

# CEVICHE Cruise Report



MGL1701

Valparaiso to Valparaiso, Chile

Jan 11<sup>th</sup> to Feb 18<sup>th</sup>, 2017

## Summary:

The Crustal Examination from Valdivia to Illapel to Characterize Huge Earthquake (CEVICHE) experiment acquired nearly 5,000 km of 2D seismic reflection data on the R/V Langseth using a 15-km-long seismic streamer and 6600 in<sup>3</sup> seismic airgun array. The goal of the project was to examine the crustal structure of ~1,000 km of the Central Chile margin from the Illapel region in the north to the southern end of Chiloe Island. This segment of the margin has recently generated three great earthquakes: the 1960, Mw 9.5 Valdivia earthquake in the south (the largest earthquake ever recorded); the 2010, Mw 8.8 Maule earthquake north of and slightly overlapping with the Valdivia event; and the 2015, Mw 8.4 Illapel earthquake, just north of Valparaiso. During the 38 day cruise we acquired three dip lines in the Illapel region, six dip lines across the Maule region, two of which are in the overlap with the Valdivia slip zone, and seven additional dip lines within the Valdivia region. Four of the dip lines overlap with OBS transects acquired during earlier seismic acquisition by German scientists during the SPOC, TIPTEQ and JC23 projects in 2001, 2004, and 2008, respectively. In addition to the dip lines we also acquired connecting coast parallel strike lines along the shelf and intermittently along the mid-slope region and on the subducting plate seaward of the trench. These data will help us determine the geometry of the subducting plate, the structure and tectonic history of the upper plate, the fate of trench sediments (which varies from a few 100m in the Illapel region to > 2.5 km in the Valdivia region) and their role in developing the plate-boundary thrust geometry and properties. With these results we will assess what factors cause irregular, spatially varying rupture segments in the Illapel and Maule rupture zones by comparison to the very regular, spatially consistent Valdivia rupture segment.

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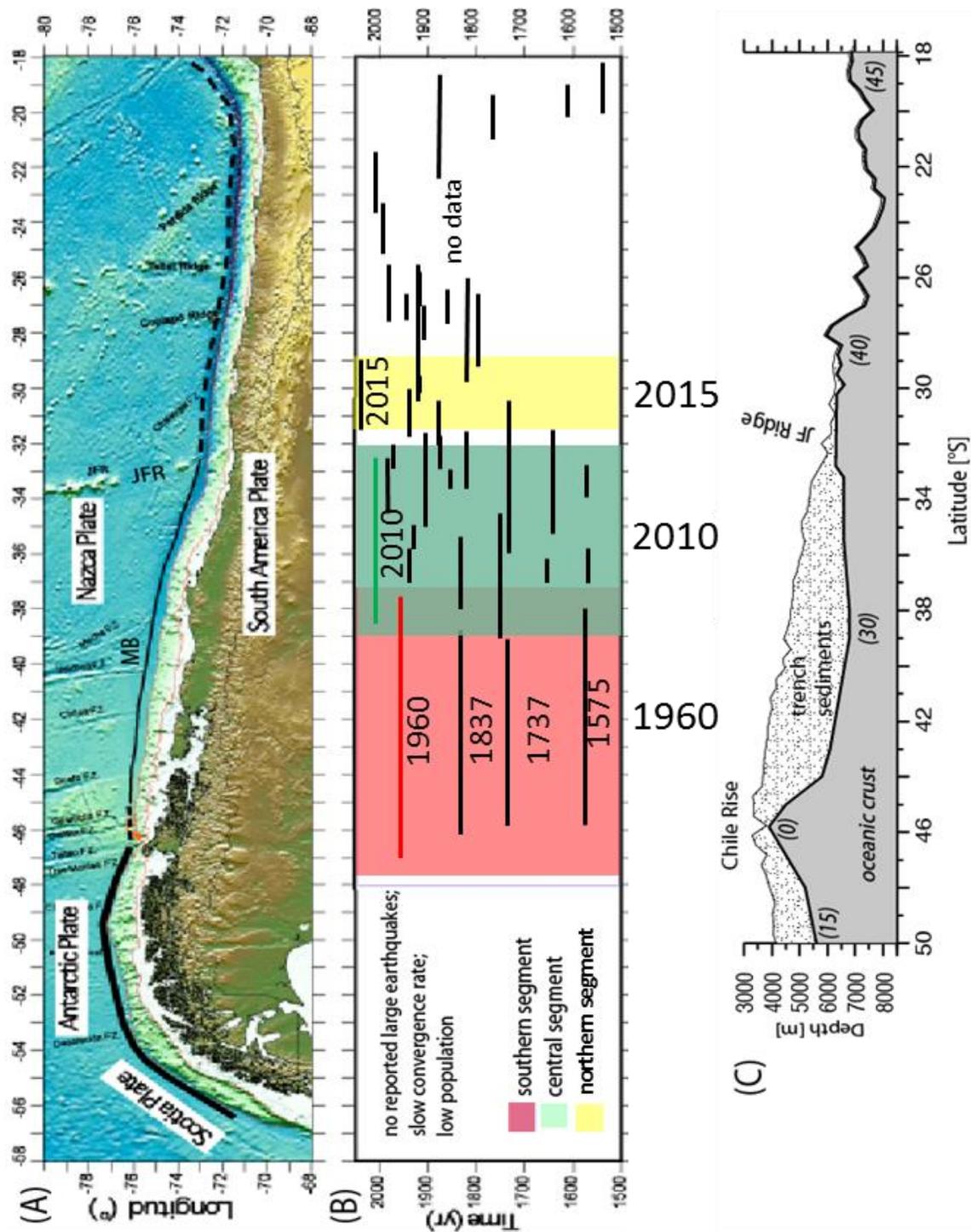
## Science Objectives:

Great earthquake rupture along the south central Chile margin dramatically illustrates variations in earthquake slip behavior that occurs in subduction zones around the world. On May 22, 1960, a 1000-km-long segment of the Nazca plate between the Chile triple junction in the south to the Mocha fracture zone in the north slipped beneath the Chile margin and generated a Mw 9.5 event. This event remains one of the most energetic earthquake ever recorded by modern instrumentation (e.g. Plafker and Savage, 1970), and caused an estimated 1,000 to 6,000 casualties. It was preceded a day earlier by a Mw 8.1 foreshock followed by additional foreshock activity that migrated over a period of 33 hours to the epicenter of the mainshock (Fig. 1; Cifuentes, 1989). It also generated a devastating tsunami with wave heights up to 25 m, that resulted in as many as 2,000 deaths in Chile and 250 deaths around the Pacific Rim, including 61 in Hawaii. In addition to the large size, what is remarkable about this segment is that historical data indicate that this segment of the Chile subduction zone has repeatedly slipped as a coherent 1000-km-long segment for every known event over the past 440 years (Fig. 1B; Comte and Pardo, 1991).

In contrast, rupture to the north has very irregular characteristics. On February 27, 2010, the Mw 8.8 Maule earthquake ruptured a ~500-km-long segment of plate boundary that overlapped with and extended to the north of the 1960 rupture (e.g. Moreno et al., 2010; Lay et al., 2010; Loreto et al. 2011). What is remarkable is that this 500-km long rupture is unusually long for this segment of the margin. Historically ruptures along this segment are much smaller and the rupture length and location for individual events varies considerably both spatially and temporally (Fig. 1B). Sometimes individual patches ~100 km long rupture whereas at other times (as during the Maule earthquake), several patches slipped in a single large event (Fig. 1B). Although it generated a tsunami that devastated the port of Talcahuano, the tsunami was uncharacteristically small for a Mw 8.8 earthquake.

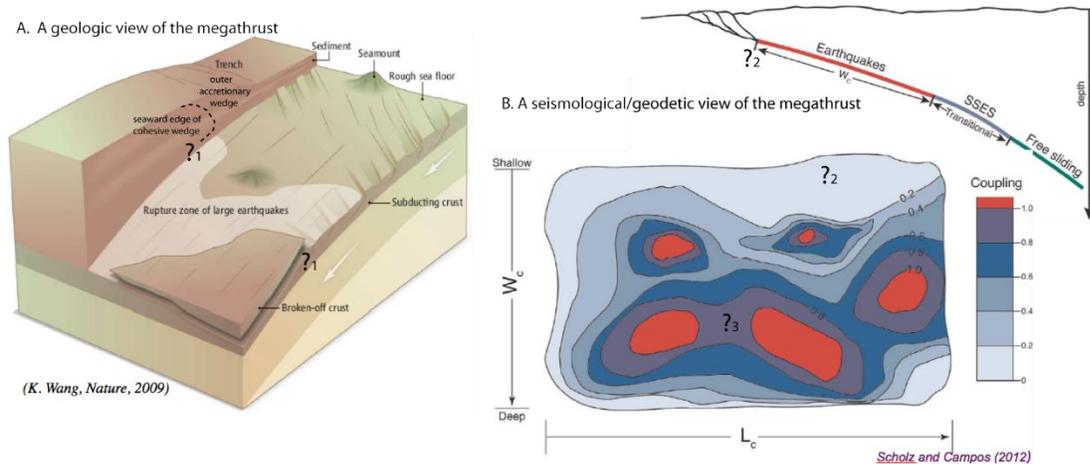
The original proposal for this project focused on the rupture zone of these two major events. However, on September 16, 2015, a month after submission of the proposal, an Mw 8.4 event (known as the Illapel earthquake) filled a seismic gap north of the 2010 event. The funded cruise was augmented by 8 days so that the seismic survey could cover the source region of the Illapel earthquake, which occurred on a sediment-starved segment of the Chile trench. In addition to the Illapel earthquake, only 2 weeks before the cruise, on Dec. 25, 2016, a Mw 7.6 event occurred beneath south Chiloe Island, in the rupture zone of the 1960 event. The southern end of the survey fortuitously coincided with the slip region of the 2016 event.

The combination of a long historic record with three adjacent, well-studied, recent megathrust earthquakes makes this an ideal region for examining the geologic factors that control megathrust slip behavior and for deciphering the imprint that different types of slip behavior leaves on the geologic record. Recent compilations by Wang and Bilek (2014) and Scholl et al. (2015) show strong circumstantial evidence for a correlation between thick sediment on the incoming plate and great earthquake magnitude, possibly due to the ability of thick sediment to fill in basement structure and create a smooth, homogeneous plate interface (Ruff, 1989). How rough seafloor and overlying sediment interact to control partitioning between sediment accretion, underplating and subduction and how the plate boundary develops at depths of a few 10s of km beneath the forearc, however, remain unconstrained with poor images. Consequently, the role basement structures have as asperities is controversial (e.g. Lallemand et al., 1989; Cloos, 1992; Cloos and Shreve, 1996; Dominguez et al., 2000; Kodaira et al., 2000; Husen et al., 2002; Collot et al., 2004, 2008, 2011; Bangs et al., 2006; Das and Watts, 2009; Tréhu et al., 2012; Hicks et al., 2013, 2014).



**Figure 1** (A) Chile and the adjacent oceanic plate. See Figure 3 for a more detailed view of the proposed study region. (B) Megathrust earthquake history of Chile (updated from Comte and Pardo, 1991). The 1960 and 2010 events are highlighted by red bars and the characteristic segments are indicated by overlapping violet and aqua rectangles. The overlap region corresponds to the region known as the Mocha Block (MB), where Mocha and Valdivia fracture zones bound a triangular region of possibly anomalous crust (see Fig. 3). (C) Sediment thickness along strike. Numbers just below the seafloor show the age of the subducting crust at the trench. Note how the Juan Fernandez Ridge (JFR) acts as a dam for northward sediment transport along the trench (adapted from Contreras-Reyes and Osses, 2010).

CEVICE was designed to acquire modern deep-penetrating seismic data to examine the evolution of the south central Chile subduction thrust from the trench deep into the seismogenic zone and to map down-dip and along-strike changes in structure and physical properties along a segment of subduction zone encompassing the rupture surfaces of the 1960, 2010, 2015 and 2016 earthquakes. This experiment directly examines the broad range of earthquake slip behavior, which remains a key component of one of the top identified “Grand Challenges” remaining in seismology ( “How do faults slip?” in Forsyth et al., 2009). South-central Chile offers the opportunity to ask the following questions. (1) What geologic changes along-strike result in quasi-periodic slip on a 1000 km-long segment south of  $\sim 37^{\circ}\text{S}$ . (2) Why is slip behavior patchier, with more frequent earthquakes and variable numbers of patches rupturing simultaneously, immediately to the north? (3) Why is there overlap between the two slip regimes?



**Figure 2A.** A geologic view of the megathrust (adapted from Wang, 2009) showing two scales of topographic features on the subducting plate. (1) Tectonic horst and graben structures reflecting the original seafloor spreading fabric and/or plate bending as it enters the trench. In some cases, two intersecting sets are observed; in other cases, bending reactivates the original fabric. (2) Constructional volcanic features (seamounts). Both types of topography are well developed in the Nazca plate that is being subducted off south-central Chile. In addition, there are a number of large, linear tectonic and volcanic structures associated with fracture zones (Fig. 1). Although seamount subduction results in clear, widely-recognized effects on the outer accretionary wedge (see Wang and Bilek, 2014, for a review), what happens to topography as it is subducted beneath the cohesive wedge remains controversial. The symbol “ $?_1$ ” indicates uncertainty about the fate of subducted topography. Figure 2B is the seismological and geodetic view of the plate boundary as a surface with patchy variability in its frictional properties (from Scholtz and Campos, 2012). The cross-section shows a locked zone characterized by velocity weakening friction flanked on the updip edge by an accretionary wedge with velocity strengthening properties and on the downdip edge by a region characterized by slow slip and episodic tremor and slip.  $?_2$  refers to uncertainty, particularly in the wake of the 2011 Tohoku earthquake, about the impact of dynamic friction on the behavior of nominally velocity strengthening sediments and the conditions under which the outer wedge can slip rapidly enough to generate seismic and tsunami waves. The plan view shows a more complex characterization of the locked zone as a region of patchy locking properties.  $?_3$  refers to questions about what controls the along-strike continuity of patches of strong coupling.

While isolating the effect of individual variables on subduction thrust behavior is notoriously difficult, the systematic, and reasonably well known differences in along strike variation in the age of the subducting crust, the thickness of trench sediment on the subducting plate (Fig. 1C), and the upper plate structure in this region provide perhaps the best environment for understanding factors controlling subduction of a young plate beneath a continent - a situation also encountered in the Cascadia subduction zone.

In particular, the experiment was designed to focus on the following three questions:

- 1) *Complete burial by sediment of subducting topography results in a stable, relatively shallow plate boundary that is clearly separated from the top of subducting ocean crust such that the plate boundary is a smooth, homogeneous surface and topography on the subducting plate is passively subducted.*
- 2) *There is a threshold sediment thickness needed to generate a smooth plate boundary; if the sediment thickness is less than this threshold, subducting topography will interact with the upper plate, creating a heterogeneous plate interface even if the topography is completely buried by trench sediment.*
- 3) *As a long-lived subducting topographic feature, the Mocha fracture zone suppresses along strike rupture propagation and forms a long-lived segment boundary because it damages the upper plate, thus creating a mechanism for regular stress release in small earthquakes.*

Although these hypotheses are not original (e.g. Ruff, 1989; Wang and Bilek, 2011, 2014; Scholl et al., 2015), they have been difficult to test in large part because of the lack of detailed structural knowledge of how the plate boundary evolves as it transitions from the shallow wedge into the seismogenic zone. The along strike and downdip variation in geology are known to control fault zone characteristics (Figure 2A) leading to zonation of the megathrust boundary downdip as inferred from earthquake activity and episodic tremor and slip (Figure 2B), but are as yet poorly constrained largely because of the difficulty in imaging and probing the seismogenic zone. The new 15-km-streamer and recording system available on the Langseth is ideally suited for imaging the plate interface deep within the margin and offers the opportunity to employ processing techniques that can effectively remove water column multiples that have obscured the existing profiles across this margin. In this survey we acquired nearly 5,000 km of multichannel seismic data, all with the 15 km streamer.

