RV Langseth
Data Reduction Summary

MGL2208

Harris Heat Flow & MCS
July 31st, 2022 – August 28th, 2022

V2.0, 2023-12-12

Lamont-Doherty Earth Observatory, Columbia University

Date	Julian Date	Time	Port
2022-07-31	212	0000 UTC	Newport, Oregon
2022-08-28	240	0000 UTC	Newport, Oregon

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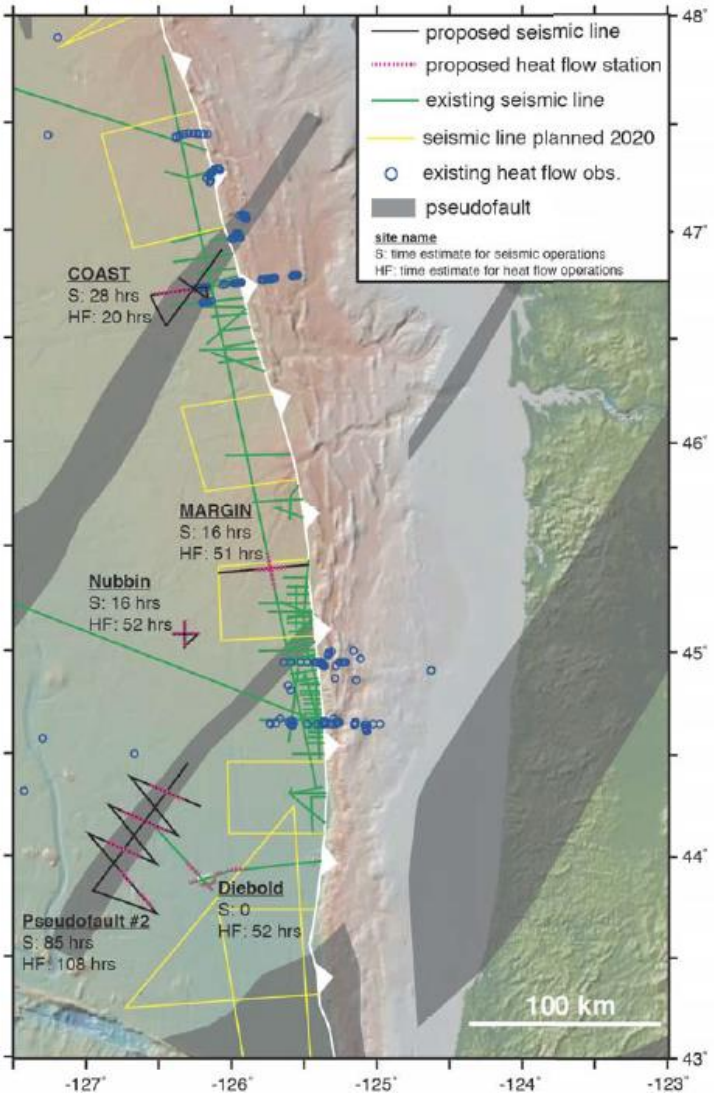
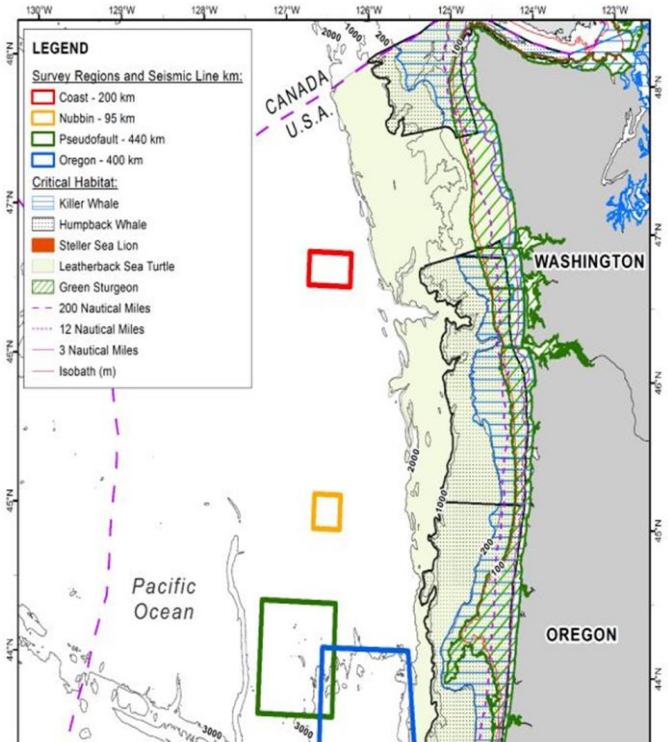
I. Background and Scientific Objectives

