1 at the beginning of the cruise, and sorted in separate folders for each sequence, named after the cruise name (MGL2314), the sequence number (Seq), the name of the line (Line), and an additional identifier (Pid) for pass number, reshoot or segmented lines.

Files: MGL2314*SeqLinePid*.*Seq*/*FFID*.segd

V. Seismic Acquisition Parameters

Acquisition Parameters Table 1
(6.25m shot point interval, 3s record length)

Field Activity ID	MGL2314
Acquisition sequence(s)	1,2,4,5
Receiver Type	MCS
Source Type	GI-Gun
Acquisition System Name	Sercel Seal 428 v1.1
Acquisition System Type	MCS
Seismic Navigation System	Orca
Survey datum	WGS84
Navigation Reference Point (primary GPS antenna)	C-Nav3050: Fore/Aft+0.0 m, Stb/pt+0.0 m, Vert.+16.9 m
Antenna (NRP) to source	287 m
Source to Near Channel	99.75
Number of channels recorded	144
Number of cables	1
Number of channels each cable	144
Channel length	6.25 m
Cable length	900 m
Cable spacing	N/A (Applicable to multi-streamer MCS only)
Near Channel Number	1
Cable depth	4 m
Number sources	1
Sub-arrays per source	1
Flipflop shooting	False
Source separation	N/A (Applicable to flipflop only)
Sub-array separation	N/A (only one array)
Source volume	90 in^3
Source pressure	1900 psi nominal
Source make, model	Gi-Gun
Source element number	2
Source depth	3 m
Shot control	Distance
Shot Interval	6.25 m
Sample interval	0.5 ms
Record length	3 s
Compass birds	7
Recording delay	False
Active tail buoy	True
Multiple ships	False

Acquisition Parameters Table 2

(12.5 m shot point interval, 4s record length)

Field Activity ID	MGL2314
Acquisition sequence(s)	3,6-19
Receiver Type	MCS
Source Type	GI-Gun
Acquisition System Name	Sercel Seal 428 v1.1
Acquisition System Type	MCS
Seismic Navigation System	Orca
Survey datum	WGS84
Navigation Reference Point (primary GPS antenna)	C-Nav3050: Fore/Aft+0.0 m, Stb/pt+0.0 m, Vert.+16.9 m
Antenna (NRP) to source	287 m
Source to Near Channel	99.75
Number of channels recorded	144
Number of cables	1
Number of channels each cable	144
Channel length	6.25 m
Cable length	900 m
Cable spacing	N/A (Applicable to multi-streamer MCS only)
Near Channel Number	1
Cable depth	4 m
Number sources	1
Sub-arrays per source	1
Flipflop shooting	False
Source separation	N/A (Applicable to flipflop only)
Sub-array separation	N/A (only one array)
Source volume	90 in^3
Source pressure	1900 psi nominal
Source make, model	Gi-Gun
Source element number	2
Source depth	3 m
Shot control	Distance
Shot Interval	12.5 m
Sample interval	0.5 ms
Record length	4 s
Compass birds	7
Recording delay	False
Active tail buoy	True
Multiple ships	False

VI. Gravity Tie Information

No gravity ties were performed immediately before or after the cruise. Data are provided for the most recent tie, recorded at WHOI on October 15.

VII. Cruise Data Archive Contents

docs	Cruise documents and logs
docs/elog	Cruise elog files
docs/elog/MGL2314_r2relog.csv	Cruise elog report
docs/gravity_tie	Gravity ties
docs/map	Cruise maps
docs/offsets	Vessel/sensor offsets
docs/operations	Operations documents
docs/operations/Daily_Reports	Cruise daily reports from
docs/operations/NavLogs	Seismic Navigation logs (orca)
docs/operations/ObsLogs	Seismic Acquisition logs
docs/operations/StreamerSheets	Streamer configuration(s)
docs/operations/MGL2314_B15_line_log.xls	Master line log table
docs/operations/MGL2314_Expendable_Drops.xls	XBT drops summary table
docs/operations/MGL2314_line_configuration_by_sequence.xls	Seismic Acquisition configuration
docs/permits	Clearance documents
docs/reports	Associated reports
docs/reports/MGL2314_DataReport.doc	This file
docs/reports/orca_EOL_reports	End Of Line Orca reports (csv and pdf formats)
docs/segd_logs	Seal 428 SEGD files lists
docs/segd_logs/MGL2314_sequences.csv	Time and files for start/end of each sequence
docs/waypoints	Waypoint and planning files
processed	**Processed data**
processed/obsip	Shotlog/OBSIP files from processed P190
processed/navigation	Processed navigation data (UKOOA P190)
raw	**Raw data**
raw/adcp	Raw ADCP data
raw/gunlink	Hydrophone data from Gunlink (SEGD)
raw/knudsen	Raw Knudsen sub-bottom profiler data
raw/multibeam	Raw EM122 multibeam data
raw/obsip	Shotlog and source data from raw navigation
raw/orca/P2	Raw seismic navigation (UKOOA P294)
raw/serial	Underway serial data
raw/XBT	XBT data