## **Basic Cruise Information**

### **Marcus G. Langseth Cruise - MGL1701**

**Cruise Start Date: January 8<sup>th</sup> 2017**

**Departure Port (start of cruise):**

**Valparaiso, Chile**

**Seismic Source: 4 Strings, 6600 in<sup>3</sup>**

**Seismic Streamer Length: 15 km**

**Total Days Departure to Arrival: 38**

**Arrival Port (end of cruise):**

**Valparaiso, Chile**

**Total Sail Kilometers of Source Data  
4827 km**

**No OBS Stations**

**Acquisition map:**

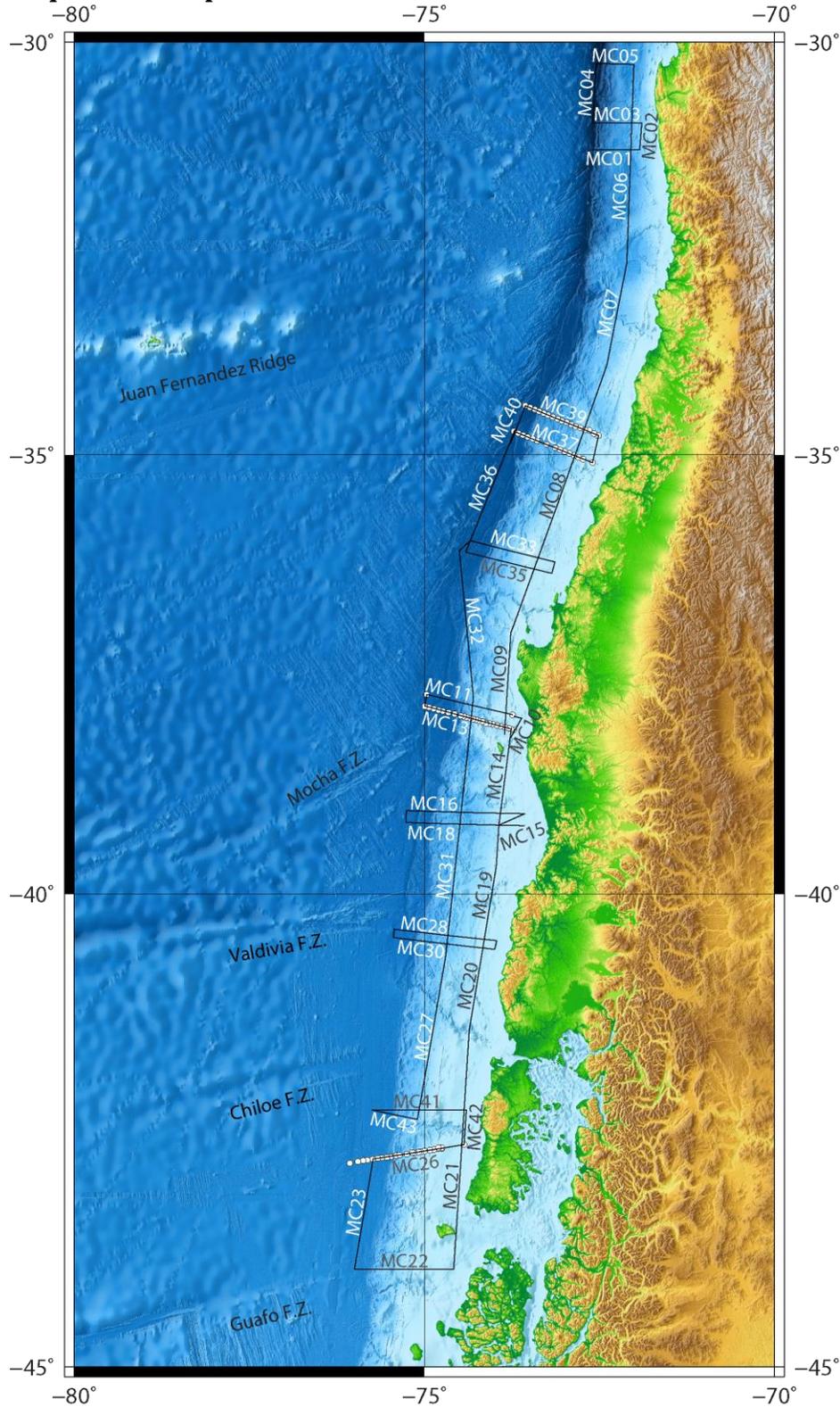


Figure 3. Map showing acquisition track covering ~5,000 km from the Illapel earthquake rupture area in the north, to the Valdivia rupture zone in the south. White circles are locations of OBS deployed during previous German studies that collocate with MGL1701 lines.

## Participants

### R/V Marcus G. Langseth

Anchored: 9 January 2017

Voyage: ML 17-01  
Chile

Port: Valparaiso,

#### CREW LIST

##### Ship's Crew

#	Name	Position
1	Waldrip, John B.	Master
2	Breckenridge, Carter C	Chief Mate
3	Clark, Cassandra A	2nd Mate
4	Woronowicz, Jason J	3rd Mate
5	Cereno, George G.	Bosun
7	Quinn, Tara J.	AB (12-4)
6	Robison, William J.	AB (4-8)
8	White, Joselyn N.	AB (8-12)
9	Perez, Rodney C.	OS
10	Remegio, Tito Hagoriles	OS
11	Butler, Gerald O.	Chief Engr.
12	Levine, Issaac Dylan	1st Asst. Engr.
13	Olson, Steven Burton	2nd Asst Engr.
14	Nasta, Joseph R.	3rd Asst. Engr.
15	Kononchik, Gregory R.	Oiler (12-4)
16	Florendo, Rodolfo A.	Oiler (4-8)
17	Uribe, Guillermo F.	Oiler (8-12) ECR
18	Rosson, Eric J.	Steward
19	Rios, Ricardo	Cook
20		Electrician

**Technical Staff**

21	Robert Steinhaus	Chief Science Officer
22	David Martinson	Science Officer – Nav/IT
23	Todd Jensvold	Science Officer - Acq
24	Tom Spoto	Chief Source Mechanic
25	Alan Thompson	Marine Science Technician
26	Thomas, Tina	Marine Tech - UNOLS
27	Josh Kasinger	Source Mechanic
28	Ambrose Mavor-Parker	Marine Science Technician
29	Andrej Smiscal	Compressor Mech
30	Gilles Guerin	Marine Science Technician

**Science Crew**

31	Nathan Bangs	Chief Scientist
32	Anne Trehu	Co- Chief Scientist
33	Eduardo Contreras-Reyes	Data processing
34	Adrien Arnulf	Data processing
35	Shuoshuo Han	Data processing
36	Ben Phrampus	Data processing
37	Sebastián Bahamondes	Watchstander
38	Brooklyn Gose	Watchstander
39	Kelly Olsen	Watchstander
40	Carmina González	Watchstander
41	Pamela Muñoz	Watchstander
42	Edward Zhang	Watchstander

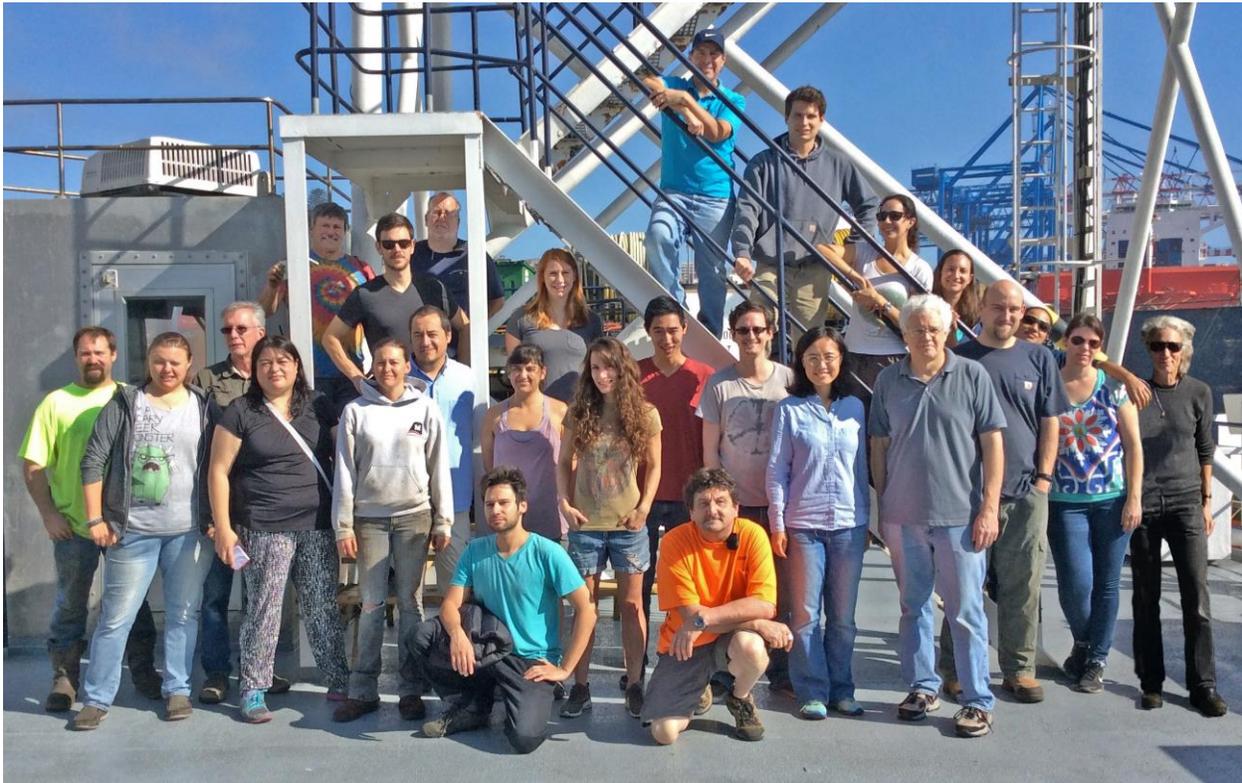
### Observers

43	Amanda Dubuque	Lead PSO
44	Laura Bluth	PAM operator
45	Cassandra Frey	PSO
46	Belen Sharon Torres	PSO
47	Yessica Vincencio Murillo	PSO
48	Jorge Gaete	SHOA observer

**Total Aboard – 50**

*Table 1. Cruise participants.*

### Cruise Participants



## Instrumentation

The primary equipment used during MGL1701 was the 15 km, 1212-channel, streamer, and 6600 in<sup>3</sup> seismic airgun array. The 15 km streamer was deployed with a GPS unit on the tailbuoy, which provided locations continuously throughout the entire cruise. In addition to the GPS in the tailbuoy, there were also GPS units on the vessel, and attached to the source array. Streamer navigation was also assisted with compasses in the streamer located every 300 m. The streamer depths were controlled with birds attached to the streamer and also located every 300 m.

In addition to the seismic acquisition system, MGL1701 used the hull-mounted Kongsberg EM122 multibeam acoustic echosounder during seismic acquisition. This system provided both bathymetric swath mapping and acoustic backscatter images. Subbottom profiling was also conducted using Knudsen 3260 3.5 kHz system. For constraints on water column velocity and accurate bathymetry, XBTs were deployed approximately once a day. In locations where water temperature variability was expected to be high and more accurate bathymetry was needed, XBTs were deployed more frequently.

Various other data sets were also acquired during the cruise. These include ADCP current profiler, gravity and magnetics data, as well as miscellaneous meteorological and sea surface temperature/salinity data. ARGO floats were also deployed during the cruise.

### Seismic Equipment/Parameters

#### Configuration # 1 (Applies to MGL1701MC01 – MC06: Seq. 1 – Seq. 6)

(differences between Configurations 1 & 2 are shown in **bold**)

#### *Seismic Recording Systems*

Recording type	Sercel SEAL 408xl
Sample rate	2 ms
Recording length	<b>16 seconds</b> w/ no Deep Sea Delay (15 s for MGL1701MC01 only)
Low Cut Filter	3.0 Hz Digital Filter / 12 dB/OCT
High Cut Filter	200 Hz Digital Filter /276 dB/OCT w/ linear phase
Data format	SEG-D 8058 Rev1 demultiplexed with External Header.
Media	Data recorded directly to disk

#### **Seismic Streamer**

Streamer type	Sercel Sentinel SSAS
No of streamers	1
Streamer length	15,150 m
No of groups	1212 Channels
Group Interval	12.5m
Group length	12.5m
Streamer depth	<b>8 m</b>
Near offset	<b>205 m</b>
Spacing of birds	~300 meters with extra redundancy at head and tail of streamer

### Seismic Source

Source type	BOLT Air-Sound Source
Shot interval	Towed Streamer Component: <b>37.5 m</b>
Number Sources	1
Source depth	<b>7 m</b> per IHA permit application
Volume	6600 in3
Air pressure	1900 +/- 100 psi
Source separation	0 m
Max timing error	+/- 2 ms

### Configuration # 2 (Applies to MGL1701MC06A – MC43: Seq. 7 – Seq. 45)

#### *Seismic Recording Systems*

Recording type	Sercel SEAL 408xl
Sample rate	2 ms
Recording length	<b>20 seconds</b> w/ no Deep Sea Delay
Low Cut Filter	3.0 Hz Digital Filter / 12 dB/OCT
High Cut Filter	200 Hz Digital Filter /276 dB/OCT w/ linear phase
Data format	SEG-D 8058 Rev1 demultiplexed with External Header.
Media	Data recorded directly to disk

#### Seismic Streamer

Streamer type	Sercel Sentinel SSAS
No of streamers	1
Streamer length	15,150 km
No of groups	1212 Channels
Group Interval	12.5m
Group length	12.5m
Streamer depth	<b>10 m</b>
Near offset	<b>235 m</b>
Spacing of birds	~300 meters with extra redundancy at head and tail of streamer

### Seismic Source

Source type	BOLT Air-Sound Source
Shot interval	Towed Streamer Component: <b>50 m</b>
Number Sources	1
Source depth	<b>9 m</b> per IHA permit application
Volume	6600 in3
Air pressure	1900 +/- 100 psi
Source separation	0 m
Max timing error	+/- 2 ms

*Table 2. Seismic configuration for the two separate streamer deployments.*

## Seismic Streamer Geometry

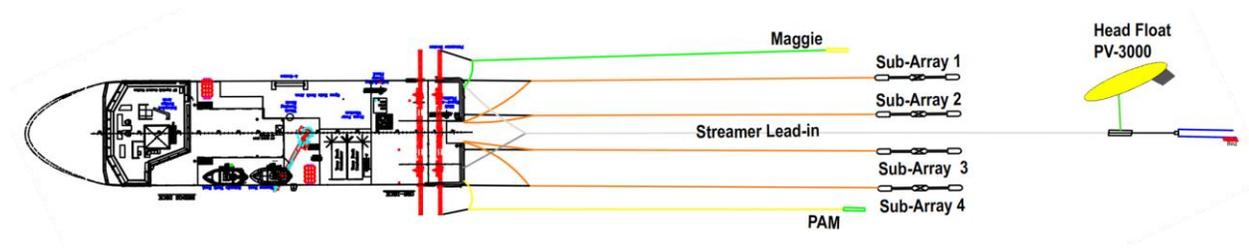


Figure 4. (top) Schematic illustration of the relationship between the ship, airgun array, magnetometer and PAM. The distance between the center of the airgun array and the center of the first hydrophone group (shown in red) is 205 and 235 m during different parts of the cruise (see table above). The minimum distance between the gun array the first hydrophone of the streamer is 20x m, and was verified by measuring the arrival time of the direct wave at the first group. The gun array measures 18x18 m. The center of this square is the position of the array given in the shot time record.

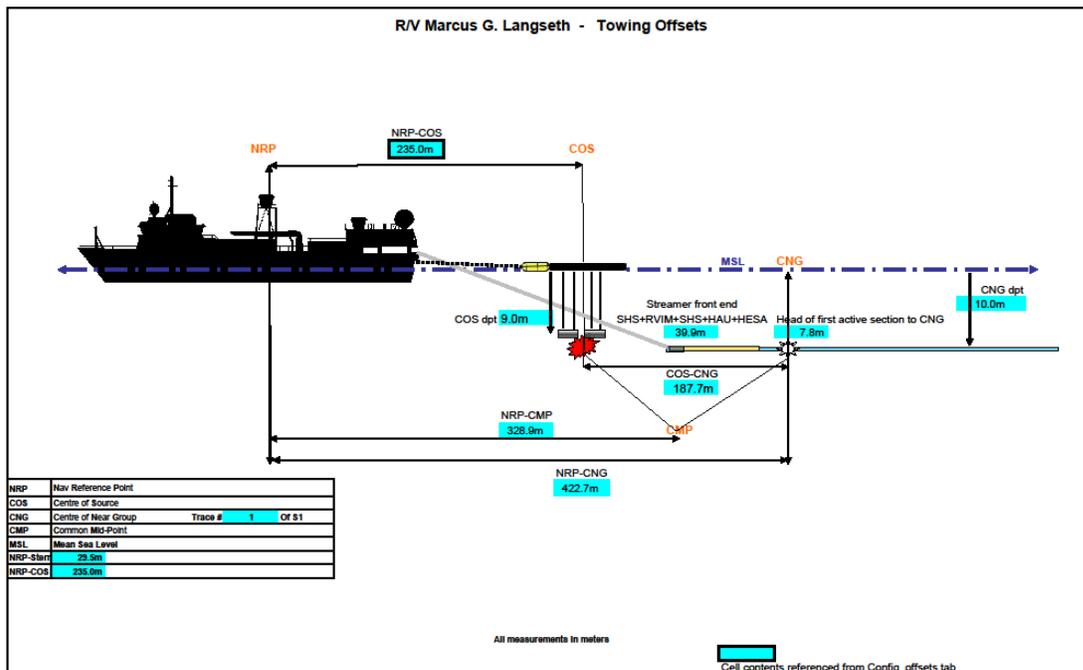


Figure 5. Diagram showing towing offsets between streamer, airguns, and ship's antenna. Note that offset configuration changed during the cruise. See table above.