The primary objective of this proposal is to understand the thermal structure of the Juan de Fuca plate as it enters the Cascadia subduction zone. Prior heatflow measurements across the flank of a buried seamount near the subduction zone offshore Washington suggest that the basement surface is approximately isothermal, which implies high permeability and fluid flow within the oceanic crust and an impermeable seal at the seafloor. Prior work on young crust near the Juan de Fuca Ridge indicate that the crustal flow paths are connected over large distances when basement outcrops are present. Recent seismic data indicate that buried seamounts are more widely distributed than previously thought, and some of these seamounts show seismic evidence for fluid flow into the overlying sediments, which is inconsistent with the idea that the thermal regime is conductive. The proposed study would acquire heat flow and seismic data across several distinct structures that have not been previously studied, including a pseudofault, buried seamounts, and small areas of exposed basement outcrops that represent the summit of much larger buried seamounts. Although existing seismic and bathymetric data are adequate for identifying targets for heat flow measurements, they are not adequate for determining basement and sediment structure in order to interpret heat flow observations.


proposed seismic line
proposed heat flow station
existing seismic line
seismic line planned 2020
existing heat flow obs.
pseudofault
site name
S: time estimate for seismic operations
HF: time estimate for heat flow operations
COAST
S: 28 hrs
HF: 20 hrs
MARGIN
S: 16 hrs
HF: 51 hrs
Nubbin
S: 16 hrs
HF: 52 hrs
Diebold
S: 0
HF: 52 hrs
Pseudofault #2
S: 85 hrs
HF: 108 hrs
100 km
48°
47°
46°
45°
44°
43°
-127°
-126°
-125°
-124°
-123°


LEGEND
Survey Regions and Seismic Line km:
Coast - 200 km
Nubbin - 95 km
Pseudofault - 440 km
Oregon - 400 km
Critical Habitat:
Killer Whale
Humpback Whale
Steller Sea Lion
Leatherback Sea Turtle
Green Sturgeon
200 Nautical Miles
12 Nautical Miles
3 Nautical Miles
Isobath (m)
CANADA
U.S.A.
WASHINGTON
OREGON
Pacific Ocean

II. Personnel

#	Name	Position	Nationality + Passport #	DOB	Date Embark	Place Embark
1	Crum, Breckenridge C.	Master			9-Jul-22	San Diego, CA
2	Turn, Stephen L.	Chief Mate			9-Jul-22	San Diego, CA
3	Pletcher, Ryan T.	3rd Mate			16-Jul-22	Newport, OR
4	Hurley, Patrick R.	3rd Mate			9-Jul-22	San Diego, CA
5	Redito, Ricardo M.	Bosun			9-Jul-22	San Diego, CA
6	Rimando, Inocencio B.	AB			9-Jul-22	San Diego, CA
7	Hammond, Robert D.	AB			9-Jul-22	San Diego, CA
8	Kerns, Mary G.	AB			17-Jul-22	Newport, OR
9	Rillera De Guzman, Marcialleo	OS			9-Jul-22	San Diego, CA
10	Butler, Gerald O.	Chief Engr.			9-Jul-22	San Diego, CA
11	Mong, Robert K.	1st A/E			18-Jul-22	Newport, OR
12	Valdiconza, Luke A.	2nd A/E			9-Jul-22	San Diego, CA
13	Baxter-Harwell, Winston G.	3rd A/E			9-Jul-22	San Diego, CA
14	Baker, Malcolm W.	Oiler			1-Aug-22	Newport, OR
15	Cochrane, Rodney L.	Oiler			1-Aug-22	Newport, OR
16	Walsh, Joseph B.	Oiler			17-Jul-22	Newport, OR
17	Dreis, Ryan C.	Wiper			11-Jul-22	San Diego, CA
18	McLean Fuller, Hervin	Steward			9-Jul-22	San Diego, CA
19	Martires, Leoncio R.	Cook			9-Jul-22	San Diego, CA
20	Dykstra, Christiaan	Cook / OS			29-Apr-22	Newport, OR
21	Bahlau, Cody	Tech			30-Jul-22	Newport, OR
22	Kasinger, Josh	Tech			30-Jul-22	Newport, OR