VIII. Serial Data Formats

Unless specified otherwise, all serial data sentences are in NMEA 0183 compatible format.
On each line, the data sentences generated by the instrument follows the instrument ID and time stamp added by the Lamont Data Logger (LDS) system.
In the following format descriptions, unless specified otherwise, x.x stands for floating point values, n for integer, and a for character. When fixed, the number of characters and precision are indicated (e.g. x.xx = two decimal point precision; nnnn = 4 integers).
In all sentences with a mode indicator associated with the checksum in the last word, if nothing else is specified, the options are: A: Autonomous mode; D: Differential mode; E: Estimated (dead reckoning) mode; M: Manual Input mode; S: Simulator mode; N: Data not valid.

MGL-bath01.*

The Knudsen 3260 depth is output to files *MGL-bath01.yYYYYdjjj* using the following format:

`$SDDPT,x.xx,x.xx,x.xx*hh`

Item	Definition	Units / Options
x.xx	Water depth relative to transducer	m
x.xx	Offset from transducer	m; positive means from transducer to water line
x.xx	Range in use	m
*hh	Checksum	n/a (hexadecimal)

MGL-bath02.*

The EM122 center beam depth is output to files *MGL-bath02.yYYYYdjjj* using the following format:

`$KIDPT,x.x,x.x,x.x*hh`

Item	Definition	Units / Options
x.x	Water depth	m
x.x	Offset from transducer	m; positive means from transducer to water line
x.x	Maximum range scale in use	n/a
*hh	Checksum	n/a (hexadecimal)

MGL-cnav.*

The C-Nav3050 GPS at the stern outputs data to files MGL-cnav.y*YYYY*d*jjj*. The following sentence types were recorded:

- $GPGGA: Global Positioning System Time, position and fix related data.
- $GPDTM: Datum reference information
- $GPVTG: Track made good and Ground speed data.

$GPDTM sentence

`$GPDTM,a,a,mm.mmmm,a,mm.mmmm,a,0,aaa*hh`

Item	Definition	Units / Options
a	Local datum code	n/a
a	Local datum subcode	n/a

mm.mmmm	Latitude offset	minutes
a	Latitude offset mark (N: +; S: -)	n/a
mm.mmmm	Longitude offset	minutes
a	Longitude offset mark (E: +; W: -)	n/a
0	Altitude offset (always 0)	m
aaa	Datum code	n/a
*hh	Checksum	n/a (hexadecimal)

$GPGGA sentence

$GPGGA,hhmmss.ss,ddmm.mmmm,a,dddmm.mmmm,a,x,nn,x.x,x.x,M,x.x,M,x.x,nnnn*hh

Item	Definition	Units / Options
hhmms.ss	UTC time of position	Hours/Minutes/Seconds.decimal.
ddmm.mmmm	Latitude	Degrees/Minutes.decimal.
a	Direction of Latitude: N = North; S = South	n/a
dddmm.mmmm	Longitude	Degrees/Minutes.decimal
a	Direction of Longitude: E = East; W = West	n/a
n	GPS Quality indicator	0: not valid; 1: Auto fix; 2: Corrected fix
nn	Number of GPS satellites used in solution fix	n/a
x.x	Horizontal Dilution of Precision (HDOP)	n/a
x.x	Antenna altitude from Mean Sea Level (MSL)	m
M	Altitude units--M indicates meters	n/a
x.x	Geoidal separation distance from MSL	m
M	Geoidal separation units--M indicates meters	n/a
x.x	Age of corrections used in solution fix	s
nnnn	Differential GPS reference station ID	n/a
*hh	Checksum	n/a (hexadecimal)