## Seismic Source Geometry

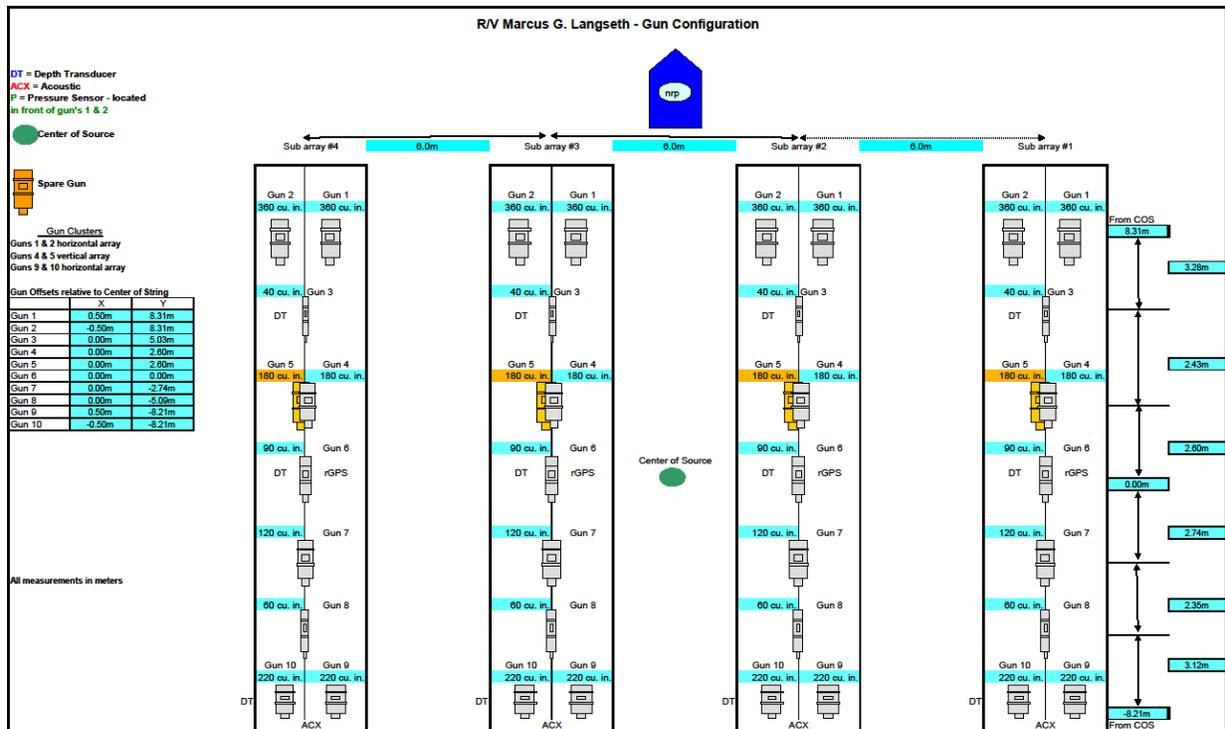


Figure 6. Diagram showing airgun towing arrangement. This same arrangement was used during the entire cruise. The array contains 40 airguns ranging in volume from 40 to 360 cubic inches. The mitigation gun is 40 cubic inches.

## Other Instrumentation

**Kongsberg EM122 multibeam echosounder:** Our IHA permitted acquisition of EM122 swath bathymetry only when shooting airguns. Continuous acquisition (with a few minor gaps) began on January 12 at ~06:00 UTC and ended on February 16 at ~ 14:30 with completion of the MCS survey. An automated data cleaning process using mbsystems was implemented to remove noisy data points, and data were gridded with a grid spacing of 100 m.

Raw data can be downloaded from the Rolling Deck to Repository (R2R) web site (<http://www.rvdata.us/catalog/MGL11701>). Data will also be incorporated into the Global Multi-Resolution Topography (GMRT) data base, available through GeoMapApp ([www.geomapapp.org](http://www.geomapapp.org)).

**Expendable Bathythermograph (XBT):** XBTs were generally acquired once a day. A total of 40 XBTs were deployed including four T4-series, twenty-eight T5-series and eight T7-series. XBT sites are given in Table 3. The locations of XBTs are shown in Figure 7 and plots of the velocity/depth functions are shown in Appendix A.

Data are open access and can be downloaded from the Rolling Deck to Repository (R2R) web site (<http://www.rvdata.us/catalog/MGL1701>).

**Knudsen 3260 3.5 kHz subbottom profiler:** Like the EM122, Knudsen 3.5 kHz data acquisition was restricted to when seismic data were being acquired. Data were saved in kea-format (binary data files, which can be replayed using Knudsen post-cruise playback software) and converted to SEG-Y format. ASCII files containing parameter settings and navigation information were also recorded (kea-format). The Knudsen ping rate was not synced with the EM122, improving the quality of the 3.5 kHz data. Acquisition began on January 12 at ~06:00 UTC and ended on February 16 at ~ 14:30, when acquisition of MCS data was complete.

Data are open access and can be downloaded from the Rolling Deck to Repository (R2R) web site (<http://www.rvdata.us/catalog/MGL1701>).

**RDI 75 kHz Acoustic Doppler Current Profiler:** ADCP data were acquired throughout the cruise at the 75 kHz. Data were processed during the cruise using University of Hawaii UHDAS software. For each day of the cruise, the archive includes map views of shallow current speed, direction and sea surface temperature, and of the north-south and east-west components of the current as a function of depth versus time, latitude and longitude (i.e. 4 plots/day for 75nb and 4 for 75bb).

The raw data, plot archive, and reprocessed data are available from the from Joint Archive for Shipboard ADCP data at the University of Hawaii ([ilikai.soest.hawaii.edu/sadcp/](http://ilikai.soest.hawaii.edu/sadcp/)) or from the R2R web site ([www.rvdata.us/catalog/MGL1701](http://www.rvdata.us/catalog/MGL1701)).

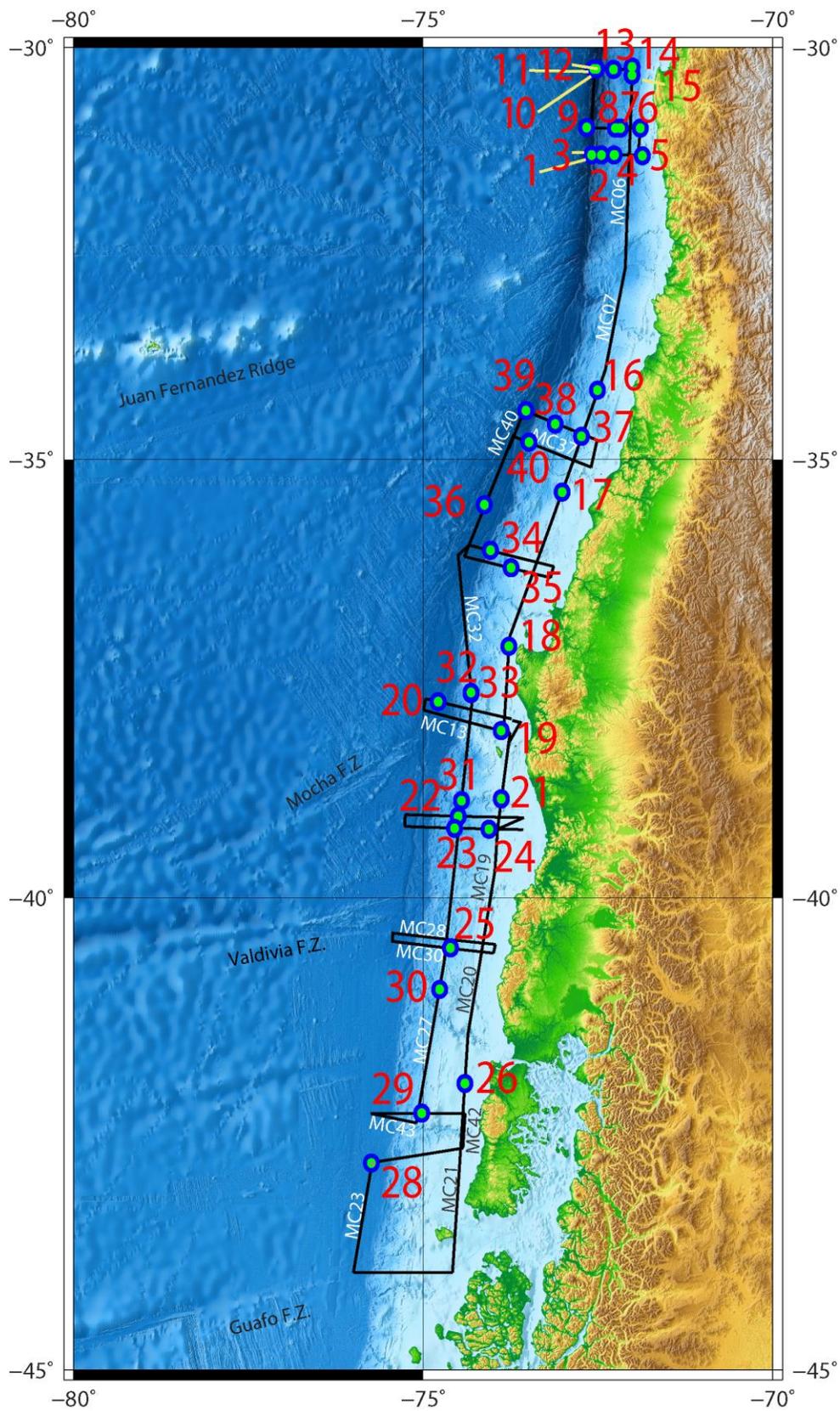


Figure 7. Map showing location of XBT casts along the MGL1701 track lines.

## XBT Deployments

XBT number	Model	Position	
01	T5	-72.7331	-31.3333
02	T5	-72.6012	-31.3333
03	T7	-72.4034	-31.3337
04	T5	-72.3964	-31.3337
05	T5	-71.8639	-31.3333
06	T5	-71.9061	-30.9997
07	T5	-72.321	-31.0005
08	T5	-72.3592	-31.0005
09	T5	-72.6385	-30.9999
10	T5	-72.5552	-30.2677
11	T7	-72.5136	-30.2686
12	T5	-72.5093	-30.2687
13	T5	-72.2604	-30.274
14	T5	-72.0073	-30.2766
15	T5	-72.0092	-30.3239
16	T7	-72.5106	-34.2148
17	T7	-73.026	-35.4126
18	T4	-73.7756	-37.1994
19	T4	-73.8477	-38.1336
20	T5	-74.8802	-37.7863
21	T4	-73.8835	-38.9248
22	T5	-74.5468	-39.0939
23	T5	-74.6087	-39.2385
24	T7	-74.0477	-39.2364
25	T5	-74.6733	-40.5483
26	T4	-74.408	-42.0334
27	T5	-75.5935	-43.9984
28	T5	-75.967	-42.8781
29	T5	-75.1466	-42.3354
30	T5	-74.7729	-41.0229
31	T5	-74.454	-38.9439
32	T5	-74.3075	-37.7393
33	T7	-74.3084	-37.7314
34	T5	-74.0272	-36.0695
35	T7	-73.6856	-36.2826
36	T5	-74.1264	-35.5645
37	T7	-72.5551	-34.7602
38	T5	-72.967	-34.6205
39	T5	-73.444	-34.4587
40	T5	-73.3948	-34.8318

*Table 3. Table of XBT casts.*

**Bell Aerospace BGM-3 gravimeter:** Gravity data were acquired during the MGL1701. The gravimeter was calibrated in Valparaiso prior to the cruise. An ad-hoc correction was applied to the data to display approximate gravity readings for monitoring by the watchstanders but only raw count data were saved.

The gravity data, along with calibration information, navigation, and ship acceleration data, is archived at R2R ([www.rvdata.us/catalog/MGL1701](http://www.rvdata.us/catalog/MGL1701)). R2R staff will correct gravity data and

make free-air anomaly data available to the community in a timely manner. Data will be open access as soon as they are archived.

**Geometrics 882 magnetometers:** Magnetic data were acquired whenever possible using one of two towed magnetometers. Magnetic declination at 0 elevation, latitude -20, longitude -72 on Nov 11, 2016: 3.26°W, changing by 0.18°W/year (Model IGRF12). Magnetic anomaly data are shown in map view in Figure 8.

Data can be downloaded from the Rolling Deck to Repository (R2R) web site (<http://www.rvdata.us/catalog/MGL1701>)

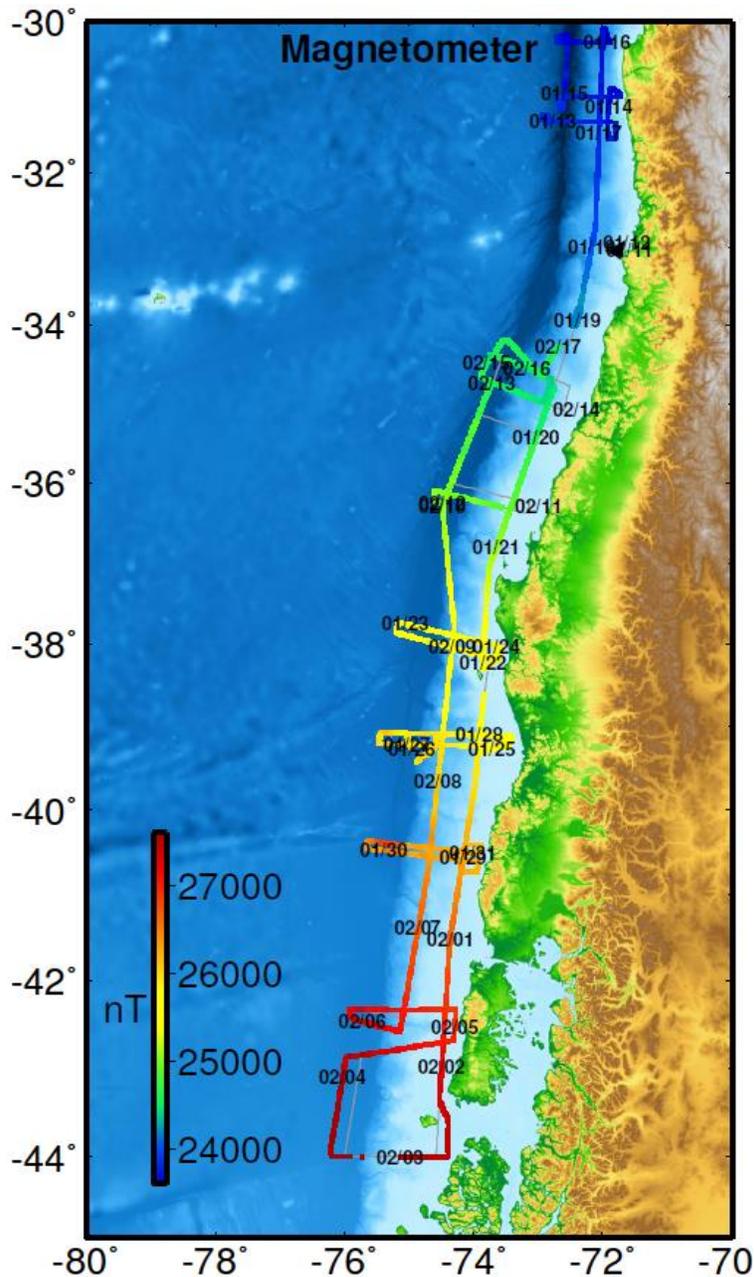


Figure 8. Magnetic anomaly data acquired during MGL1701.

**ARGOS float deployments:** As a service to NOAA, we deployed 11 ARGOS floats at the following locations.

**ARGO Float Deployment Times and Locations**

- 1) 2017:015:11:52 30 10.6275' S 72 32.5554' W
- 2) 2017:023:06:31 37 20.372' S 74 38.003' W
- 3) 2017:026:17:39 39 08.143' S 75 28' 26.934' W
- 4) 2017:034:11:01 43 31.533' S 76 45.248' W
- 5) 2017:035:03:36 42 01.012' S 75 23.613' W
- 6) 2017:036:22:57 42 26.99' S 75 49.03' W
- 7) 2017:040:14:07 37 06.023' S 74 24.682' W
- 8) 2017:041:04:20 35 44.724' S 74 51.623' W
- 9) 2017:043:12:57 35 17.630' S 74 24.283' W
- 10) 2017:044:01:45 34 37.39' S 73 40.77' W;
- 11) 2017:045:21:50 34 22.06' S 73 43.33' W;

*Table 4. Locations where ARGOS floats were deployed.*

**Meteorological and seasurface temperature/salinity data:** Data acquisition was running during the entire cruise. We had reasonably good weather for the whole cruise. Swell was < 3-4 m most of the time. There were occasional white caps with winds up to ~35 kts, but winds were never sustained long enough to build up a large, local swell. Most of the swell was generated from storms to the south and travelled into our survey area. Seasurface temperature and salinity are shown in map view in Figure 20.

Data can be downloaded from the Rolling Deck to Repository (R2R) web site (<http://www.rvdata.us/catalog/MGL1701>).