23	Walker, Mark	Tech			16-Jul-22	Newport, OR
24	Parolski, Albert	Tech			1-Aug-22	Newport, OR
25	Agee, Brian	Tech			30-Jul-22	Newport, OR
26	Spinelli, Glenn	Science			1-Aug-22	Newport, OR
27	Trehu, Anne	Science			1-Aug-22	Newport, OR
28	Harris, Robert	Science			1-Aug-22	Newport, OR
29	Kiger, Mandy	Science			1-Aug-22	Newport, OR
30	Dickerson, Kristen	Science			1-Aug-22	Newport, OR
31	Jiang, Danqi	Science			1-Aug-22	Newport, OR
32	Stanbury, Clara	Science			1-Aug-22	Newport, OR
33	Kyritz, Thomas	Science			1-Aug-22	Newport, OR
34	Norvell, Benjamin	Science			1-Aug-22	Newport, OR
35	Islam, Ariful	Science			1-Aug-22	Newport, OR
36	Mukhatzhanov, Aldiyar	Science			1-Aug-22	Newport, OR
37	Perry, Matt	Science			1-Aug-22	Newport, OR
38	Russell, Ben	Science			1-Aug-22	Newport, OR
39	Perrin, Robert	Science			1-Aug-22	Newport, OR
40	McLeod, Justin	Science			2-Aug-22	Newport, OR
41	Dubuque, Amanda	PSO			2-Aug-22	Newport, OR
42	Frey, Cassandra	PSO			2-Aug-22	Newport, OR
43	Lira, Ana Rosa	PSO			2-Aug-22	Newport, OR
44	Klein, Michelle	PSO			2-Aug-22	Newport, OR
45	Ortega, Jimena	PSO			2-Aug-22	Newport, OR
46	Martinez, Maritza	PSO			2-Aug-22	Newport, OR

III. Instrumentation Summary

All science instruments aboard the Langseth are listed below with data formats in section VI. Summary notes on operation during this cruise are listed below.

Instrument Data Files

Instrument	Description	Data Set	Data Outputs	Files	Interval
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
DS80	Furuno DS80 Doppler Speedlog	Full	serial logs	MGL-slog01.*	1s
XBT/XCTD	Sippican MK21 XBT/XCTD Launcher	Not used	raw output to file	See below	n/a
TSG	SeaBird SBE45 Thermosalinograph	Full	raw serial logs	MGL-tsgraw.*	1s
CNAV3050 Stern	C&C Tech. CNAV 3050 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	Not used	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
MICROSV	Applied Microsystems Sound Velocity USS Unit	Full	serial logs	MGL-svuss01.*	1s
ADCP	RDI OS75 Current Profiler	Full	serial logs	MGL-adcp.*	N/A
Vaisala	Vaisala WXT-520 Ultrasonic Weather Station	Full	serial logs	MGL-vaisala1.*	1s
Vaisala	Vaisala WXT-520 Ultrasonic Weather Station	Full	serial logs	MGL-vaisala2.*	1s

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

IV. Data Strings

EM-122 Multibeam
EM122 swath data is saved to the cruise archive under MGL2208/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. Data gaps are approximately 8-12 minutes in duration, and every effort is made to schedule them during turns or areas where coverage already exists. See MGL2208/docs/elog for times and durations of tests.

File id: bath02
Logging interval: variable with water depth

bath02 data format:

```
bath02      2008:192:00:00:12.6663  $KIDPT,2938.25,0.0,12000.0*4a
bath02      2008:192:00:00:30.3301  $KIDPT,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 operated only in permitted areas for the length of the cruise. Data written in proprietary KEB, KEA, and SEGY format. Reference MGL2208/docs/elog for information on any data gaps or degraded operation.

DS80 Speedlog
The Furuno DS-80 is a Doppler speed log. Reference MGL2208/docs/elog for information on any data gaps or degraded operation.

File id: slog01
Logging interval: 1 second

slog01 data format:

```
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
```

CNAV3050
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. Reference MGL2208/docs/elog for information on any data gaps or degraded operation.
File id: cnav
Logging interval: 1 second

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. Reference MGL2208/docs/elog for information on any data gaps or degraded operation.

File id: cnav3050all
Logging interval: 1 second

cnav3050 data format:

```
cnav3050all 2020:284:00:00:00.9338
      $GNGGA,000000.00,5408.8791,N,16627.4934,W,2,18,0.7,36.5,M,0.0,M,6.0,0678*4C
cnav3050all 2020:284:00:00:00.9916
      $PNCTGGA,000000.00,5408.879124,N,16627.493375,W,2,18,0.7,36.484,M,0.000,M,6.0
,0436*4A
cnav3050all 2020:284:00:00:00.9917
      $GNGLL,5408.879124,N,16627.493375,W,000000.00,A,D*63
cnav3050all 2020:284:00:00:01.0520  $GNVTG,355.3,T,,M,9.03,N,16.72,K,P*3A
cnav3050all 2020:284:00:00:01.0521  $GNZDA,000000.00,10,10,2020,00,00*78
cnav3050all 2020:284:00:00:01.1085
      $GNGSA,A,3,01,03,04,06,09,17,19,22,25,31,,,1.5,0.7,1.3,1*32
cnav3050all 2020:284:00:00:01.1086
      $GNGSA,A,3,65,66,67,74,75,81,82,88,,,,,1.5,0.7,1.3,2*33
```

GC80 Gyrocompass

The GC80 gyrocompass is installed on the bridge and used for ship and seismic navigation. Reference MGL2208/docs/elog for information on any data gaps or degraded operation.

File id: gy01
Logging interval: 1 second

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 320

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. Reference MGL2208/docs/elog for information on any data gaps or degraded operation.

File id: posmv
Logging interval: 1 second

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 330
The Kongsberg Seapath is an inertial navigation system. Operational for the duration of the cruise. Reference MGL2208/docs/elog for information on any data gaps or degraded operation.

File id: seapath
Logging interval: 1 second

seapath data format:

```
seapath     2020:283:00:00:00.4225
      $INGGA,000000.18,5354.327837,N,16631.306673,W,2,08,1.0,9.98,M,9.48,M,2.0,0291
*7F
seapath     2020:283:00:00:00.6563
      $INGLL,5354.327837,N,16631.306673,W,000000.18,A,D*6E
seapath     2020:283:00:00:00.6564  $INVTG,307.97,T,299.43,M,0.0,N,0.0,K,D*39
seapath     2020:283:00:00:00.6565  $INHDT,232.73,T*12
seapath     2020:283:00:00:00.6566  $PSXN,20,0,0,0,0*3B
seapath     2020:283:00:00:00.7294  $PSXN,23,0.03,0.83,232.73,0.01*36
```

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. Reference MGL2208/docs/elog for information on any data gaps or degraded operation.

Logging interval: 1 second
File id: mag01
mag01 data sample:

```
mag01 2015:329:00:00:01.2776  $ 45499.940,0881,0691
mag01 2015:329:00:00:01.3735  $ 45500.167,0879,0691
mag01 2015:329:00:00:01.4695  $ 45499.940,0874,0691
```

SBE-45 Thermosalinograph
The Seabird TSG output is logged by LDS to the "tsgraw" set. Reference MGL2208/docs/elog for information on any data gaps or degraded operation.

File id: tsgraw
Logging interval: 1 second

tsgraw data sample:
```
tsgraw      2015:337:00:01:15.3000  t1= 18.9500, c1= 5.17155, s= 39.1095,
sv=1522.706, t2= 18.7851
tsgraw      2015:337:00:01:25.3004  t1= 18.9526, c1= 5.17196, s= 39.1105,
sv=1522.715, t2= 18.7878
tsgraw      2015:337:00:01:35.3018  t1= 18.9539, c1= 5.17219, s= 39.1113,
sv=1522.720, t2= 18.7892
```

BGM-3 Gravimeter
The Bell Aerospace BGM-3 Gravimeter operated normally during the length of this cruise. Reference MGL2208/docs/elog for information on any data gaps or degraded operation.
File id: vc01
Logging interval: 1 second

vc01 data format:
```
vc01  2011:130:00:00:08.2866  01:024436 00
vc01  2011:130:00:00:09.2926  01:024548 00
```

AML Oceanographic – Micro-X SV-Xchange sensor Unit
Reference MGL2208/docs/elog for information on any data gaps or degraded operation.

File id: svuss01
Logging interval: 1 second
svuss01 data format:
```
svuss01     2015:338:00:00:15.1382   1521.897
svuss01     2015:338:00:00:16.1282   1521.900
```

Mk21 XBT System

Files: *.RDF,*.EDF

XBT drops were made during this cruise. The data set(s) are saved to the raw/XBT directory in the cruise archive. Refer to the MGL2208 Expendable Drops.xls spreadsheet in the docs/operations directory of the cruise archive for more information.

Vaisala Meteorological Ultrasonic Integrated Weather
The weather station is used to log wind speed, direction, air temperature, relative humidity, precipitation, dew point, and barometric pressure. The unit was functioning during the cruise. Reference MGL2208/docs/elog for information on any data gaps or degraded operation.

File id: vaisala1
Logging interval: 1 second

vaisala data format:

```
vaisala     2015:346:00:00:00.0038 $WIMWV,129,R,15.7,N,A*04
vaisala     2015:346:00:00:00.9930 $WIXDR,A,125,D,0,A,129,D,1,A,134,D,2,S,15.3,N
,0,S,15.7,N,1,S,16.5,N,2,C,14.2,C,0,C,14.4,C,1,H,52.9,P,0,P,1018.3,H,0,V,0.00,M,0,Z
,0,s,0,R,0.0,M,0,V,0.0,M,1,Z,0,s,1,R,0.0,M,1,R,66.5,M,2,R,0.0,M,3*6D
```

File id: vaisala2
Logging interval: 1 second

vaisala data format:

```
vaisala     2015:346:00:00:00.0038 $WIMWV,129,R,15.7,N,A*04
vaisala     2015:346:00:00:00.9930 $WIXDR,A,125,D,0,A,129,D,1,A,134,D,2,S,15.3,N
,0,S,15.7,N,1,S,16.5,N,2,C,14.2,C,0,C,14.4,C,1,H,52.9,P,0,P,1018.3,H,0,V,0.00,M,0,Z
,0,s,0,R,0.0,M,0,V,0.0,M,1,Z,0,s,1,R,0.0,M,1,R,66.5,M,2,R,0.0,M,3*6D
```

Offsets

All antenna and in-water offset drawings are in the file ***MGL2208_Offsets_MCS_900m_Streamer***

Orca

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

SeisPos

SeisPos is used for post processing of Orca UKOOA P294 files to produce UKOOA P190 files with improved positioning.

V. Acquisition Parameter Table(s)

Acquisition Parameter Table 1	
FieldActivityID	MGL2208
Acquisition_sequence(s)	Seq 1 – 7 and 9 - 20
ReceiverType	MCS
SourceType	Airgun
Acquisition System Name	Sercel Seal 408
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 330 calculated center of gravity) waterline
Antenna(NRP)_to_source	302 m
Source_to_Near_Channel	101 m
Number_of_channels_recorded	144
Number_of_cables	1
Number_of_channels_each_cable	144
Channel_length	6.25 m
Cable_length	900m
Cable_spacing	Applicable to multi-streamer MCS only
Near_Channel_Number	1
Cable_depth	4
Number_sources	1
Sub-arrays_per_source	1 – refer to logs for sub-arrays in use
Flipflop_shooting (dual source alternating)	False
Source_separation	Applicable to flipflop (dual source alternating) only
Sub-array_separation	n/a
Source_volume	90
Source_pressure	2000 psi nominal
Source_make,model	2 GI air gun cluster, in true GI(45/105) mode
Source_element_number	2
Source_depth	3 m
Shot_control	Distance
Shot_Interval	25m
Sample_interval	0.5 ms
Record_length	8 s
Compass_birds	7
Recording_delay	False
Active_tail_buoy	Yes
Multiple_ships	False

Acquisition Parameter Table 2	
FieldActivityID	MGL2208
Acquisition_sequence(s)	Seq 8
ReceiverType	MCS
SourceType	Airgun
Acquisition System Name	Sercel Seal 408
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 330 calculated center of gravity) waterline
Antenna(NRP)_to_source	235 m
Source_to_Near_Channel	167.5 m
Number_of_channels_recorded	144
Number_of_cables	1
Number_of_channels_each_cable	144
Channel_length	6.25 m
Cable_length	900m
Cable_spacing	Applicable to multi-streamer MCS only
Near_Channel_Number	1
Cable_depth	4
Number_sources	1
Sub-arrays_per_source	1 – refer to logs for sub-arrays in use
Flipflop_shooting (dual source alternating)	False
Source_separation	Applicable to flipflop (dual source alternating) only
Sub-array_separation	n/a
Source_volume	90
Source_pressure	2000 psi nominal
Source_make,model	2 GI air gun cluster, in true GI(45/105) mode
Source_element_number	2
Source_depth	3 m
Shot_control	Distance
Shot_Interval	25m
Sample_interval	0.5 ms
Record_length	8 s
Compass_birds	7
Recording_delay	False
Active_tail_buoy	Yes
Multiple_ships	False

VI. RV Langseth Gravity Tie Information

Please refer to the documents located under MGL2208/docs/gravity_tie for detailed records.

VII. Archive Contents

Key files are bolded.

MGL2208/docs	Cruise documents and logs
MGL2208/docs/elog	Cruise elog