$GPVTG sentence

$GPVTG,x.x,T,mmm.m,M,x.x,N,x.x,K,a*hh

Item	Definition	Units / Options
x.x	Course over ground (COG)	Degrees from True North
T	Indicates course relative to True North	n/a
x.x	COG relative to magnetic north	Degrees from Magnetic North
M	Indicates course relative to magnetic north	n/a
x.x	Speed over ground (SOG)	Nautical miles per hour (knots)
N	Indicates that SOG is in knots	n/a
x.x	SOG	km/h
K	Indicates that SOG is in km/h	n/a
a	Mode Indicator	n/a
*hh	Checksum	n/a (hexadecimal)

MGL-cnav3050all.*

The main C-Nav3050 GPS receiver outputs data to files MGL-cnav3050all.y*YYYY*d*jjj*. The following sentence types were recorded:

- $GNDTM: Datum reference information
- $GNGGA: Global Positioning System Time, position and fix related data
- $GNGLL: Position data: position fix, time of position fix, and status
- $GNGSA: GPS Dilution of Precision (DOP) and active satellites
- $GNVTG: Track made good and Ground speed data
- $GNZDA: UTC day, month, and year, and local time zone offset
- $PNCTDTM: C-Nav proprietary Datum reference information
- $PNCTGGA: C-Nav proprietary GPS Time, position and fix related data

$GNDTM sentence

`$GNDTM,aaa,a,mm.mmmm,a,mm.mmmm,a,0,aaa*hh`

Item	Definition	Units / Options
aaa	Local datum code	n/a
a	Local datum subcode	n/a
mm.mmmm	Latitude offset	minutes
a	Direction of Latitude	N: North; S: South
mm.mmmm	Longitude offset	minutes
a	Direction of Longitude	E: East; W: West
0	Altitude offset	m (always 0)
aaa	Datum code	n/a
*hh	Checksum	n/a (hexadecimal)

$GNGGA sentence

`$GNGGA,hhmmss.ss,ddmm.mmmm,a,dddmm.mmmm,a,x,n,x.x,x.x,M,x.x,M,x.x,a*hh`

Item	Definition	Units / Options
hhmms.ss	UTC time of position	Hours/Minutes/Seconds.decimal.
ddmm.mmmm	Latitude	Degrees/Minutes.decimal.
a	Direction of Latitude	N: North; S: South
dddmm.mmmm	Longitude	Degrees/Minutes.decimal
a	Direction of Longitude	E: East; W: West
n	GPS Quality indicator	0: not valid; 1: Auto fix; 2: Corrected fix
n	Number of GPS satellites used in solution fix	n/a
x.x	Horizontal Dilution of Precision	n/a
x.x	Antenna altitude from Mean Sea Level (MSL)	m
M	Altitude units--M indicates meters	n/a
x.x	Geoidal separation distance from MSL	m
M	Geoidal separation units	n/a (M indicates meters)
x.x	Age of corrections used in solution fix	s
nnnn	Differential GPS reference station ID	n/a
*hh	Checksum	n/a (hexadecimal)

$GNGLL sentence

$GNGLL,ddmm.mmmmmm,a,dddmm.mmmmmm,a,hhmmss.ss,a,a*hh

Item	Definition	Units / options
ddmm.mmmmmm	Latitude	Degree, decimal minute
a	Latitude direction	N: North; S: South
dddmm.mmmmm	Longitude	Degree, decimal minute
a	Longitude direction	E: East; W: West
hhmmss.ss	UTC time	Hour/minute/Sec.dec
a	Status indicator	A: valid; V: not valid
a	Mode Indicator	n/a
*hh	Mode*Checksum data	n/a (hexadecimal)

$GNGSA sentence

$GNGSA,A,3,nn,nn,nn,nn,nn,nn,nn,nn,nn,nn,nn,x.x,x.x,x.x,1*3D

Item	Definition	Units / options
a	Mode	M: Manual; A: Automatic
n	Solution	1: N/A; 2: 2D; 3: 3D
nn	ID (PRN) of satellites used	Up to 12 values
x.x	Position (3D) of Dilution of Precision (PDOP)	N/A
x.x	Horizontal Dilution of Precision (HDOP)	N/A
x.x	Vertical Dilution of Precision (VDOP)	N/A
n	System ID	1 = GPS
*hh	Checksum	n/a (hexadecimal)