# Acquisition

## Detailed Track Maps

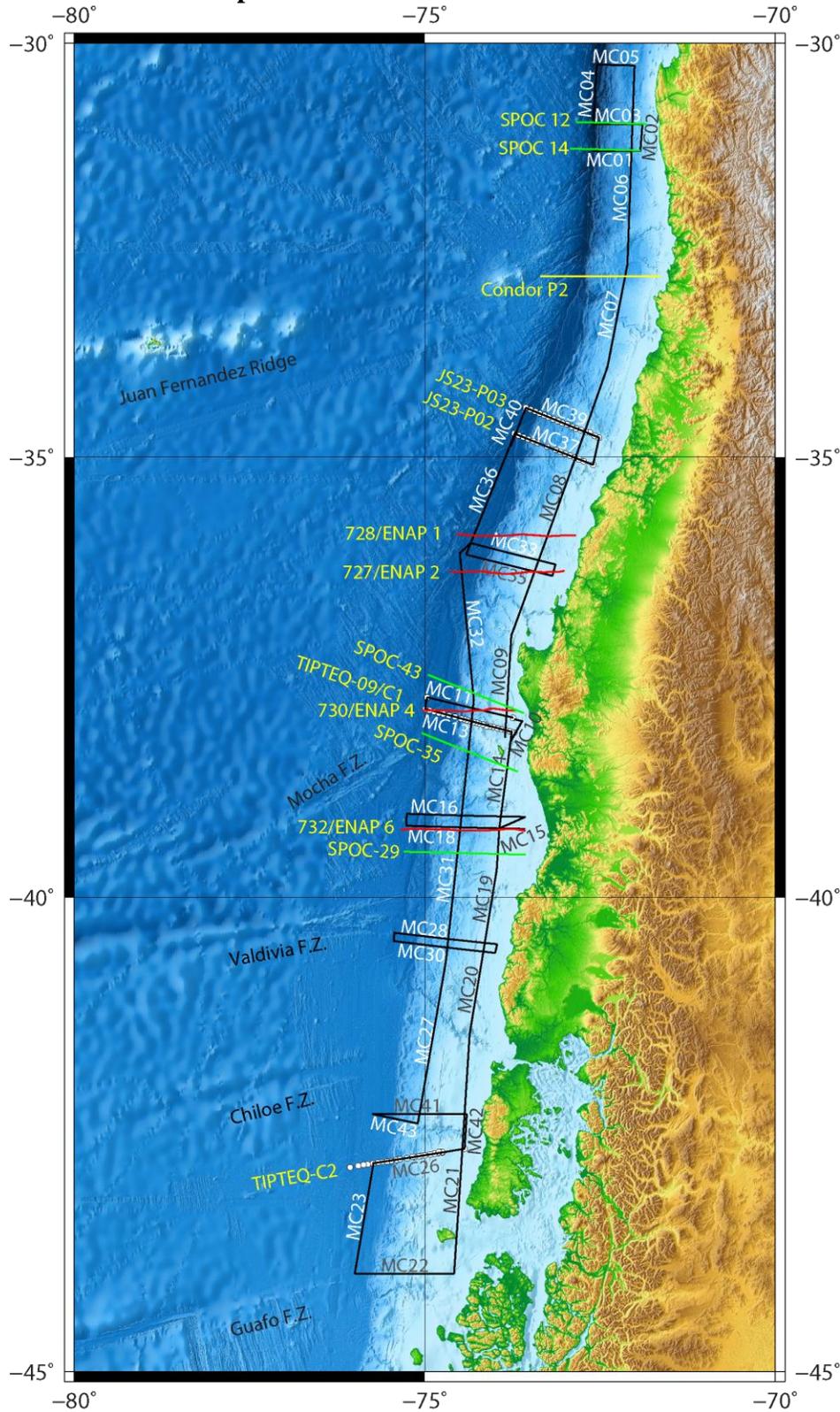


Figure 9. Map showing the acquisition track as in Figure 3. Also included here are the locations of the primary transects of past US and German seismic reflection and refraction projects.

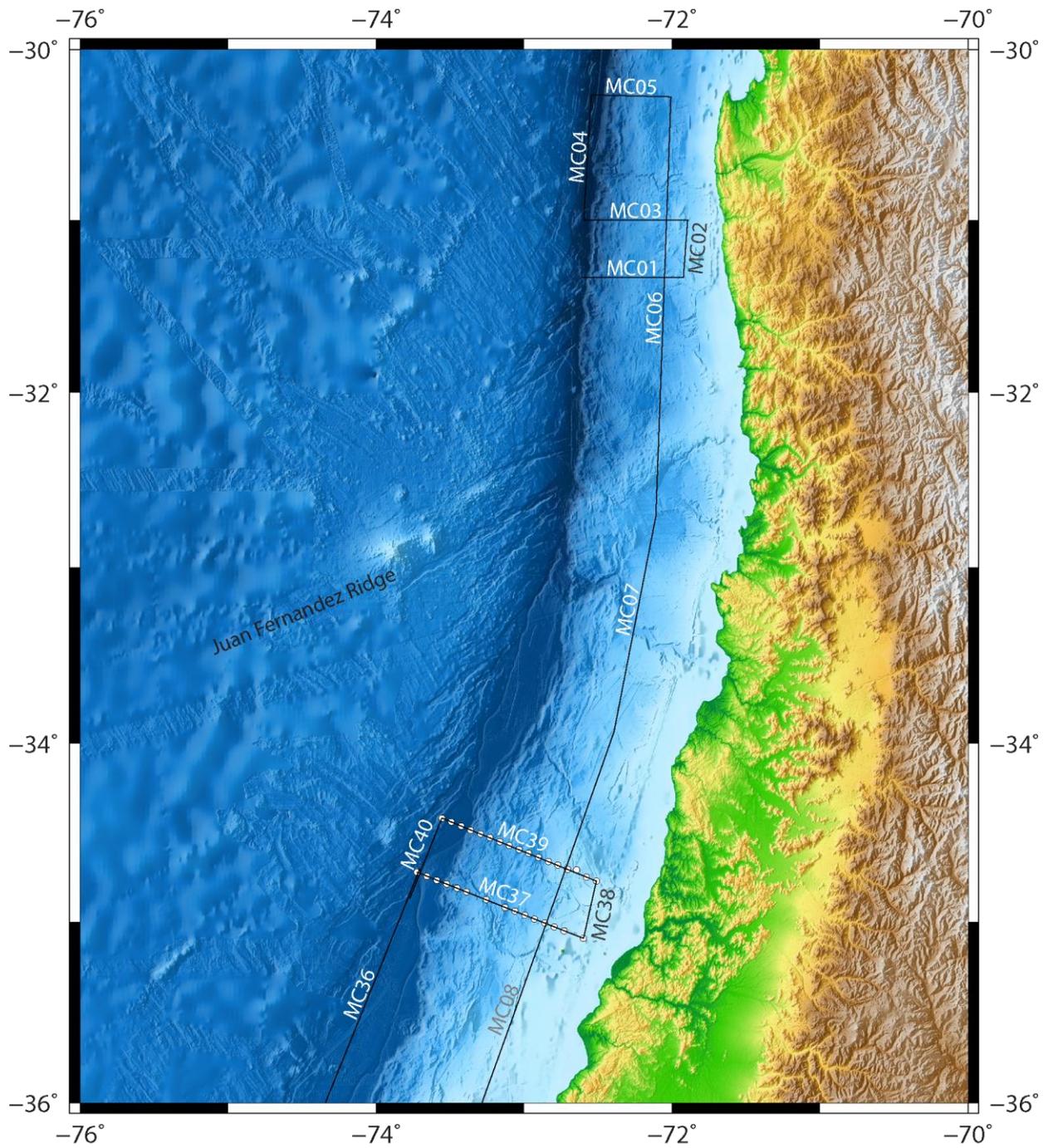


Figure 10. Detailed track map of the northern survey, including the Illapel earthquake rupture area. Enlargement shows line locations relative to multibeam bathymetry and onshore physiography. White circles mark locations of OBS deployments on previous German expeditions.

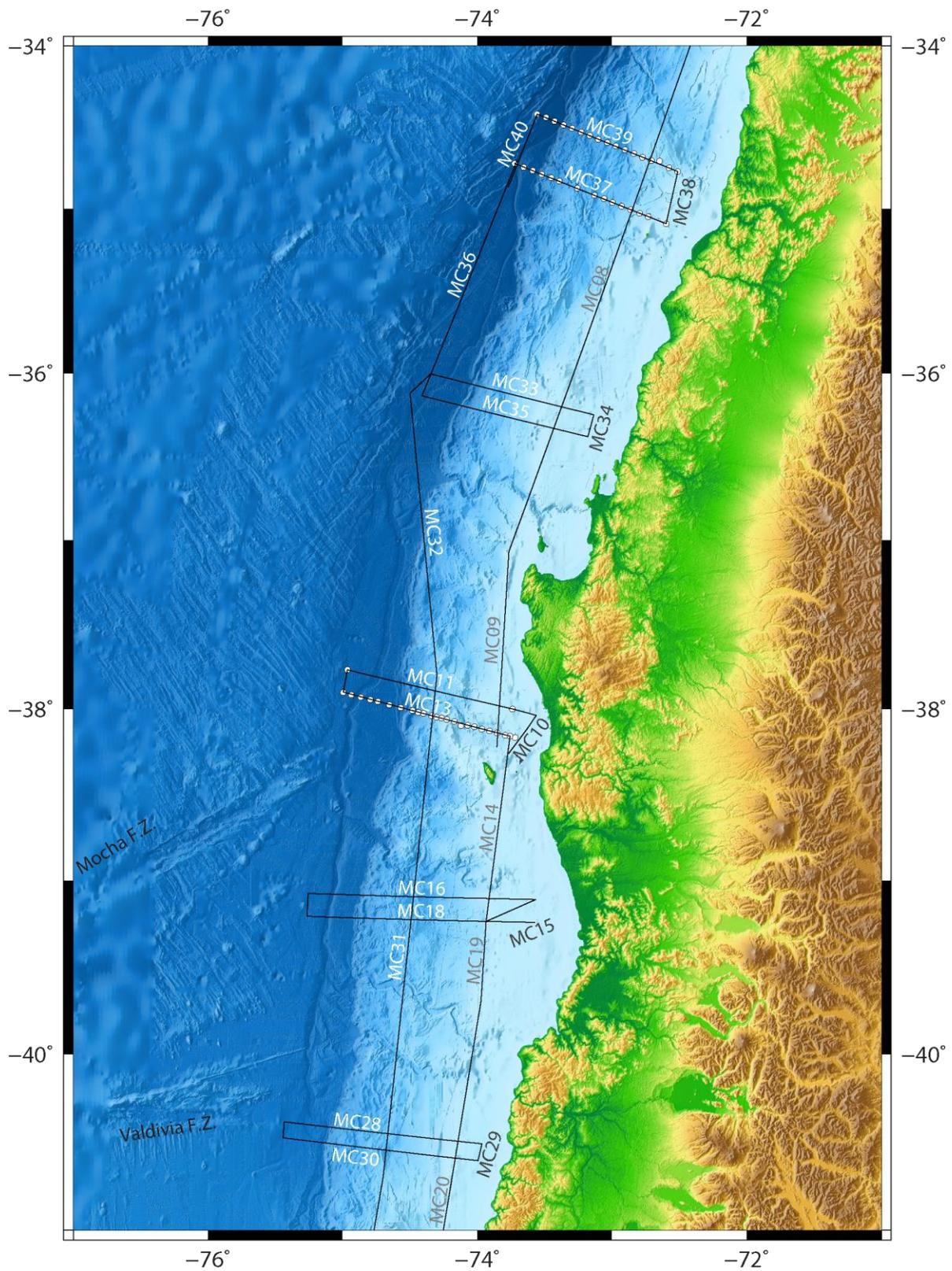


Figure 11. Detailed track map of the central survey, including the Maule earthquake rupture area. Enlargement shows line locations relative to multibeam bathymetry and onshore physiography. White circles mark locations of OBS deployments on previous German expeditions.

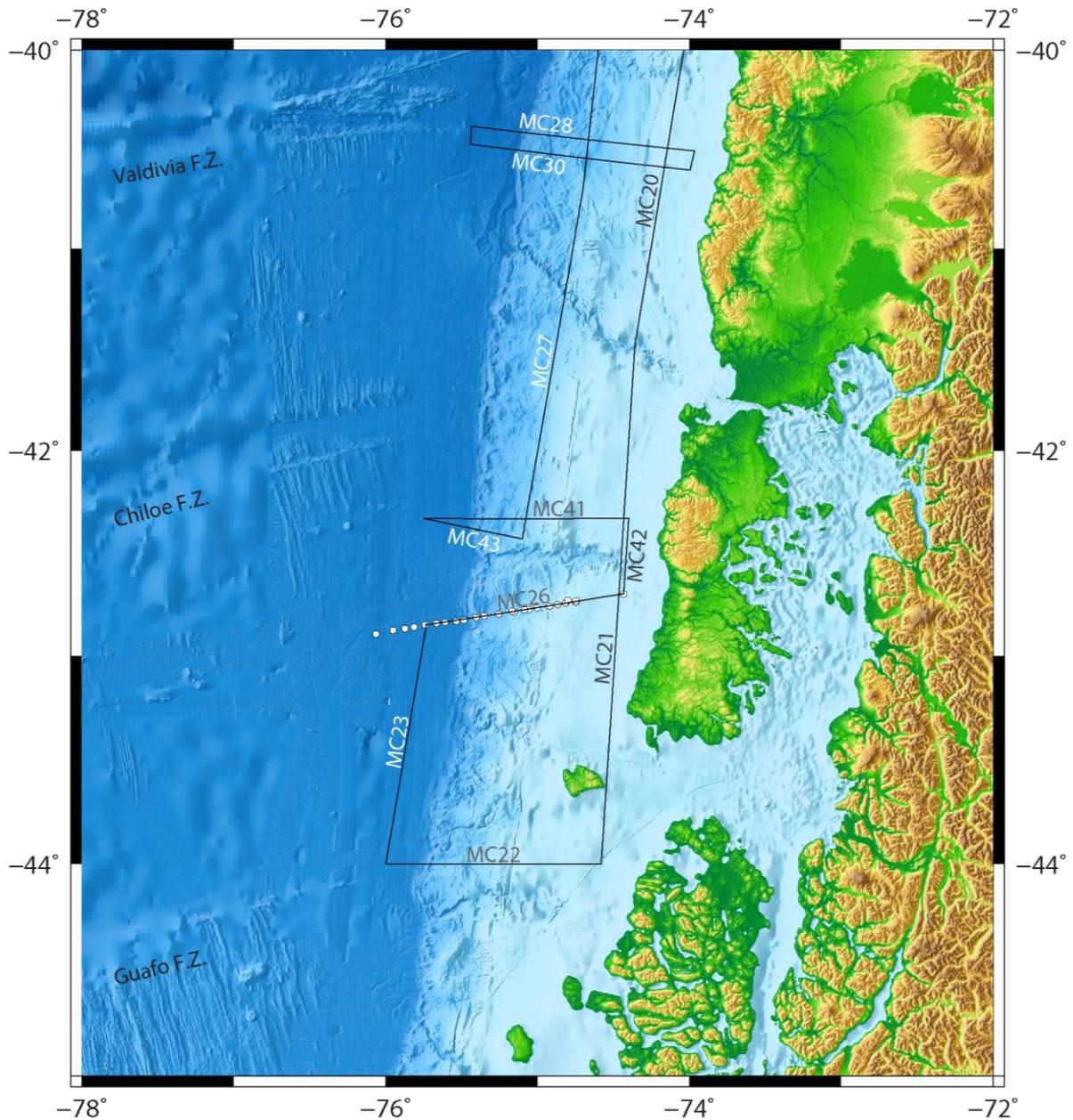


Figure 12. Detailed track map of the northern survey, including the Valdivia earthquake rupture area. Enlargement shows line locations relative to multibeam bathymetry and onshore physiography. White circles mark locations of OBS deployments on previous German expeditions.

## Line Naming

Line numbers were assigned prior to the start of the cruise and were not changed when logistical issues required changes in the shooting plans. Consequently, some lines were never shot and do not exist. These are MGL1701MC12, 17, 24, 25, 29, 34, 38, and 40. The example below illustrates the formula used to define line names.