MGL2208/docs/gravity_tie	Gravity Tie information
MGL2208/docs/map	Cruise maps, track map
MGL2208/docs/offsets	Vessel/sensor offsets
MGL2208/docs/operations/	Operations documents
MGL2208/docs/operations/Daily_Reports	Cruise Daily Reports from Chief Science Officer
MGL2208/docs/operations/NavLogs	Seismic navigation logs (orca)
MGL2208/docs/operations/ObsLogs	Seismic acquisition logs (gun controller)
MGL2208/docs/operations/MGL2208_B15_line_log_multi_channel_seismics.xls	**Master line log table**
MGL2208/docs/permits	Clearance Documents
MGL2208/docs/waypoints	Waypoint files
MGL2208/docs/personnel	Personnel rosters, org chart, bunk and phone lists
MGL2208/docs/reports/MGL2208_DataReport_v1.0.doc	**This file**
MGL2208/docs/offsets/MGL2208_Offsets_MCS.xls	**Vessel/sensor offsets**
MGL2208/processed	Processed data
MGL2208/processed/reflex (3D data-sets only, not applicable to OBS and 2D)	Orca reflex files
MGL2208/processed/obsip	Shot log files & Source vol
MGL2208/processed/seispos	Seispos UKOOA P190s
MGL2208/processed/svp	Sound velocity profiles
MGL2208/raw	Raw data
MGL2208/raw/adcp	Raw ADCP data
MGL2208/raw/knudsen	Raw Knudsen sub-bottom profiler data
MGL2208/raw/MarkeyWinch	DESH-5 Winch Tension / Payout data files
MGL2208/raw/multibeam	Raw EM122 data
MGL2208/raw/serial	Underway serial data: gps, tsg, weather, etc.
MGL2208/raw/orca/P1	orca underway p190

MGL2208/raw/orca/P2	Raw seismic navigation, p294
MGL2208/raw/XBT	Raw XBT data

VIII. 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 /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-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 /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

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

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 lllllllllllllll
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
lllllllllllllll	linename	n/a

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.llllll, 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.llllll	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	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

SEAPATH 330 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, hhmmss.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	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	

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

AML Oceanographic Micro-X XChange 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

Vaisala Ultrasonic Meteorological Station Data
The meteorological data from the Viasala integrated ultrasonic weather station is output in the following sentence format:
$WIMWV,105,R,3.8,N,A*32
$WIMWV,x.x,R,y.y,N,A*32

Item	**Definition**	**Units**
x.x	Wind direction value: Wind direction is given in relation to the devices north-south axis.	Degrees
R	Wind direction unit (R = relative)	n/a
y.y	Wind speed value	Knots
N	Wind speed unit (knots	n/a
A	Data status: A = valid, V = Invalid	n/a

$WIXDR,A,105,D,0,A,105,D,1,A,105,D,2,S,3.7,N,0,S,3.8,N,1,S,3.9,N,2,C,27.2,C,0,C,28.4,C,1,H,70.5,P,0,P,1013.5,H,0,V,0.00,M,0,Z,0,s,0,R,0.0,M,0,V,0.0,M,1,Z,0,s,1,R,0.0,M,1,R,1.7,M,2,R,0.0,M,3*6D

$WIXDR,A,xxx,D,0,A,xxx,D,1,A,xxx,D,2,S,x.x,N,0,S,x.x,N,1,S,x.x,N,2,C,xx.x,C,0,C,xx.x,C,1,H,xx.x,P,0,P,xxxx.x,H,0,V,x.xx,M,0,Z,0,s,0,R,x.x,M,0,V,x.x,M,1,Z,0,s,1,R,x.x,M,1,R,x.x,M,2,R,x.x,M,3*6D

Item	**Definition**	**Units**
A	**Transducer id 0 type (Wind Direction)**	**n/a**