$GNVTG sentence

$GNVTG,xxx.x,T,xxx.x,M,x.xx,N,x.xx,K,a*hh

Item	Definition	Units / Options
ttt.t	Course over ground (COG)	Degrees from True North
T	Indicates course relative to True North	n/a
mmm.m	COG relative to magnetic north	Degrees from Magnetic North
M	Indicates course relative to magnetic north	n/a
x.xx	Speed over ground (SOG)	Nautical miles per hour (knots)
N	Indicates that SOG is in knots	n/a
x.xx	SOG	km/h
K	Indicates that the SOG is in km/h	n/a
a	Mode Indicator	n/a
*hh	Checksum	n/a (hexadecimal)

$GNZDA sentence

$GNZDA,hhmmss.sss,dd,mm,yyyy,hh,mm*hh

Item	Definition	Units / options
hhmmss.sss	UTC time	Hour/minute/Sec.dec
dd	Day	01-31
mm	Month	01-12

yyyy	Year	
hh	Local time zone offset from GMT, hours	00-13
mm	Local time zone offset from GMT, minutes	00-59
*hh	Checksum	n/a (hexadecimal)

$PNCTDTM sentence

$PNCTDTM,aaa,,,,,,,aaa*54

Item	Definition	Units / Options
aaa	Local datum code	n/a
a	Local datum subcode	n/a
mm.mmmm	Latitude offset	minutes
a	Latitude direction	N: North; S: South
mm.mmmm	Longitude offset	minutes
a	Direction of Longitude	E: East; W: West
0	Altitude offset from reference	m
aaa	Reference Datum code	n/a
*hh	Checksum	n/a (hexadecimal)

$PNCTGGA sentence

$PNCTGGA,hhmmss.ss,ddmm.mmmmmm,a,dddmm.mmmmmm,a,n,n,x.x,x.x,M,x.x,M,x.x,iijj*hh

Item	Definition	Units / Options
hhmms.ss	UTC time of position	Hours/Minutes/Seconds.decimal.
ddmm.mmmmmm	Latitude	Degrees/Minutes.decimal.
a	Direction of Latitude	N: North; S: South
dddmm.mmmmmm	Longitude	Degrees/Minutes.decimal
a	Direction of Longitude	E: East; W: West
n	GPS Quality indicator	0: not valid; 1: GPS SPS fix; 2: DGPS SPS fix
n	Number of GPS satellites used in solution fix	n/a
x.x	Horizontal Dilution of Precision	n/a
x.x	Antenna altitude from Mean Sea Level (MSL)	m
M	Antenna Altitude units	n/a (M indicates meters)
x.x	Geoidal separation distance from MSL	m
M	Geoidal separation units	n/a (M indicates meters)
x.x	Age of corrections used in solution fix	s
iijj	Differential GPS reference ID	ii:satellite beam; jj: correction type
*hh	Checksum	n/a (hexadecimal)

MGL-gy01.*

The Simrad GC80 Dual Gyro Compass output to files *MGL-gy01.yYYYYdjjj*. The following sentence types were recorded:

- HEHDT: True Heading
- HEROT: Rate Of Turn
- PTKM: Alarm

$HEHDT Sentence

`$HEHDT,x.x,T*hh`

Item	Definition	Units / Options
x.x	Heading	Degrees
T	T = Preceding value is True heading	n/a
*hh	Checksum	n/a (hexadecimal)

$HEROT Sentence

`$HEROT,x.x,T*hh`

Item	Definition	Units / Options
x.x	Rate of turn	Degrees per minute; "-" = bow turns to port
a	Status	n/a; A: Valid data
*hh	Checksum	n/a (hexadecimal)

$PTKM Sentence

`$PTKM,aaaa,nnnn,n,a*hh`

Item	Definition	Units / Options
HEALM	Almanac code	n/a
nnnn	unspecified	n/a
n	unspecified	n/a
*hh	Checksum	n/a (hexadecimal)

MGL-mag01.*

The Geometrics 882 magnetometer outputs serial to files *MGL-mag01.yYYYYdjjj* in the following format, which doesn't follow the NMEA standard.

`$ xxxxx.xxx,nnnn,nnnn`

Item	Definition	Units / Options
xxxxx.xxx	Magnetic Field Intensity	nT
nnnn	Signal level	Internal format
nnnn	Additional A/D channel	Internal format

MGL-orcahdr.*

The Orca navigation system outputs for each shot point its trigger header informations, combined with the Gunlink Gun Controller String to serial files *MGL-orcahdr.yYYYYdjjj*, which doesn't follow the NMEA standard. It is used to produce the raw obsip/shotlog files.