Example: MGL1701MC01

Cruise Number:	MGL1701
Acquisition Type (OBS or MCS) -	-----OB/MC
Line Number:	-----01
Line Type:	----- R

R= Reshot  
A,B, and T = additional segments of original line

## Seismic Acquisition Summary

Line #	Seq #	Start of line		End of line		Start of line		End of line		tape #s	Length seconds
		Date	Time (UTC)	Date	Time (UTC)	shot #	file #	shot #	file #		
MGL1701MC01	001	2017-01-13	00:06	2017-01-13	12:40	601	1	2943	2343	1-3	15
MGL1701MC02	002	2017-01-13	19:43	2017-01-14	02:46	763	2344	2192	3773	4-5	16
MGL1701MC03	003	2017-01-14	07:42	2017-01-14	18:14	998	3774	2990	5766	6-7	16
MGL1701MC04	004	2017-01-14	23:10	2017-01-15	11:31	914	5767	3772	8223	8-10	16
MGL1701MC05	005	2017-01-15	15:53	2017-01-16	00:02	927	8224	2584	9881	11-12	16
MGL1701MC06	006	2017-01-16	05:21	2017-01-17	02:29	946	9882	5040	13967	13-17	16
MGL1701MC06A	007	2017-01-17	02:44	2017-01-17	06:22	5088	13968	5768	14645	18	16
MGL1701MC06B	008	2017-01-17	06:25	2017-01-17	18:45	6587	14647	8401	16460	19-20	20
MGL1701MC07	009	2017-01-17	18:47	2017-01-18	16:32	1005	16461	3767	19217	21-23	20
MGL1701MC08	010	2017-01-18	16:34	2017-01-18	17:17	1007	19218	1113	19322	24	20
MGL1701MC08R	011	2017-01-18	23:47	2017-01-21	04:48	977	19324	8382	26720	25-32	20
MGL1701MC09	012	2017-01-21	04:50	2017-01-22	00:02	1005	26721	3569	29282	33-35	20
MGL1701MC10	013	2017-01-22	03:02	2017-01-22	06:02	1098	29283	1553	29739	36	20
MGL1701MC11	014	2017-01-22	08:15	2017-01-23	00:54	971	29740	3516	32280	37-39	20
MGL1701MC13	015	2017-01-23	04:55	2017-01-23	21:44	909	32281	3510	34874	40-46	20
MGL1701MC14	016	2017-01-24	03:22	2017-01-24	21:30	946	34876	3565	37471	47-49	20
MGL1701MC15	017	2017-01-24	23:39	2017-01-25	03:15	1379	37472	1960	38053	50	20
MGL1701MC16	018	2017-01-25	05:33	2017-01-25	21:17	982	38054	3510	40579	51-53	20
MGL1701MC16A	019	2017-01-25	10:41	2017-01-25	17:31	3109	40580	4229	41699	54-55	20
MGL1701MC18	020	2017-01-26	21:13	2017-01-27	17:38	982	41700	4083	44796	56-59	20
MGL1701MC18T	021	2017-01-27	20:25	2017-01-27	23:52	1211	44797	1760	45345	60	20
MGL1701MC19	022	2017-01-28	01:53	2017-01-28	09:53	921	45346	2023	46448	61-62	20
MGL1701MC20	023	2017-01-28	09:55	2017-01-28	12:00	1005	46449	1255	46696	63	20
MGL1701MC20A	024	2017-01-28	12:59	2017-01-29	02:45	1397	46697	3290	48589	64-65	20
MGL1701MC30	025	2017-01-29	07:57	2017-01-30	02:48	995	48590	3769	51361	66-68	20
MGL1701MC28	026	2017-01-30	06:13	2017-01-31	01:06	975	51362	3599	53985	69-71	20
MGL1701MC20B	027	2017-01-31	10:19	2017-01-31	23:27	3201	53986	5018	55803	72-73	20
MGL1701MC21	028	2017-01-31	23:30	2017-02-02	15:31	1009	55804	6559	61350	74-79	20
MGL1701MC22	029	2017-02-02	17:10	2017-02-03	10:52	961	61351	3592	63982	80-82	20
MGL1701MC23	030	2017-02-03	12:47	2017-02-03	03:32	1291	63983	3500	66192	83-85	20
MGL1701MC26	031	2017-02-04	06:07	2017-02-04	22:02	963	66193	3360	68589	86-88	20
MGL1701MC42	032	2017-02-05	00:18	2017-02-05	02:42	1379	68590	1751	68962	89	20
MGL1701MC41	033	2017-02-05	04:04	2017-02-05	20:43	983	68963	3488	71468	90-92	20
MGL1701MC43	034	2017-02-05	23:11	2017-02-06	06:14	1115	71469	2202	72556	93-94	20
MGL1701MC27	035	2017-02-06	07:58	2017-02-07	09:28	923	72557	4909	76543	95-98	20
MGL1701MC31	036	2017-02-07	09:30	2017-02-09	03:30	1006	76544	7472	82972	99-105	20
MGL1701MC32	037	2017-02-09	03:32	2017-02-10	04:20	1003	82973	5021	86989	106-110	20
MGL1701MC33	038	2017-02-10	06:52	2017-02-10	23:49	990	86990	3481	89481	111-113	20
MGL1701MC35	039	2017-02-11	04:45	2017-02-11	20:09	1248	89482	3581	92807	114-116	20
MGL1701MC36	040	2017-02-12	01:38	2017-02-13	01:35	972	91808	4583	95414	117-120	20
MGL1701MC37	041	2017-02-13	06:21	2017-02-13	23:08	971	95415	3514	97923	121-123	20
MGL1701MC39	042	2017-02-14	05:55	2017-02-14	13:34	968	97924	2129	99085	124-125	20
MGL1701MC39A	043	2017-02-14	14:28	2017-02-14	21:40	2280	99086	3370	100166	126-127	20
MGL1701MC37R	044	2017-02-15	04:37	2017-02-15	14:33	922	100168	2541	101784	128-129	20
MGL1701MC39R	045	2017-02-15	21:40	2017-02-16	05:56	1942	101785	3244	103082	130-131	20

Table 5. Acquisition summary table showing lines in sequence, acquisition time, shot and FFID numbers, along with tape numbers and record length on tape.

## Cruise Narrative

(note: times in the narrative are local)

*Jan. 8:* The science party arrived in Valparaiso. The various members of the science party meet up on Langseth during the afternoon and evening. Group dinner with Columbia representatives and others participating in the President's visit.

*Jan. 9:* Tour groups arranged by Columbia through the Columbia Center in Santiago visited the Langseth in the morning. Various presentations and Q&A were held in different parts of the vessel. At 12:30 President Michelle Bachelet arrived along with the US ambassador and Margaret Leinen. The president toured the vessel and listened to presentations. She also asked questions and participated in discussions. Following tours, speeches were presented by the various dignitaries and Art Lerner-Lam of Columbia. The president's visit lasted ~ 2 ½ hours. Many journalists were present, and many newspaper and television reports in Chile followed.



*Figure 13. President Michelle Bachelet addressing dignitaries, reporters, and visitors on the R/V Langseth. In back are: (row 1) Captain Waldrup, Art Lerner-Lam, Sean Higgins, and Margaret Leinen; (row 2) Eduardo Contreras-Reyes, Emilio Vera.*

*Jan. 10:* The UTIG computers arrived in Santiago airport, following delays with airlines and Customs. They were picked up and brought to Valparaiso. Meanwhile the Langseth is moved from the dock to anchor to begin fueling with the science party on board. Fueling was not possible at the anchorage due because of interference with the paravanes and paravane related structures on the side of Langseth. Fueling was delayed until the follow day.

*Jan. 11:* Moved close to docks to allow fueling. Fueling began at 7:00 and finished ~ 3 PM local time. Cleared customs and immigration; underway at 8:09 PM local.

*Jan. 12:* On site ~ 2:00 AM local time. Began deployment with the tail buoy in the water at ~ 3AM. Streamer deployment finished late afternoon after ~ 18 hours. Guns deployed at ~ 6PM and first shots beginning ramp up at ~ 6:30 PM.  
Today is Kelly's birthday, celebrated with a cake and chocolate.

*Jan. 13:* Completed first line with very few issues. Record length on the first line of 15 s was a little short to record more than a few seconds at far offsets. We did not anticipate needing to record such a long record, but we increased the record lengths to 16 s for lines 02 – 06. First turn was very slow because of too large a turn. The crew is learning how to maneuver with the 15 km streamer. Five XBTs are deployed. Multiple XBTs are needed for accurate water velocities for multibeam in the Illapel region. XBTs were deployed on the shelf, mid-slope and trench areas to cover the wide range in water depth. Many of the XBTs showed very strange high temperature excursions below ~ 800 m. The cause of these was not determined, but these data below ~ 800 m were not considered to be real. First line finished at 3:00 PM.

*Jan. 14:* First power down for a pinniped. Continued acquisition for the Illapel region.

*Jan. 15:* First science meeting at 7 PM. Anne presented some basics on seismology and earthquakes. Eduardo gave an overview of the structure along line 03. We discussed a blog and other things we would like to do during the cruise. Continued data acquisition along line 05.

*Jan. 16:* Swell down this AM. Not nearly as much rolling. Finished the Illapel area. Heading south. Began a reconfiguration of the guns and streamer. We changed from a configuration of 7 m towing depth for the guns, 8 m towing depth for the streamer, 37.5 shot spacing, and 16 s records. The new configuration is designed to target deeper with a source at 9 m and streamer at 10 m with the goal of reaching deeper targets. The configuration was designed as a trade-off between the deepest targets at ~ 8-10 s and the shallow structure near the seafloor. The shot interval was increased to 50 m to allow sufficiently long records of 20 s and to prevent interference from previous shot noise.  
The reconfiguration took ~ 4 hours.

*Jan. 17:* Science party meeting today. Sebastian presented his processing scheme and results of processing for line 003. Anne also discussed some of the basics of processing. Weather heavy with 35 kt winds and lots of rolling.

*Jan. 18:* Weather heavy with some roll. The PAM became wrapped ~ 30 times around the lead in to the streamer. We had to circle around and reshoot the beginning of line 8. This cost us about 6 hours.

*Jan. 19:* Science party meeting today. Adrien presented his FWI presentation explaining the technique and results from NZ. PAM redeployed given that the seas are a bit calmer. Beginning to get through all of the processing issues and producing rough stacks and migrations.

*Jan. 20:* Weather calms and swell diminishes as we stay along the shelf. Swell noise issues with the data are much improved and data look clean.

*Jan. 21:* Science party meeting to look at initial processing. We examined initial results from Lines 1,3,5 in Illapel area. Beautiful evening sunset heading toward Isla Mocha. Weather and swell calm on the shelf. Turned to shoot first dip line south of Valparaiso.

*Jan. 22:* Strong wind, but reasonable seas. Not too much swell, and swell noise reasonable. Heading into the trough is good for acquisition, but strong streamer feathering.

*Jan. 23:* Continued with data acquisition and data processing.

*Jan. 24:* Due to shallow water along the shelf, the tow points are changed to prevent the lead in from reaching bottom. Water depths should be above 25 m, but water depths as shallow as 17 m were crossed. These areas were uncharted. No harm done.

*Jan. 25:* Emergency radar beacon was detected by the bridge and we were required to break off our line and transit to the site about 4-5 hours away. Nothing detected at the location where the radar beacon was detected. Transiting back to finish the line and continue with survey. Will resume shooting in the morning of the 26<sup>th</sup>. Weather remains calm for now, but anticipating a storm farther south on the 30<sup>th</sup> / 31<sup>st</sup>.

*Jan. 26:* Emergency beacon back comes occasionally, in the same spot more or less, but we do not respond. Possible weather coming to the southern part of survey, 44 degrees. On the basis of Robert's time estimate we will not need to change from the 15 km streamer to the 12.5 km streamer to speed up and save time. This change was planned to have enough time to finish the survey; however, that will no longer be necessary. Also because of the available time we will add a line close to one of our original dip lines near the German TIPTEQ OBS line 3 around 45 degree S. We are not permitted to work below 44 degrees S and will shoot the new line along the 44th parallel. In order to avoid bad weather anticipated in the south, we will finish dip lines 28 and 30 in the north before heading to the southernmost line.

*Jan. 27:* Shuoshuo Han gave us a presentation on the data processing during our science meeting today. She showed the results of the student/watch picks of velocities on line 11. We compared these results to Eduardo's OBS model. She also showed the results from applying deconvolution and radon decomposition for multiple suppression.

*Jan. 28:* Lots of swell coming from the south. Acquisition continues.

*Jan. 29:* Jorge (the Chilean observer) gave us a nice presentation on the tsunami warning system in Chile.

*Jan. 30:* Continuing with acquisition.

*Jan. 31:* Acquisition is going well. Swell is up again. Lots of fresh, cold water from rivers causing the streamer to sink as we cross perpendicular to the outflow channels. We heard a presentation by Ben on gas hydrates. Ben showed a calculation for heat flow implied by BSR observations on line 28.

*Feb. 1:* Weather calms down as we steam along Chiloe Island. Nice view of land and sunset. Unidentified noises are occasionally showing up on the cable. The noise does not look like a side echo from our source, and it appears as pings generated from somewhere nearby.

*Feb. 2:* Groundhog day. Weather very calm as we reach our southernmost line at 44°. Science meeting covered the results of velocity picking. Each of the watches picked velocities for line 18, and the line was stacked and migrated with those velocities. The results showed some of the problems that can arrive from incorrect velocity picks, inadequate mutes, and large lateral variations in velocity. This was a good learning exercise for the students. Next we will be working on mutes.

We decided to make some changes to the survey track. The NS line on the ocean crust seaward of the trench will be sacrificed. Instead we will shoot a NS line along the slope to look for any shallow sediment subduction that might link to deeper sediment subduction potentially seen on the shelf line. The protected species permit quota for shooting at depths <1000 m has been largely used up. Consequently we have designed this line to be in greater than 1000 m water depth.

*Feb. 3:* Continued data acquisition. Headed north.

*Feb. 4:* Turned onto line 42 and encountered a strong following sea. The streamer surfaced and was hard to control. Not enough speed through the water for the streamer after the turn and with the following sea. Streamer depth was set for 14 m, which is more stable.

*Feb. 5:* Acquisition continues.

*Feb. 6:* Very slow internet today (slower than usual). Rough weather and equipment issues were causing both internet receivers to be unable to track satellite signals. For the science meeting today we looked through all of the migrations of existing data from the cruise.

*Feb. 7:* Acquisition continues.

*Feb. 8:* Very large swell coming from the south. With our N course, the following sea is causing tension problems with the streamer. Eduardo presented an overview of the structure and geology of the Chile margin.

*Feb. 9:* As we turn on to our E-W course to shoot line 33, the swell hits us from the side and lots of rolling. T-Shirt design voting begins. A revised estimate of timing shows that we have an extra 12 hours at the end and will still make it back on the 17<sup>th</sup>, a day earlier than planned. Consequently we have changed our trackline for the final days. First we realize that the original line 39, which was located along the German OBS line P3, runs oblique to a canyon and will have extensive side swipe. Line 39 is changed to follow a third German OBS line, Line P1, which runs parallel to the original Line 39 but farther north. This line avoids canyons and is also along a line that has been surveyed with high resolution seismic reflection and with multiple passes with swath bathymetry, both before and after the 2010 Maule earthquake. With the possible additional 12 hours estimated, we add a third dip line south and parallel to the original line 39. This line was picked where the margin width and slope are similar to lines farther north, and where there are no large canyons.

*Feb. 10:* Acquisition continues. No science meeting today. Weather hard on airguns. Cluster came apart and bent the spreader bars, which had to be changed.

*Feb. 11:* Acquisition continues.

*Feb. 12:* Weather picks up. Swell is worse, especially on EW course. Nathan presents the Costa Rica 3D data during the science meeting, which closes with a discussion comparing Chile and Costa Rica.

*Feb. 13:* Midnight meals begin. The captain decided that we should have them to make up for the limited food choices and low availability of food in the late hours. This is a welcome change. T-Shirt logo is selected by vote from the whole crew. Brooklyn and Jorge are the winners with Jorge providing a front logo and Brooklyn providing a back logo.

*Feb. 14:* Valentine's Day with lots of candy and decorations. Lines 37 and 39 are interrupted with numerous whale and pinniped sightings. Both of these lines will have to be reshot. Unfortunately there is not enough time to reshoot both lines entirely and we will only be able to reshoot pieces of each. We also had to abandon our plan to add another line to the S between lines 37 and 33. Pinged the OBS lost from a previous cruise when we passed over it and heard a response. We will attempt a recovery after we retrieve the streamer. Line 39 was changed to become two segments, 39 and 39A, because of the extended shut down of the guns due to pinnipeds.

*Feb. 15:* Reshooting lines 37 and 39/39A as 37R and 39R. These reshoots began on the western side and we shot toward the east. Shooting began at ~ 1 AM, and the westernmost gap was filled just after daybreak. The seas were very calm and visibility was excellent, leading to many sightings of protected species and resulting in numerous power downs and shut downs. Consequently the second large gap was not filled on line 39 and the gaps across line 37 were very poorly covered until after sunset and the final gaps across the trench sequence were filled.

*Feb. 16:* Shooting ends at 3:00 AM with shot number 103082. After some streamer re-tensioning, streamer recovery begins. Streamer on board at 11:30. Steamed to OBS site to attempt a recovery. OBS recovery was not successful. The instrument responded and was signaled to release, but failed to release. Continued steaming to Valparaiso.

*Feb. 17:* Arrived at the dock at 8:30AM. Packed up computers and prepared them for shipping home.

*Feb. 18:* Departed Langseth and made our separate ways home.

## Seismic Acquisition Examples

Shot gather with/without swell noise

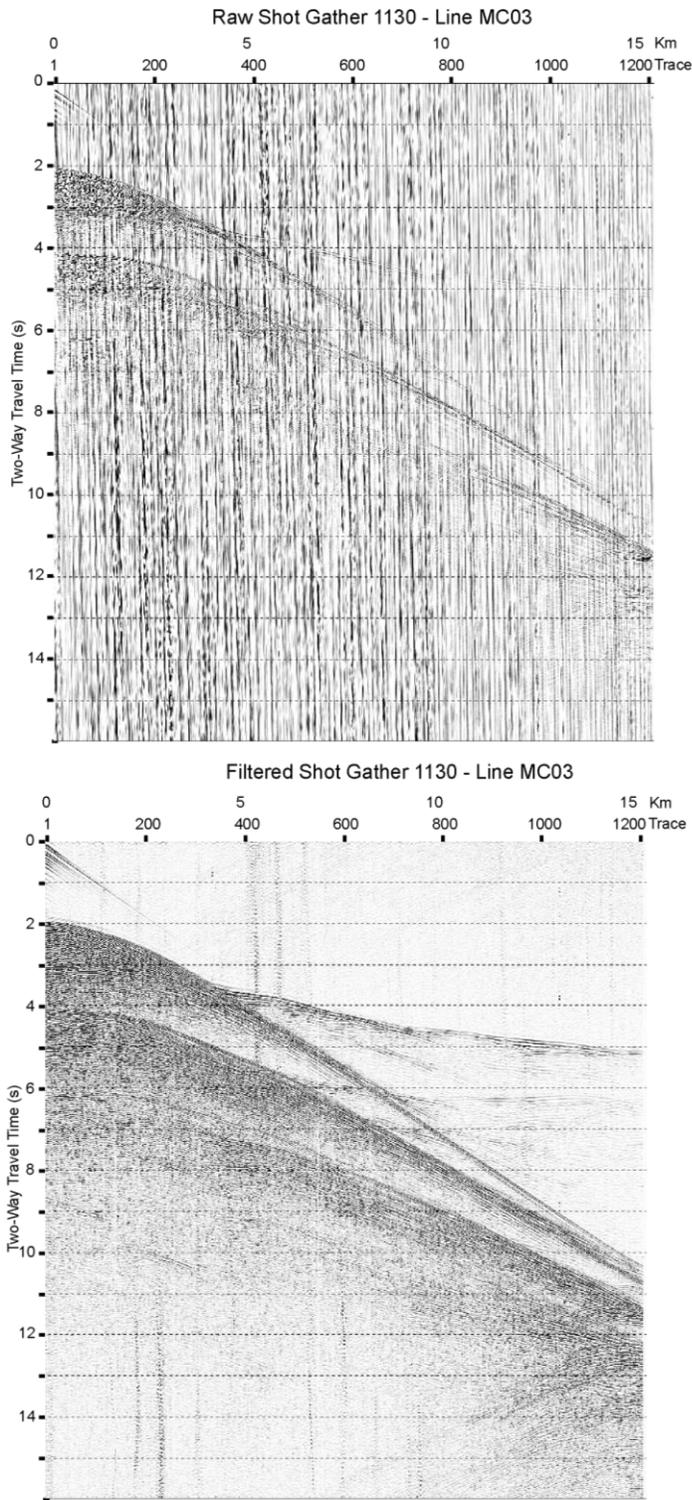


Figure 14. Examples of shot gathers acquired using the 15 km streamer. Top-row shot gather (Shot 1130) from line MC03 with considerable low frequency swell noise. Bottom- Shot 1130 after filtering to remove swell noise. Note the prominent refracted arrivals (first arrivals beyond 5 km offset).