xxx	Transducer id 0 data (min wind direction)	Degrees
D	Transducer id 0 units (degrees, min wind direction)	n/a
0	Transducer id for min wind direction	n/a
A	Transducer id 1 type (wind direction)	n/a
xxx	Transducer id 1 data (average wind direction)	Degrees
D	Transducer id 1 units (degrees, average wind direction)	n/a
1	Transducer id for average wind direction	n/a

A	Transducer id 2 type (wind direction)	n/a
xxx	Transducer id 2 data (max wind direction)	Degrees
D	Transducer id 2 units (degrees, max wind direction)	n/a
2	Transducer id for max wind direction	n/a
S	**Transducer id 0 type (wind speed)**	**n/a**
x.x	Transducer id 0 data (min wind speed)	Knots
N	Transducer id 0 units (Knots, min wind speed)	n/a
0	Transducer id for min wind speed	n/a
S	Transducer id 1 type (wind speed)	n/a
x.x	Transducer id 1 data (average wind speed)	Knots
N	Transducer id 1 units (Knots, average wind speed)	n/a
1	Transducer id for average wind speed	n/a
S	Transducer id 2 type (wind speed)	n/a
x.x	Transducer id 2 data (max wind speed)	Knots
N	Transducer id 2 units (Knots, max wind)	n/a
2	Transducer id for max wind speed	n/a

C	**Transducer id 0 type (Temperature)**	**n/a**
xx.x	Transducer id 0 data (Temperature)	Celcius
C	Transducer id 0 units (C, Temperature)	n/a
0	Transducer id for Temperature	n/a
C	**Transducer id 1 type (temperature)**	**n/a**
xx.x	Transducer id 1 data (Tp internal temperature)	Celcius
C	Transducer id 1 units (C, Tp internal temperature)	n/a
1	Transducer id for Tp internal temperature	n/a
H	**Transducer id 0 type (Humidity)**	**n/a**
xx.x	Transducer id 0 data (Humidity)	% Reletive Humidity
P	**Transducer id 0 units (%, Humidity)**	**n/a**
0	Transducer id for Humidity	n/a
P	**Transducer id 0 type (Pressure)**	**n/a**
xxxx.x	Transducer id 0 data (Pressure)	hPA
H	Transducer id 0 units (hPa, Pressure)	n/a
0	Transducer id for Pressure	n/a

V	**Transducer id 0 type (Accumulated rainfall)**	**n/a**

x.xx	Transducer id 0 data (Accumulated rainfall)	millimeters
I	Transducer id 0 units (mm, Accumulated rainfall)	n/a
0	Transducer id for Accumulated rainfall	n/a
Z	**Transducer id 0 type (Rain duration)**	**n/a**
xx	Transducer id 0 data (Rain duration)	seconds
s	Transducer id 0 units (s, Rain duration)	n/a
0	Transducer id for Rain duration	n/a
R	**Transducer id 0 type (Rain intensity)**	**n/a**
x.x	Transducer id 0 data (Rain intensity)	mm/hr
M	Transducer id 0 units (mm/h, Rain intensity)	n/a
0	Transducer id for Rain intensity	n/a
V	**Transducer id 1 type (Hail accumulation)**	**n/a**
x.x	Transducer id 1 data (Hail accumulation)	hits/cm2
M	Transducer id 1 units (hits/cm2, Hail accumulation)	n/a
1	Transducer id for Hail accumulation	n/a
Z	**Transducer id 1 type (Hail duration)**	**n/a**
x	Transducer id 1 data (Hail duration)	seconds
s	Transducer id 1 units (s, Hail duration)	n/a
1	Transducer id for Hail duration	n/a
R	**Transducer id 1 type (Hail intensity)**	**n/a**
x.x	Transducer id 1 data (Hail intensity)	hits/cm2h
M	Transducer id 1 units (hits/cm2h, Hail intensity)	n/a
1	Transducer id for Hail intensity	n/a
R	**Transducer id 1 type (Rain peak intensity)**	**n/a**
x.x	Transducer id 1 data (Rain peak intensity)	mm/h
M	Transducer id 1 units (mm/h, Rain peak intensity)	n/a
2	Transducer id for Rain peak intensity	n/a
R	**Transducer id 1 type (Hail peak intensity)**	**n/a**
x.x	Transducer id 1 data (Hail peak intensity)	hits/cm2
M	Transducer id 1 units (hits/cm2, Hail peak intensity)	n/a