The first 125 characters are the general navigation header, with words of specific length:

```
$10615000303000143.82501620230602UTC183098   MGL2309057P49  34.263647 -75.789171 500.3  34.265851 -75.787189218.2213
.1 2.6001
```

Columns	Format	Definition
1-2	$1	Start of general navigation header
3-6	nnnn	Length of header (bytes)
7-10	0003	Program revision – 0003 default for Orca
11-12	03	Line status 03=online
13-33	hhmmss.ssssssYYYYMMDD	High precision shot time and date (UTC)
34-36	UTC	Time reference
37-42	nnnnnn	Shot number
43-58	MGL2314aaaaaaaaa	Line Name
59-69	dddd.dddddd	Master Latitude (Degrees.decimal)
70-80	dddd.dddddd	Master Longitude (Degrees.decimal)
81-86	nnnn.n	Water depth (m)
87-97	dddd.dddddd	Source Latitude (Degrees.decimal)
98-108	dddd.dddddd	Source Longitude (Degrees.decimal)
109-113	ddd.d	Master gyro (degrees.decimal)
114-118	ddd.d	Master Course Made Good (Degrees.decimal)
119-122	nn.n	Master speed (knots)
123-125	001	ID of the vessel (001)

The next part of the sentence is made of the formatted gun section, starting with *GCS90. Following are some of the most relevant words:

```
*GCS90049606057P49000018309803E23/06/02:00:01:43121818000000080330000.040.195    1958
```

Columns	Format	Definition
1-6	*GCS90	Start of formatted gun section
6-10	nnnn	Length of gun section (bytes)
11-18	aaaaaaaa	Line name
23-28	nnnnnn	Shot number
29-30	nn	Active array mask
31	a	Trigger mode (I: Internal; E: External)
32-48	YY/MM/DD:HH:MM:SS	Date and time
49	n	Sequence number (flipflop)
50	n	Number of subarrays
51-52	nn	Number of guns in array
53-54	nn	Number of active guns
64-68	nnnnn	Total volume fired (in^3)
83-86	nnnn	Manifold pressure (psi)

The rest of the sentence is made of detailed information for each gun in the array. Here are the details

for one gun:

01AP1N 000146500000005602AP1N 000140499-0105603AP1N …

Columns	Format	Definition
1-2	nn	Gun number
3	a	Mode (A: Auto; M: Manual; S: Spare; O: off)
4	a	Detect (P: Peak; Z: Zero)
5	n	Sequence number (flipflop)
6	a	Autofire (Y/N)
8-10	nnn	Static offset (1/10 msecs)
11-13	nnn	Gun delay (1/10 msecs)
14-16	nnn	Gun fire time (1/10 msecs)
17-19	nnn	Delta (1/10 msecs)
20-22	nnn	Depth (1/10 meters)

MGL-posmv.*

Data from the POS/MV inertial navigation system are recorded in files *MGL-posmv.yYYYYdjjj*. The following sentences were recorded. Two attitude data strings are available.

- $INGGA: Global Positioning System Time, position and fix related data
- $INGST: GPS Pseudorange Noise Statistics
- $INHDT: True Heading
- $INVTG: Course over Ground and Ground speed Data
- $INZDA: GPS Time and Date
- $PASHR: Proprietary Attitude data
- $PRDID: Proprietary Attitude data

$INGGA sentence

$INGGA,hhmmss.sss,ddmm.mmmm,a,dddmm.mmmm,a,n,n,x.x,x.x,M,,,n,nnnn*hh

Item	Definition	Units / Options
hhmms.ss	UTC time of position	Hours/Minutes/Seconds.decimal.
ddmm.mmmm	Latitude	Degrees/Minutes.decimal.
a	Direction of Latitude	N: North; S: South
dddmm.mmmm	Longitude	Degrees/Minutes.decimal
a	Direction of Longitude	E: East; W: West
n	GPS Quality indicator	0: not valid; 1: Auto fix; 2: DGS fix; 3: PPS fix
n	Number of GPS satellites used in solution fix	n/a
x.x	Horizontal Dilution of Precision	n/a
x.x	Altitude of IMU from Mean Sea Level (MSL)	M; “-“ indicates below seal level
M	Altitude units--M indicates meters	n/a
Null		
Null		
n	Age of corrections used in solution fix	s
nnnn	Differential GPS reference station ID	0000 to 1023
*hh	Checksum	n/a (hexadecimal)