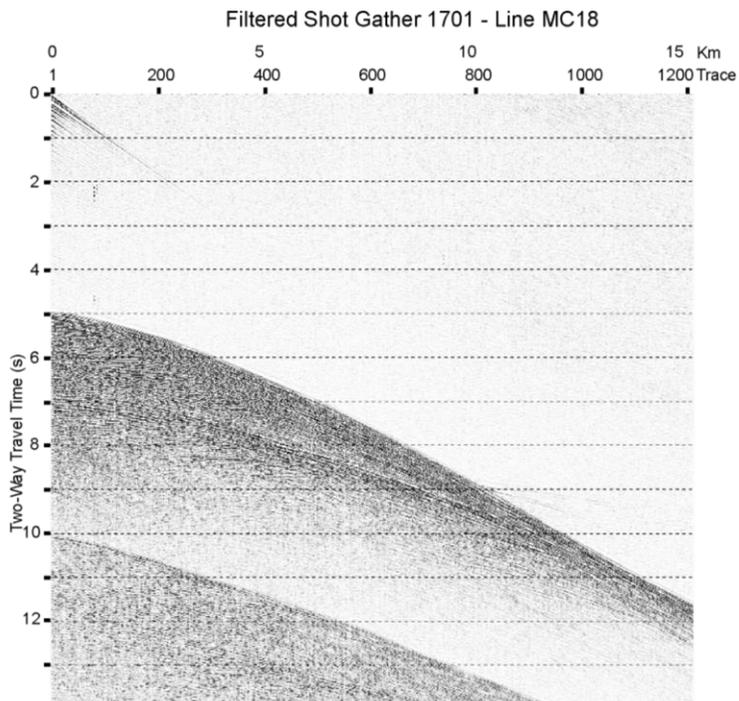
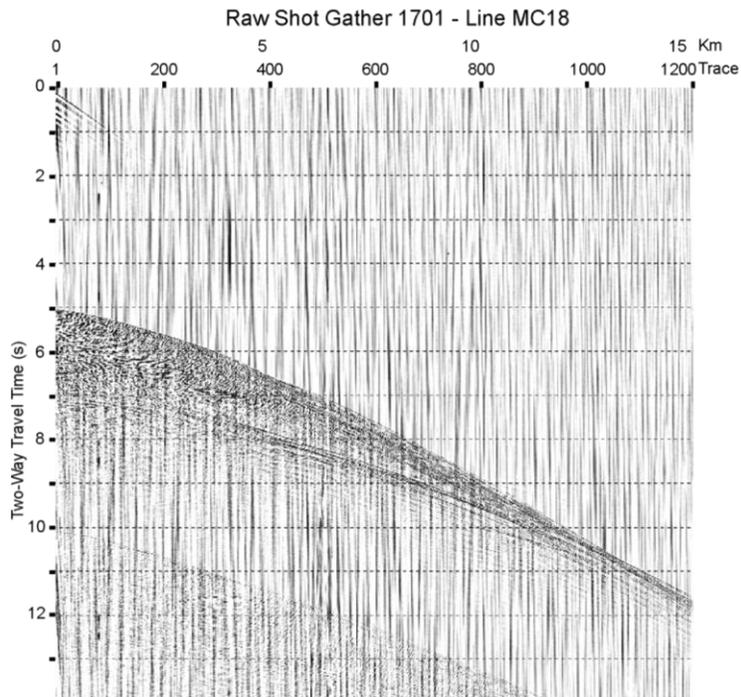


Figure 15. Examples of shot gathers acquired using the 15 km streamer. Top-row shot gather (Shot 1701) from line MC03 with considerable low frequency swell noise. Bottom- Shot 1701 after filtering to remove swell noise. Note the weak refracted arrivals (first arrivals beyond 10 km offset).

Line MC03 – Migrated

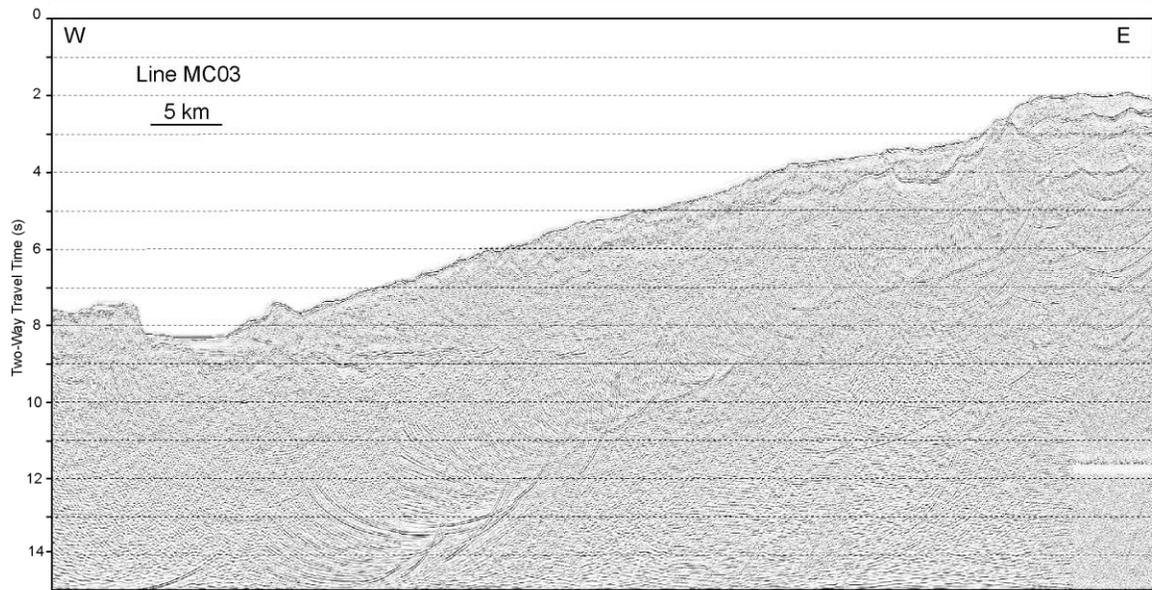


Figure 16. Migrated seismic line MC03 as an example of profiles across the Illapel earthquake rupture area. Location shown in Figure 3. Enlargements shown in Figures 17 & 18.

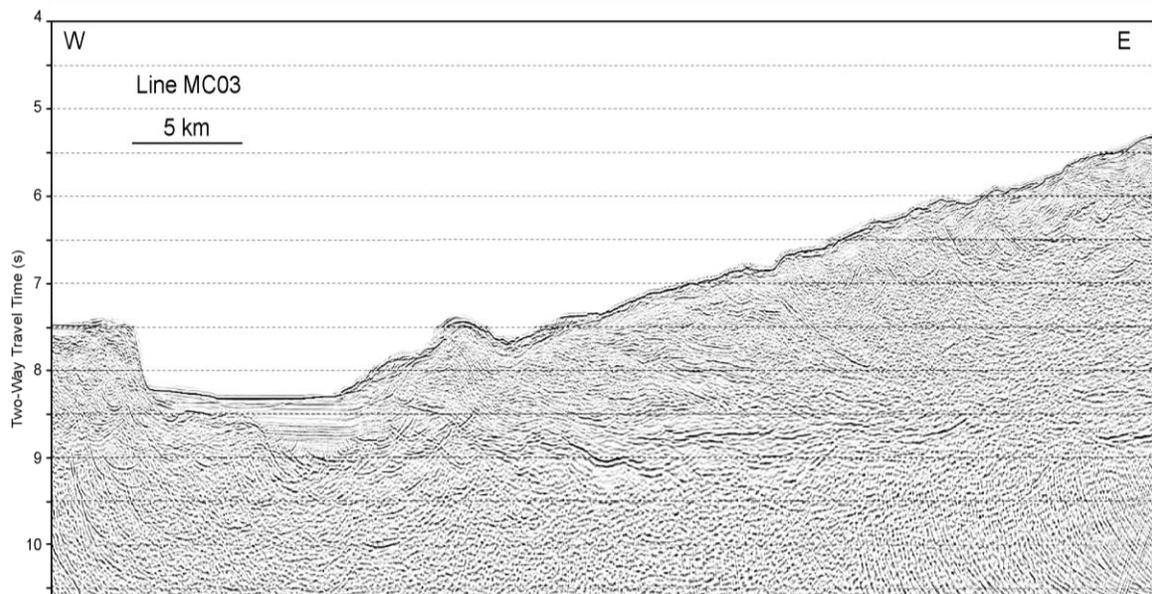


Figure 17. Enlargement of the trench and lower slope region of migrated seismic line MC03. Note the narrow, thin trench basin infill and top of the subducting ocean plate at ~ 8.5 – 9 s.

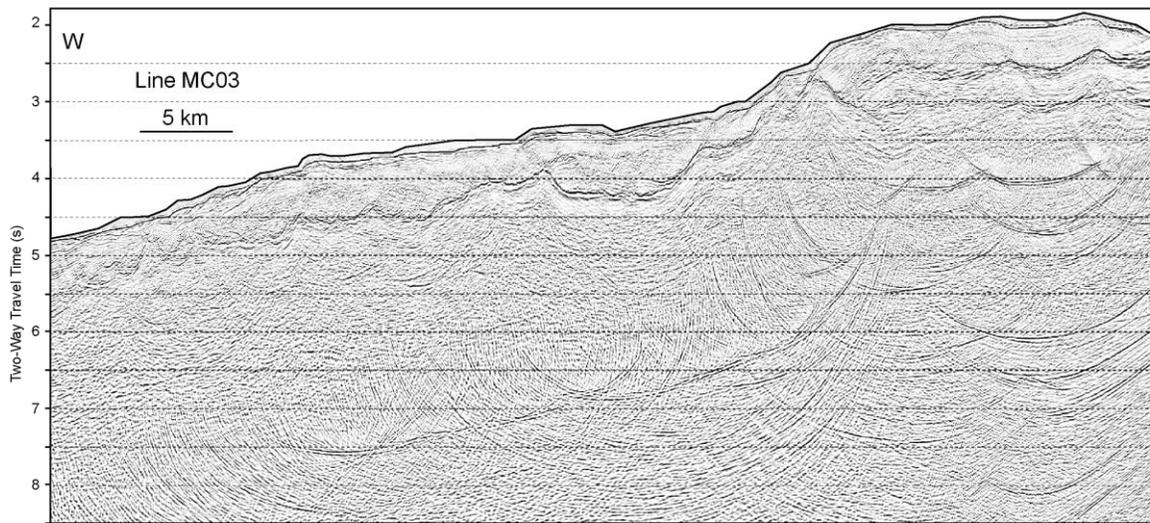


Figure 18. Enlargement of migrated section MC03 across the upper slope and narrow shelf region of the Illapel earthquake rupture area.

#### Line MC28 – Migrated

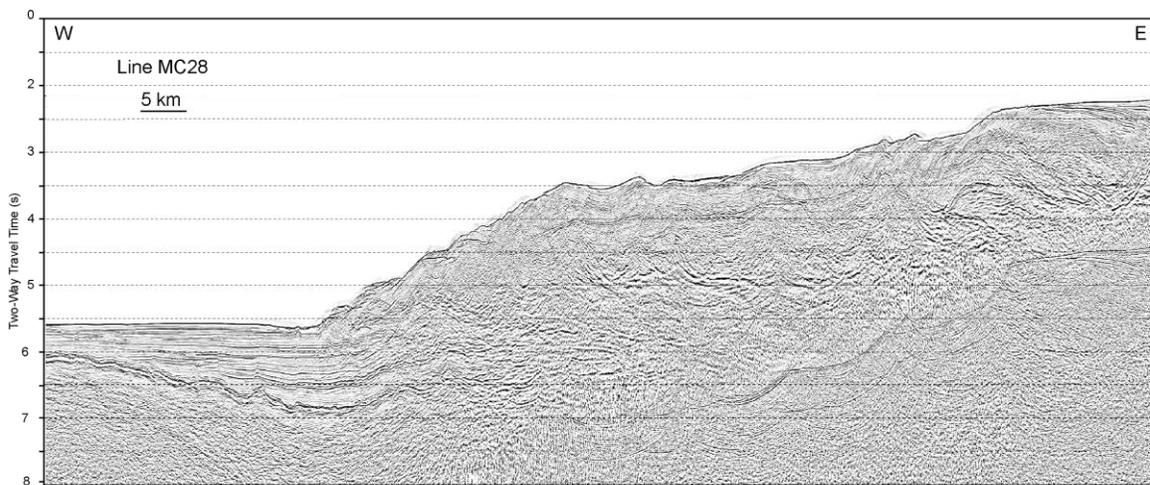


Figure 19. Seaward portion of migrated seismic line MC28 as an example from the Valdivia earthquake rupture area. Location is shown in Figure 3. Note the nearly 2 km of sediment in the trench and steep to flate frontal accretionary wedge geometry across the lower slope. Numerous reflections also appear within the section above the multiple.

## Data Handling

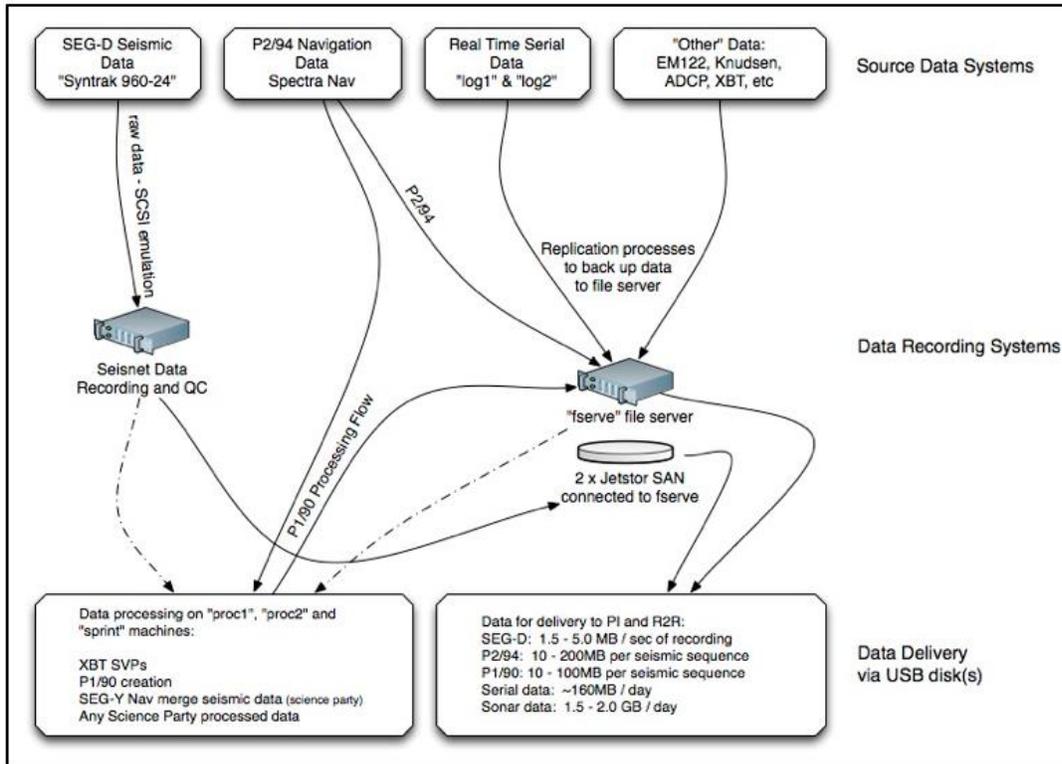


Figure 20. Schematic of the shipboard data acquisition and integration system.

All raw MCS data will be archived at the LDEO Academic Seismic Portal (ASP) along with this report and all additional metadata on the navigation, streamer and gun array. Stacked and migrated sections will be archived with the UTIG ASP (<http://www-udc.ig.utexas.edu/sdc/>).