$INGST sentence

$INGST,hhmmss.sss,,x.x,x.x,x.x,x.x,x.x,x.x*hh		
Item	**Definition**	**Units / Options**
hhmms.ss	UTC time of position	Hours/Minutes/Seconds.decimal.
Null	Null	
x.x	Std deviation of semi-major axis of error ellipse	m
x.x	Std deviation of semi-minor axis of error ellipse	m
x.x	Orientation of semi-major axis of error ellipse	Degrees from true north
x.x	Std deviation of latitude	m
x.x	Std deviation of longitude	m
x.x	Std deviation of altitude	m
*hh	Checksum	n/a (hexadecimal)

$INHDT sentence

$INHDT,x.x,T*hh		
Item	**Definition**	**Units / Options**
x.x	Vessel heading	Degrees
T	T = Preceding value is True heading	n/a
*hh	Checksum	n/a (hexadecimal)

$INVTG sentence

$INVTG,x.x,T,,M,x.x,N,x.x,K,a*hh		
Item	**Definition**	**Units / Options**
x.x	True vessel track in the vessel frame	Degrees
T	T = Preceding value is True heading	n/a
Null		
M		M: Magnetic
x.x	Speed in the vessel frame	Knots
N	Preceding value is in Knots	N: Knots
x.x	Speed in the vessel frame	km/h
K	Preceding value is in km/h	K: km/h
a	Mode indicator	n/a
*hh	Checksum	n/a (hexadecimal)

$INZDA sentence

$INZDA,hhmmss.sss,dd,mm,yyyy,,*hh		
Item	**Definition**	**Units / options**
hhmmss.sss	UTC time	Hour/minute/Sec.dec
dd	Day	01-31
mm	Month	01-12
yyyy	Year	
Null		
Null		
*hh	Checksum	n/a (hexadecimal)

$PASHR sentence

`$PASHR,hhmmss.sss,x.xx,T,x.xx,x.xx,x.xx,x.xxx,x.xxx,x.xxx,n,n*3B`

Item	Definition	Units / options
hhmms.ss	UTC time of position	Hours/Minutes/Seconds.decimal.
x.xx	True Vessel Heading	Degrees
T	T = Preceding value is True heading	n/a
x.xx	Roll	Degrees
x.xx	Pitch	Degrees
x.xx	Heave	m
x.xxx	Roll Accuracy	Degrees
x.xxx	Pitch Accuracy	Degrees
x.xxx	Heading Accuracy	Degrees
n	Flag: Accuracy Heading	0: no aiding; 1: GNSS; 2:GNSS & GAMS
n	Flag: IMU	0: IMU out; 1: IMU satisfactory
*hh	Checksum	n/a (hexadecimal)

$PRDID sentence

`$PRDID,x.x,x.x,x.x*hh`

Item	Definition	Units / options
x.x	Pitch	Degrees
x.x	Month	Degrees
x.x	Sensor Heading	Degrees
*hh	Checksum	n/a (hexadecimal)

MGL-seapath.*

The Seapath 330 Inertial Navigation System outputs data to the MGL-seapath.yYYYYdjjj files. The following sentences were recorded:

- $INGGA: Global Positioning System Time, position and fix related data
- $INGLL: Geographic Position - Latitude/Longitude
- $INHDT: True Heading
- $INVTG: Course over Ground and Ground speed Data
- $PSXN,20: Proprietary QC data
- $PSXN,23: Proprietary Attitude

$INGGA sentence

`$INGGA,hhmmss.sss,ddmm.mmmm,a,dddmm.mmmm,a,n,n,x.x,x.x,M,x.x,M,n,nnnn*hh`

Item	Definition	Units / Options
hhmms.ss	UTC time of position	Hours/Minutes/Seconds.decimal.
ddmm.mmmm	Latitude	Degrees/Minutes.decimal.
a	Direction of Latitude	N: North; S: South
dddmm.mmmm	Longitude	Degrees/Minutes.decimal
a	Direction of Longitude	E: East; W: West
n	GPS Quality indicator	0: not valid; 1: Auto fix; 2: DGS fix; 3: PPS fix
n	Number of GPS satellites used in solution fix	n/a
x.x	Horizontal Dilution of Precision	n/a
x.x	Altitude of IMU from Mean Sea Level (MSL)	meters; "-" indicates below seal level
M	Altitude units	n/a (M indicates meters)
x.x	Geoidal separation distance from MSL	m
M	Geoidal separation units	n/a (M indicates meters)
x.x	Age of corrections used in solution fix	s
nnnn	Differential GPS reference station ID	0000 to 1023
*hh	Checksum	n/a (hexadecimal)