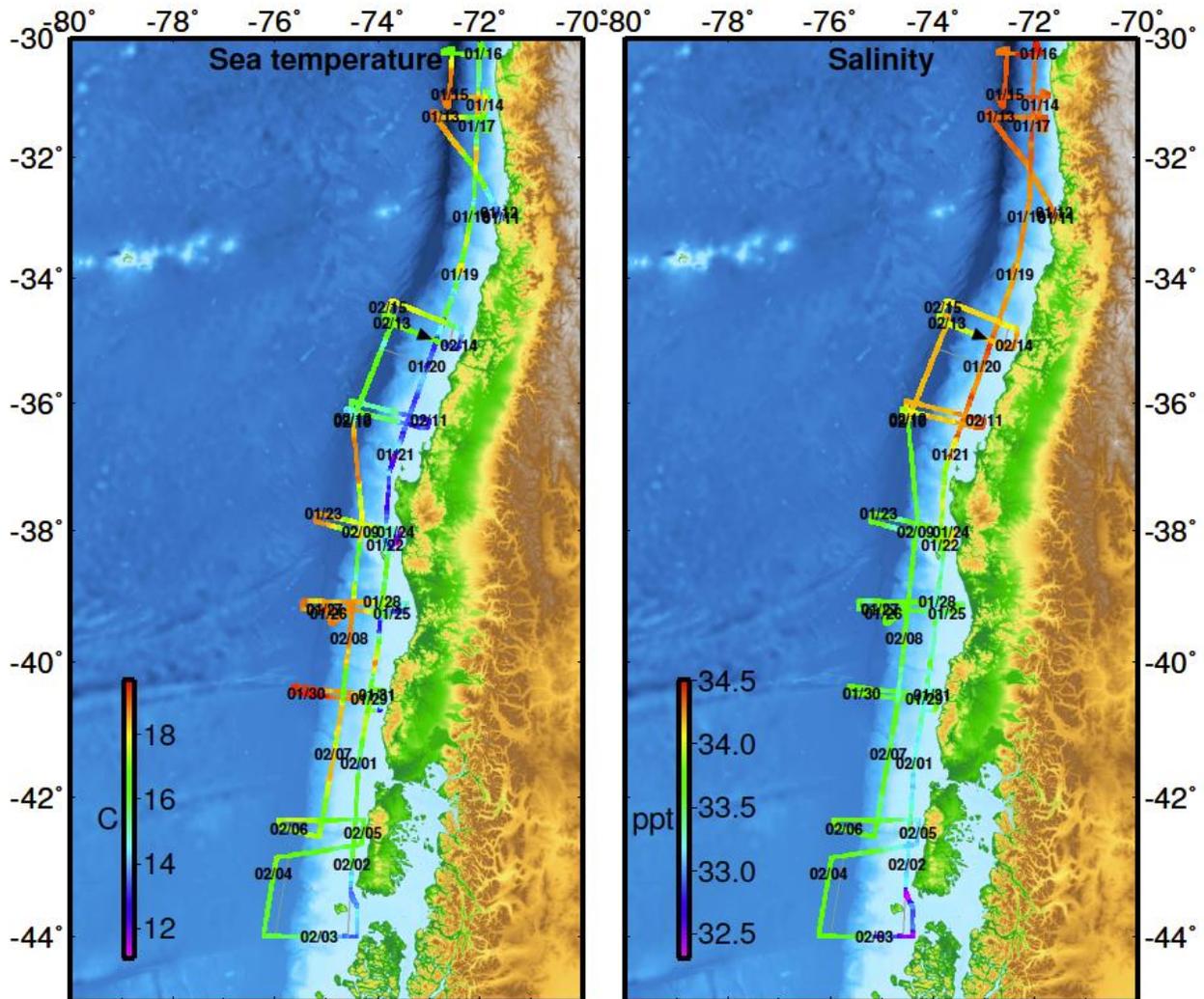


Figure 21. Seasurface salinity and temperature during MGL1701. Large, local changes were observed due to input of cold, fresh water from rivers.

### Protected Species Observing and Passive Acoustic Monitoring: Procedures and Observations

A crew of 5 protected species observers stood watch during the entire cruise. Generally, 2 observers were on visual watch during daylight hours, with a 3<sup>rd</sup> observer in the lab around the clock watching the Seiche™ Passive Acoustic Monitoring (PAM) system. Source power was increased gradually (“ramp-up” when the source was initially fired up and after any shut down lasting more the 8 minutes. The observers followed the logic tree shown in Figure 13 when deciding whether to call for a “power down” (i.e. shutting off all but a small 40 cubic inch “mitigation” airgun) or a “shut down” (complete shut-down of all airguns). Times and positions of data gaps due to power or shut downs are given in Tables 5 and 6, respectively. The complete final monitoring report will be found on the NOAA site with all the other project documents at:

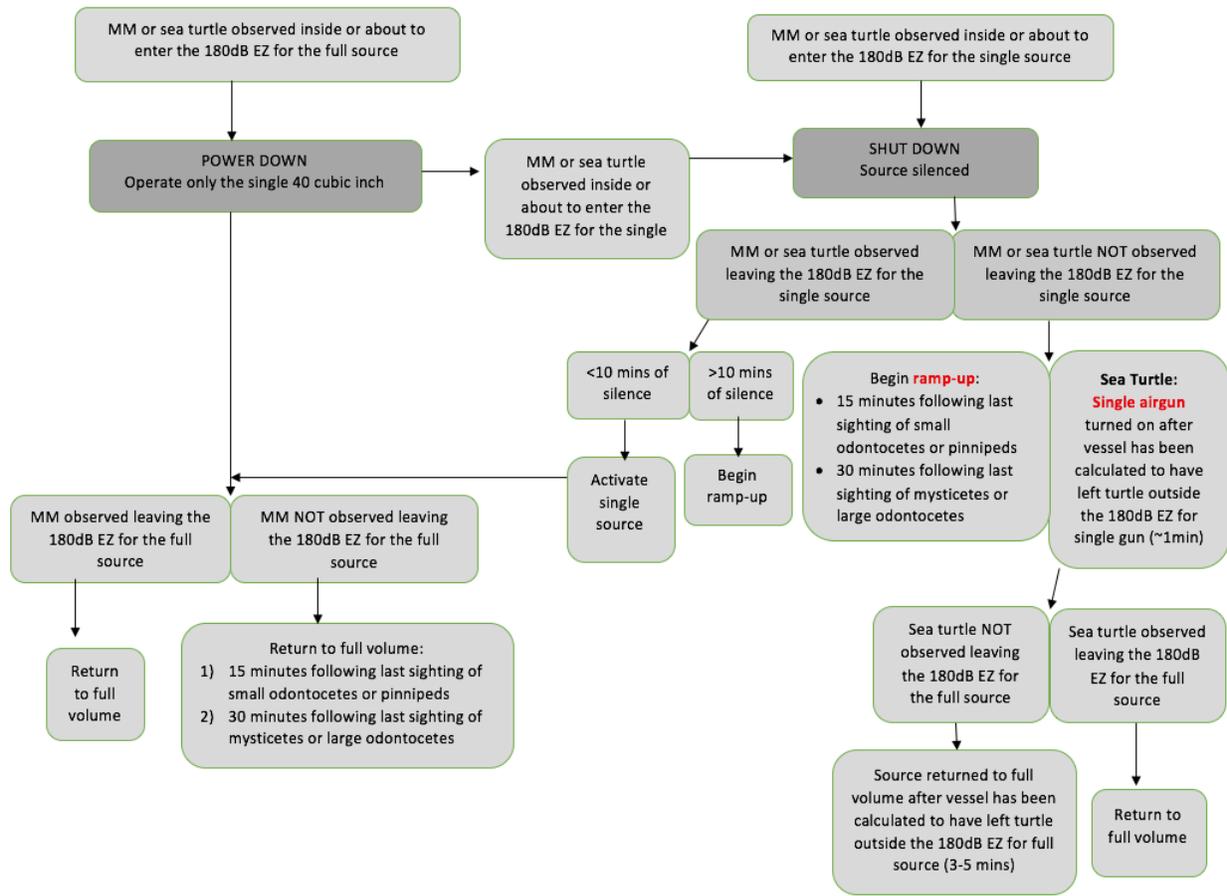


Figure 22. Logic tree for determining actions to mitigate impact of airguns of protected species.

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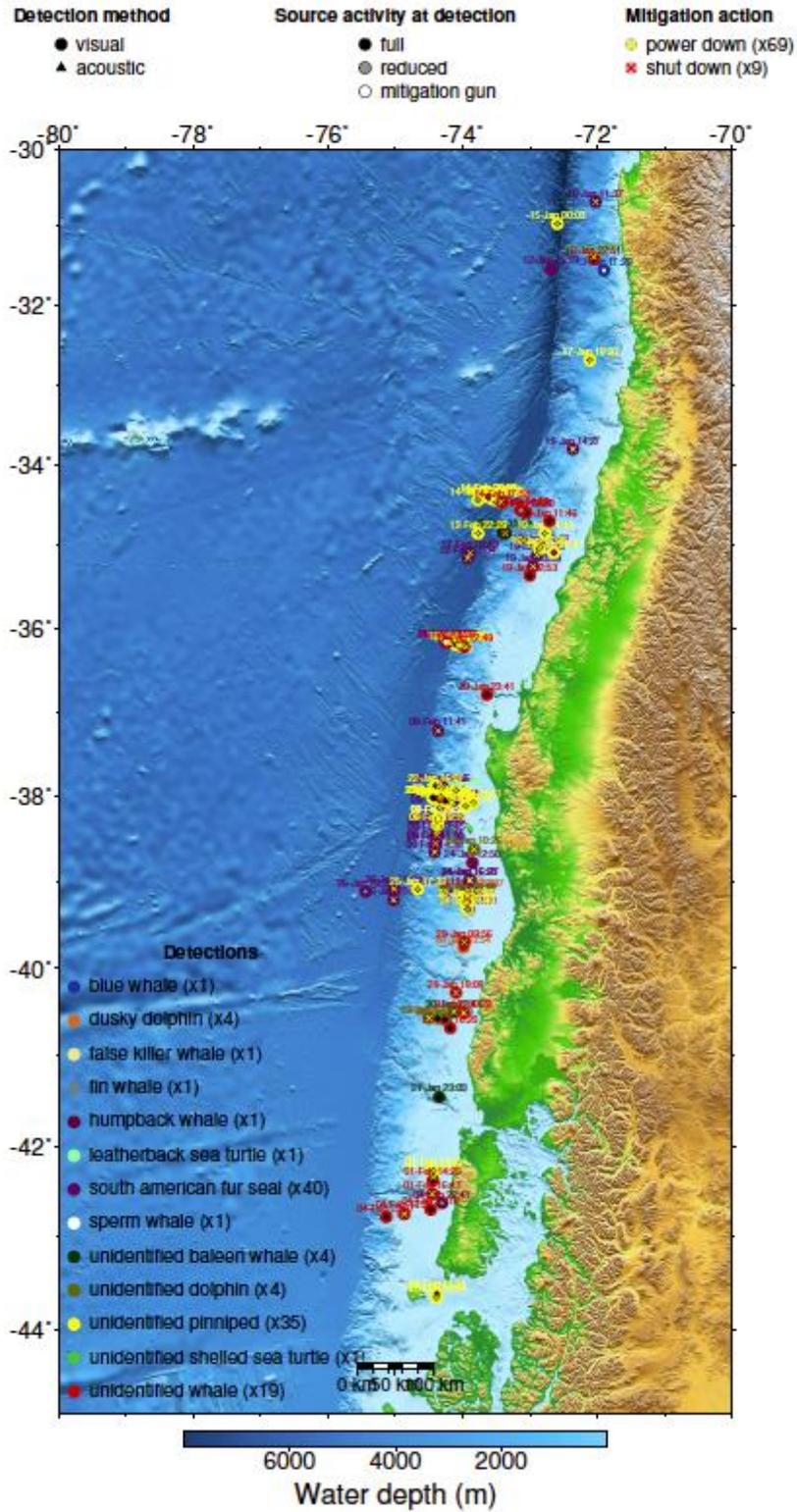


Figure 23. Summary of protected species detections.

## Appendices

### Appendix A - XBT Profiles

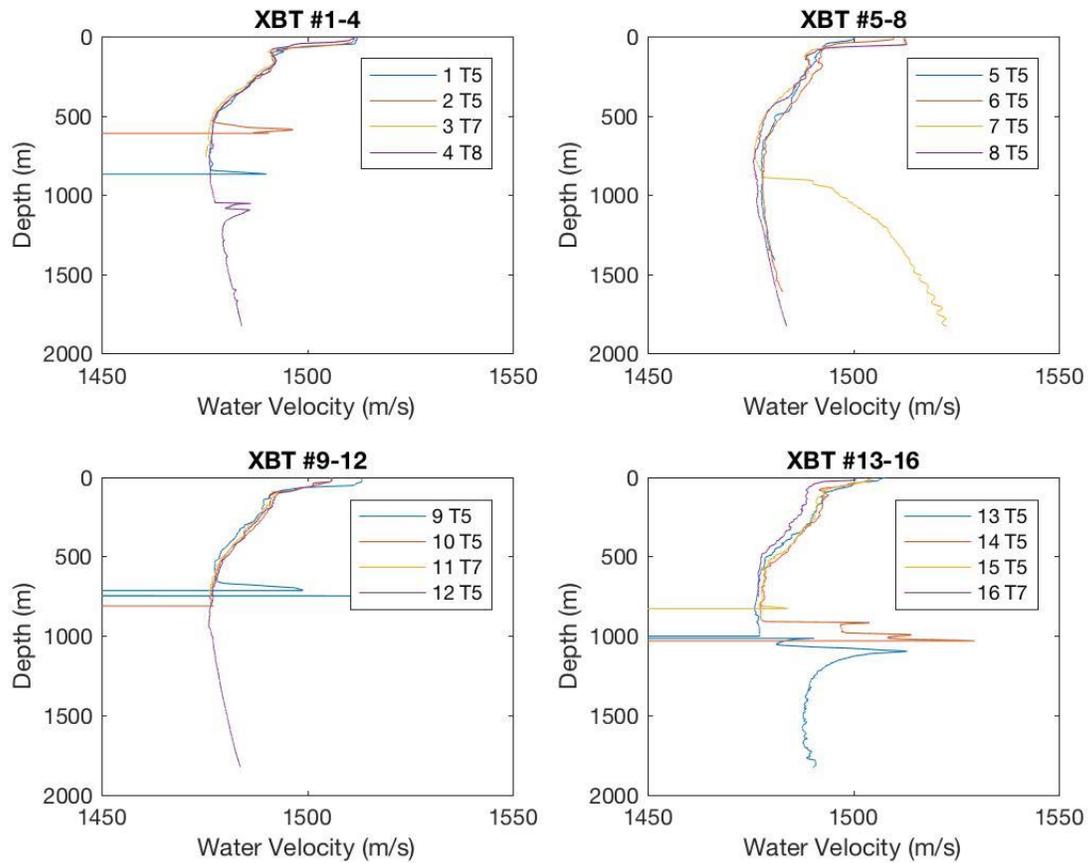


Figure A1. Water velocity as a function of depth derived from the XBT temperature data for groups of XBT deployments. XBTs are described in Table 3 above. Locations are shown in Figure 7. Velocity was calculated assuming a salinity of 30 ppt.

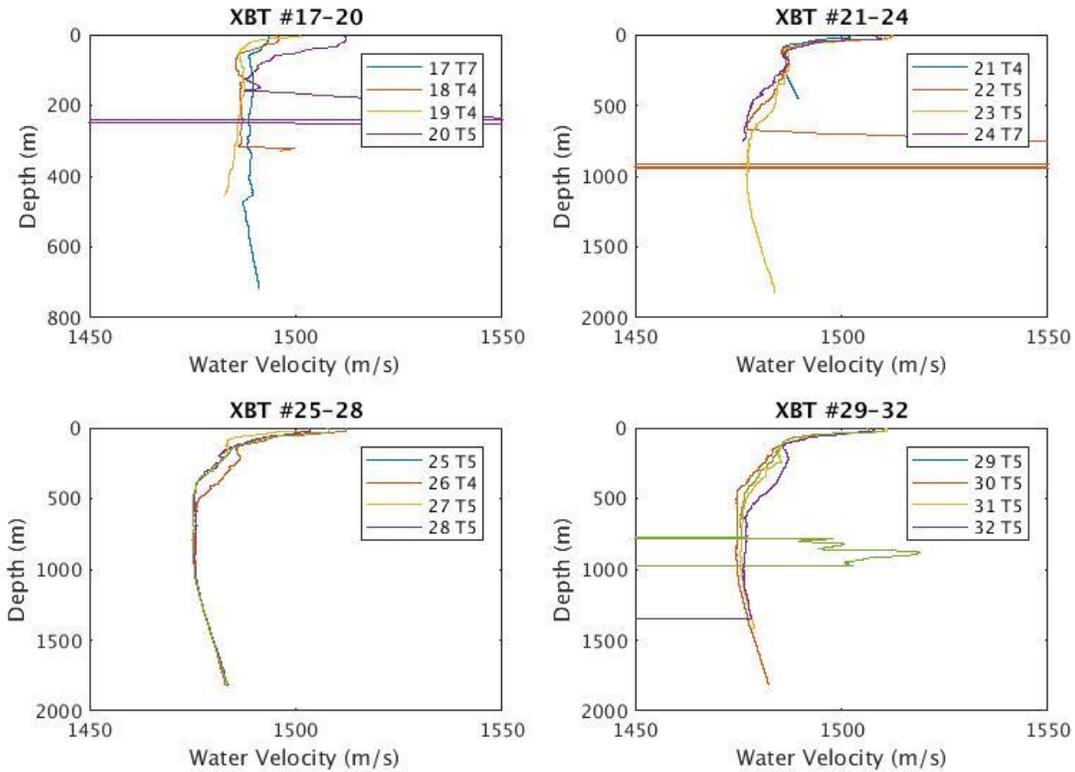


Figure A2. Water velocity as a function of depth derived from the XBT thermal data for groups of XBT deployments. XBTs are described in Table 3 above. Locations are shown in Figure 7. Velocity was calculated assuming a salinity of 30 ppt.