$INGLL sentence

`$INGLL,ddmm.mmmm,a,dddmm.mmmm,a,hhmmss.ss,a,a*hh`

Item	Definition	Units / Options
ddmm.mmmm	Latitude	Degrees/Minutes.decimal.
a	Direction of Latitude	N: North; S: South
dddmm.mmmm	Longitude	Degrees/Minutes.decimal
a	Direction of Longitude	E: East; W: West
hhmms.ss	UTC time of position	Hours/Minutes/Seconds.decimal.
a	Status	A: valid; V: not valid
a	Mode	A: GPS; D: DGPS; E: dead reckoning; N:invalid
*hh	Checksum	n/a (hexadecimal)

$INHDT sentence

$INHDT,x.x,T*hh		
Item	**Definition**	**Units / Options**
x.x	True vessel heading	Degrees
T	T = Preceding value is True heading	n/a
*hh	Checksum	n/a (hexadecimal)

$INVTG sentence

$INVTG,x.x,T,,M,x.x,N,x.x,K,a*hh		
Item	**Definition**	**Units / Options**
x.x	True vessel track in the vessel frame	Degrees
T	T = Preceding value is True heading	n/a
Null		
M		M: Magnetic
x.x	Speed in the vessel frame	Knots
N	Preceding value is in Knots	N: Knots
x.x	Speed in the vessel frame	Km/h
K	Preceding value is in km/h	K: km/h
a	Mode indicator	n/a
*hh	Checksum	n/a (hexadecimal)

$PSXN,20 sentence

$PSXN,20,n,n,n,n*hh		
Item	**Definition**	**Units / Options**
20	Sentence ID	20: following words are quality indicators
n	Horizontal position and velocity quality	0: Normal; 1: reduced quality; 2:invalid
n	Height and vertical velocity quality	0: Normal; 1: reduced quality; 2:invalid
n	Heading quality	0: Normal; 1: reduced quality; 2:invalid
n	Roll and pitch quality	0: Normal; 1: reduced quality; 2:invalid
*hh	Checksum	n/a (hexadecimal)

$PSXN,23 sentence

$PSXN,23,x.x,x.x,x.x,x.x*hh		
Item	**Definition**	**Units / Options**
23	Sentence ID	23: following words are attitude data
x.x	Roll	Degrees
x.x	Pitch	Degrees
x.x	Heading	Degrees
x.x	Heave	m
*hh	Checksum	n/a (hexadecimal)

MGL-slog01.*

The Furuno DS-80 Doppler speed log outputs data to files MGL-slog01.y*YYYY*d*jjj*, named after the year YYYY and the julian day jjj. The following sentence types were recorded:

- $VDVBW: Dual Ground/Water Speed
- $VDVLW: Distance Traveled through Water

$VDVBW sentence

$VDVBW,x.x,x.x,a,x.x,x.x,a*hh		
Item	**Definition**	**Units / Options**
x.x	Longitudinal water speed	Knots; - means astern
x.x	Transverse water speed	Knots; - means port
a	Status	A: valid; V: not valid
x.x	Longitudinal ground speed	Knots; - means astern
x.x	Transverse ground speed	Knots; - means port
a	Status	A: valid; V: not valid
*hh	Checksum	n/a (hexadecimal)

$VDVLW sentence

$VDVLW,x.x,N,x.x,N*hh		
Item	**Definition**	**Units / Options**
x.x	Total cumulative water distance	Nautical miles
N	Indicates distance travelled in nautical miles	n/a
x.x	Water distance since last reset	Knots; - means astern
N	Indicates distance travelled in nautical miles	Knots; - means port
*hh	Checksum	n/a (hexadecimal)

MGL-svuss01.*

The AML Oceanographic Micro-X SV Xchange velocity probe outputs serial data to files *MGL-svuss01.yYYYdjjj* in the following format, which doesn't follow the NMEA standard.

xxxx.xxx		
Item	**Definition**	**Units / Options**
xxxx.xxx	Sound velocity	m/s

MGL-tsgraw.*

The SeaBird SBE45 MicroTSG Thermosalinograph outputs serial data to files *MGL-tsgraw.yYYYYdjjj* in the following format, which doesn't follow the NMEA standard. Each data item is listed by its code and its value separated by "=".

`t1= xx.xxxx, c1= x.xxxxx, s= xx.xxxx, sv=xxxx.xxx, t2= xx.xxxx`

Item	Definition	Units / options
t1	Temperature	°C
c1	conductivity	S/m (Siemens/meter)
s	salinity	ppt
sv	Sound velocity	m/s
t2	Remote Temperature	°C

MGL-vaisala1.*

The meteorological data from the Vaisala integrated ultrasonic weather stations is output to files *MGL-vaisala1.yYYYdjjj*. The following sentences were recorded:

- $WIMWV: wind speed and angle
- $WIXDR: all transducers data

$WIMWV sentence

`$WIMWV,n,a,x.x,a,a*hh`

Item	Definition	Units / Options
n	Wind direction, referenced to instrument axis	Degrees
a	Reference	R: relative; T: Theoretical
x.x	Wind speed	Defined by next word
a	Wind Speed Unit	N: knots; K: km/h; M: m/s
a	Status	A: valid; V: not valid
*hh	Checksum	n/a (hexadecimal)

$WIXDR sentence

`$WIXDR,C,x.x,C,0,C,x.x,C,1,H,x.x,P,0,P,x.x,H,0*hh`

Item	Definition	Units / Options
C	Transducer id 0 type	C: Temperature
x.x	Transducer id 0 data (Temperature)	°C
C	Transducer id 0 Unit	C: °C
0	Transducer id for temperature	n/a
C	Transducer id 1 type	C: Temperature
x.x	Transducer id 1 data (Internal Temperature)	°C
C	Transducer id 1 Unit	C: °C
1	Transducer id for internal temperature	n/a
H	Transducer id 0 type	H: Humidity
x.x	Transducer id 0 data (humidity)	%
P	Transducer id 0 Unit	P: %

0	Transducer id for humidity	n/a
P	Transducer id 0 type	P: Pressure
x.x	Transducer id 0 data (pressure)	hPa
H	Transducer id 0 Unit	H: hPa
0	Transducer id for pressure	n/a
*hh	Checksum	n/a (hexadecimal)

MGL-vc01.*

The gravimeter serial data is output to files MGL-vc01.y*YYYY*d*jjj* in the following format, which doesn't follow the NMEA standard.

04:nnnnnn a

Item	Definition	Units
04	output frequency	0.25Hz (4 = 4 × clock periods = 1Hz)
nnnnnn	raw counts	n/a
a	sensor status	n/a

IX. Operation and Log files Description

docs/operations/Daily_Reports contains the daily production report compiled by the CSO.

docs/operations/NavLogs contains line logs for the Orca Integrated Navigation System on a sequence by sequence basis.

docs/operations/ObsLogs contains line logs made by the observer on the gun controller and Seal acquisition system, on a sequence by sequence basis.

docs/operations/Science_Support_Plan contains all of the revisions of the plan which details the intended survey activity.

docs/operations/StreamerSheets contains serial number and configuration documentation for each streamer deployed during the cruise.

docs/reports/ MGL2314_streamer_QC.pdf is an automatically generated report with figures to provide a quick QC assessment for each sequence: the streamer tension, the vessel speed through water (STW) and over ground (SOG), the heading and depth of all birds, the source volume, a measure of the noise along the streamer and the display of a single receiver, all displayed along shotpoint numbers.

docs/segd_logs contains listings off all the SEGD files recorded, on a sequence by sequence basis, (MGL2314*SeqLine*.segdlog) for the processed files, and on a daily basis (MGL2314_raw_segd_*YYYYMMDD*.csv) for the continuous files. Informations recorded include the FFID, shot point, time and source volume for each shot, as well as the ID of the continuous files used for each processed SEGD file.

raw/obsip and **processed/obsip** contain files (***.shotlog**) for each sequence with the high precision time, the position of the ship and position of the source recorded for each shot point. **raw/obsip** also contain files (***.source.csv**) with the number of guns, the total volume and the manifold pressure for each shot point.
All the files are named after the sequence number, line name and pass identifier, MGL2314*SeqLinePid*.*. The files under raw were created from the orca headers during acquisition, while the processed files are generated from the processed P190 files.

raw/MGL2314_serial_data_1min.csv and **raw/MGL2314_serial_data_10s.csv** are comma separated values (csv) files with record of various key serial data, sampled and filtered every minute and 10 second, respectively.

raw/orca/MGL2314_orca_sequences.csv is a table of sequences automatically generated from the orca database.

raw/orca/MGL2314_orca_shots.csv is an automated list of all the shots triggered by orca, sorted by sequence.

raw/orca/MGL2314_orca_vessel.csv lists the ship positions and acquisition status recorded every minute by orca.