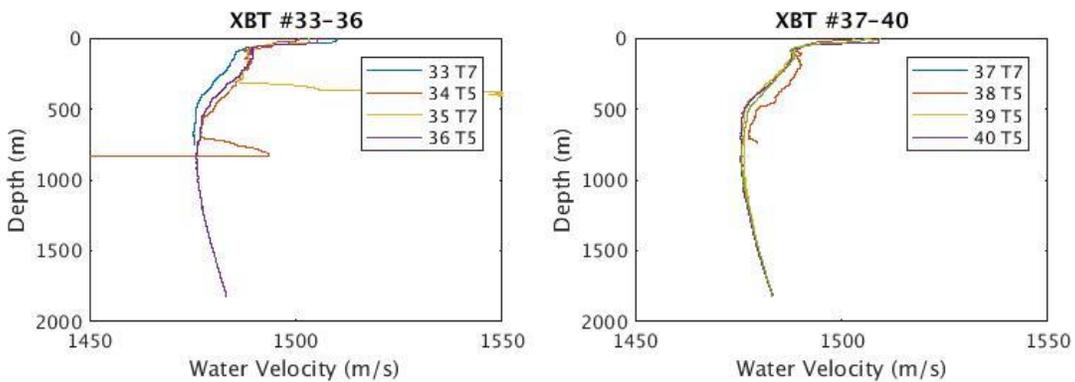


Figure A3. Water velocity as a function of depth derived from the XBT thermal data for groups of XBT deployments. XBTs are described in Table 3 above. Locations are shown in Figure 7. Velocity was calculated assuming a salinity of 30 ppt.

## Appendix B - Tape Summary

Note: These data are helpful to locate raw shot data.

First Line FFID Shot Lat Lon Yr Month Day Min Sec Depth  
Last Line FFID Shot Lat Lon Yr Month Day Min Sec Depth

TAPE: TAPE0001.REEL

1 MGL1701MC01 000001 000601 -31.333199 -72.764559 2017 01 13 00 06 35.635871 5132.3  
1000 MGL1701MC01 001000 001600 -31.333785 -72.370921 2017 01 13 05 39 30.602874 4314.7  
Number of shots on TAPE0001.REEL: 1000

TAPE: TAPE0002.REEL

1 MGL1701MC01 001001 001601 -31.333780 -72.370528 2017 01 13 05 39 51.039873 4336.4  
1000 MGL1701MC01 002000 002600 -31.333456 -71.976890 2017 01 13 10 57 26.008873 2079.6  
Number of shots on TAPE0002.REEL: 1000

TAPE: TAPE0003.REEL

1 MGL1701MC01 002001 002601 -31.333454 -71.976496 2017 01 13 10 57 43.227874 2075.3  
343 MGL1701MC01 002343 002943 -31.333340 -71.841735 2017 01 13 12 40 07.818875 1356.7  
Number of shots on TAPE0003.REEL: 343

TAPE: TAPE0004.REEL

1 MGL1701MC02 002344 000763 -31.412536 -71.918828 2017 01 13 19 43 56.981874 2009.1  
1000 MGL1701MC02 003343 001762 -31.074821 -71.901408 2017 01 14 00 46 49.538898 1611.8  
Number of shots on TAPE0004.REEL: 1000

TAPE: TAPE0005.REEL

1 MGL1701MC02 003344 001763 -31.074484 -71.901381 2017 01 14 00 47 06.163872 1612.2  
430 MGL1701MC02 003773 002192 -30.999771 -71.889060 2017 01 14 02 46 46.142873 1560.3  
Number of shots on TAPE0005.REEL: 430

TAPE: TAPE0006.REEL

1 MGL1701MC03 003774 000998 -30.999837 -71.895806 2017 01 14 07 42 58.383873 1459.3  
1000 MGL1701MC03 004773 001997 -31.000460 -72.288061 2017 01 14 12 35 12.996873 4006.0  
Number of shots on TAPE0006.REEL: 1000

TAPE: TAPE0007.REEL

1 MGL1701MC03 004774 001998 -31.000471 -72.288455 2017 01 14 12 35 31.119874 4002.6  
993 MGL1701MC03 005766 002990 -30.999812 -72.677944 2017 01 14 18 14 45.568874 5774.3  
Number of shots on TAPE0007.REEL: 993

TAPE: TAPE0008.REEL

1 MGL1701MC04 005767 000914 -31.027521 -72.598443 2017 01 14 23 09 59.915874 6267.6  
1000 MGL1701MC04 006766 001915 -30.689562 -72.574508 2017 01 15 03 50 55.932873 6169.9  
Number of shots on TAPE0008.REEL: 1000

TAPE: TAPE0009.REEL

1 MGL1701MC04 006767 001916 -30.689223 -72.574486 2017 01 15 03 51 13.197874 6186.7  
1000 MGL1701MC04 007766 002915 -30.351916 -72.551014 2017 01 15 08 53 33.041874 6315.6  
Number of shots on TAPE0009.REEL: 1000

TAPE: TAPE0010.REEL

1 MGL1701MC04 007767 002916 -30.351577 -72.550993 2017 01 15 08 53 52.888873 6315.8  
457 MGL1701MC04 008223 003372 -30.197623 -72.539932 2017 01 15 11 31 33.924873 6192.0  
Number of shots on TAPE0010.REEL: 457

TAPE: TAPE0011.REEL

1 MGL1701MC05 008224 000927 -30.267507 -72.571779 2017 01 15 15 53 08.495875 6223.9

1000 MGL1701MC05 009223 001926 -30.275689 -72.182553 2017 01 15 20 55 30.797874 3655.1  
Number of shots on TAPE0011.REEL: 1000

TAPE: TAPE0012.REEL  
1 MGL1701MC05 009224 001927 -30.275690 -72.182162 2017 01 15 20 55 47.991878 3652.7  
658 MGL1701MC05 009881 002584 -30.280792 -71.926166 2017 01 16 00 02 24.348872 3029.2  
Number of shots on TAPE0012.REEL: 658

TAPE: TAPE0013.REEL  
1 MGL1701MC06 009882 000946 -30.262340 -72.006872 2017 01 16 05 20 14.868876 3215.1  
1000 MGL1701MC06 010881 001945 -30.600057 -72.020474 2017 01 16 10 27 21.940879 2856.9  
Number of shots on TAPE0013.REEL: 1000

TAPE: TAPE0014.REEL  
1 MGL1701MC06 010882 001946 -30.600396 -72.020470 2017 01 16 10 27 39.844895 2855.8  
1000 MGL1701MC06 011881 002951 -30.940115 -72.034565 2017 01 16 15 30 25.312898 2604.8  
Number of shots on TAPE0014.REEL: 1000

TAPE: TAPE0015.REEL  
1 MGL1701MC06 011882 002952 -30.940455 -72.034572 2017 01 16 15 30 43.456882 2541.9  
1000 MGL1701MC06 012881 003952 -31.278464 -72.048681 2017 01 16 20 38 34.829874 2598.4  
Number of shots on TAPE0015.REEL: 1000

TAPE: TAPE0016.REEL  
1 MGL1701MC06 012882 003953 -31.278806 -72.048692 2017 01 16 20 38 55.347869 2596.8  
1000 MGL1701MC06 013881 004954 -31.617133 -72.062945 2017 01 17 02 03 34.880873 2990.2  
Number of shots on TAPE0016.REEL: 1000

TAPE: TAPE0017.REEL  
1 MGL1701MC06 013882 004955 -31.617473 -72.062945 2017 01 17 02 03 53.371872 2991.4  
86 MGL1701MC06 013967 005040 -31.646202 -72.064196 2017 01 17 02 29 57.671873 2984.1  
Number of shots on TAPE0017.REEL: 86

TAPE: TAPE0018.REEL  
1 MGL1701MC06A 013968 005088 -31.662424 -72.064850 2017 01 17 02 44 28.704874 2993.6  
678 MGL1701MC06A 014645 005768 -31.892514 -72.074569 2017 01 17 06 22 37.440872 3050.4  
Number of shots on TAPE0018.REEL: 678

TAPE: TAPE0019.REEL  
1 MGL1701MC06B 014647 006587 -31.897368 -72.074811 2017 01 17 06 27 37.195874 3034.1  
1000 MGL1701MC06B 015646 007586 -32.347516 -72.093964 2017 01 17 13 19 52.791873 2044.0  
Number of shots on TAPE0019.REEL: 1000

TAPE: TAPE0020.REEL  
1 MGL1701MC06B 015647 007587 -32.347967 -72.093993 2017 01 17 13 20 16.171874 2041.3  
814 MGL1701MC06B 016460 008401 -32.714719 -72.110115 2017 01 17 18 45 43.854873 2470.0  
Number of shots on TAPE0020.REEL: 814

TAPE: TAPE0021.REEL  
1 MGL1701MC07 016461 001005 -32.716379 -72.110530 2017 01 17 18 47 13.995874 2473.6  
1000 MGL1701MC07 017460 002004 -33.158564 -72.212093 2017 01 18 03 36 24.396875 2019.0  
Number of shots on TAPE0021.REEL: 1000

TAPE: TAPE0022.REEL  
1 MGL1701MC07 017461 002005 -33.158988 -72.212169 2017 01 18 03 36 58.600880 2018.8  
1000 MGL1701MC07 018460 003004 -33.601099 -72.314560 2017 01 18 11 04 55.274875 1360.1  
Number of shots on TAPE0022.REEL: 1000

TAPE: TAPE0023.REEL  
1 MGL1701MC07 018461 003005 -33.601531 -72.314642 2017 01 18 11 05 19.334873 1354.4  
757 MGL1701MC07 019217 003767 -33.938825 -72.393941 2017 01 18 16 32 00.366873 1541.1  
Number of shots on TAPE0023.REEL: 757

TAPE: TAPE0024.REEL  
1 MGL1701MC08 019218 001007 -33.941005 -72.395016 2017 01 18 16 34 13.562876 1536.4  
106 MGL1701MC08 019323 001114 -33.986491 -72.414306 2017 01 18 17 17 30.975872 1428.1  
Number of shots on TAPE0024.REEL: 106

TAPE: TAPE0025.REEL  
1 MGL1701MC08R 019324 000977 -33.928429 -72.389050 2017 01 18 23 47 20.964874 1547.6  
1000 MGL1701MC08R 020323 001976 -34.353034 -72.569381 2017 01 19 06 32 51.479872 1874.2  
Number of shots on TAPE0025.REEL: 1000

TAPE: TAPE0026.REEL  
1 MGL1701MC08R 020324 001977 -34.353442 -72.569578 2017 01 19 06 33 14.333873 1873.5  
1000 MGL1701MC08R 021323 002976 -34.778018 -72.750895 2017 01 19 13 08 32.997877 979.8  
Number of shots on TAPE0026.REEL: 1000

TAPE: TAPE0027.REEL  
1 MGL1701MC08R 021324 002977 -34.778422 -72.751081 2017 01 19 13 08 58.892873 988.1  
1000 MGL1701MC08R 022323 003983 -35.205586 -72.935852 2017 01 19 20 14 16.600873 902.1  
Number of shots on TAPE0027.REEL: 1000

TAPE: TAPE0028.REEL  
1 MGL1701MC08R 022324 003984 -35.206014 -72.936033 2017 01 19 20 14 42.309872 895.3  
1000 MGL1701MC08R 023323 004985 -35.630766 -73.121570 2017 01 20 03 33 08.864874 352.5  
Number of shots on TAPE0028.REEL: 1000

TAPE: TAPE0029.REEL  
1 MGL1701MC08R 023324 004986 -35.631189 -73.121750 2017 01 20 03 33 32.096873 354.1  
1000 MGL1701MC08R 024323 005985 -36.054763 -73.309006 2017 01 20 10 16 03.314858 200.8  
Number of shots on TAPE0029.REEL: 1000

TAPE: TAPE0030.REEL  
1 MGL1701MC08R 024324 005986 -36.055192 -73.309175 2017 01 20 10 16 28.399872 201.2  
1000 MGL1701MC08R 025323 006985 -36.478452 -73.498400 2017 01 20 17 32 24.671872 130.9  
Number of shots on TAPE0030.REEL: 1000

TAPE: TAPE0031.REEL  
1 MGL1701MC08R 025324 006986 -36.478875 -73.498601 2017 01 20 17 32 50.697874 131.9  
1000 MGL1701MC08R 026323 007985 -36.901806 -73.689885 2017 01 21 01 40 29.805874 285.5  
Number of shots on TAPE0031.REEL: 1000

TAPE: TAPE0032.REEL  
1 MGL1701MC08R 026324 007986 -36.902229 -73.690085 2017 01 21 01 40 55.898874 281.9  
397 MGL1701MC08R 026720 008382 -37.070005 -73.765726 2017 01 21 04 48 08.931877 321.6  
Number of shots on TAPE0032.REEL: 397

TAPE: TAPE0033.REEL  
1 MGL1701MC09 026721 001005 -37.071706 -73.765841 2017 01 21 04 50 09.012872 252.0  
1000 MGL1701MC09 027720 002004 -37.520919 -73.800278 2017 01 21 12 57 01.005873 218.2  
Number of shots on TAPE0033.REEL: 1000

TAPE: TAPE0034.REEL  
1 MGL1701MC09 027721 002005 -37.521371 -73.800323 2017 01 21 12 57 28.684873 216.6  
1000 MGL1701MC09 028720 003005 -37.971017 -73.835132 2017 01 21 20 17 14.175861 137.2  
Number of shots on TAPE0034.REEL: 1000

TAPE: TAPE0035.REEL  
1 MGL1701MC09 028721 003006 -37.971468 -73.835170 2017 01 21 20 17 39.305873 138.1  
562 MGL1701MC09 029282 003569 -38.224584 -73.855032 2017 01 22 00 02 39.075875 418.5  
Number of shots on TAPE0035.REEL: 562

TAPE: TAPE0036.REEL  
1 MGL1701MC10 029283 003569 -38.228824 -73.730153 2017 01 22 03 00 39.000000 155.2  
457 MGL1701MC10 029739 001553 -38.072485 -73.554194 2017 01 22 06 04 06.728800 73.6

Number of shots on TAPE0036.REEL: 457

TAPE: TAPE0037.REEL

1 MGL1701MC11 029740 000971 -38.003415 -73.726214 2017 01 22 08 15 38.269872 116.3  
1000 MGL1701MC11 030739 001972 -37.900227 -74.280571 2017 01 22 14 43 09.982875 1789.4  
Number of shots on TAPE0037.REEL: 1000

TAPE: TAPE0038.REEL

1 MGL1701MC11 030740 001973 -37.900137 -74.281127 2017 01 22 14 43 31.777874 1799.4  
1000 MGL1701MC11 031739 002975 -37.795109 -74.834747 2017 01 22 21 20 43.448887 4639.7  
Number of shots on TAPE0038.REEL: 1000

TAPE: TAPE0039.REEL

1 MGL1701MC11 031740 002976 -37.794992 -74.835294 2017 01 22 21 21 07.872879 4638.0  
541 MGL1701MC11 032280 003516 -37.738421 -75.133333 2017 01 23 00 54 14.704873 4445.7  
Number of shots on TAPE0039.REEL: 541

TAPE: TAPE0040.REEL

1 MGL1701MC13 032281 000909 -37.894383 -75.042959 2017 01 23 04 55 27.407874 4515.5  
569 MGL1701MC13 032849 001477 -37.960268 -74.730811 2017 01 23 08 40 33.622873 4687.1  
Number of shots on TAPE0040.REEL: 569

TAPE: TAPE0041.REEL

1 MGL1701MC13 032849 001477 -37.960268 -74.730811 2017 01 23 08 40 33.622873 4687.1  
1 MGL1701MC13 032849 001477 -37.960268 -74.730811 2017 01 23 08 40 33.622873 4687.1  
Number of shots on TAPE0041.REEL: 1

TAPE: TAPE0042.REEL

1 MGL1701MC13 032849 001477 -37.960268 -74.730811 2017 01 23 08 40 33.622873 4687.1  
1 MGL1701MC13 032849 001477 -37.960268 -74.730811 2017 01 23 08 40 33.622873 4687.1  
Number of shots on TAPE0042.REEL: 1

TAPE: TAPE0043.REEL

1 MGL1701MC13 032849 001477 -37.960268 -74.730811 2017 01 23 08 40 33.622873 4687.1  
1 MGL1701MC13 032849 001477 -37.960268 -74.730811 2017 01 23 08 40 33.622873 4687.1  
Number of shots on TAPE0043.REEL: 1

TAPE: TAPE0044.REEL

1 MGL1701MC13 032849 001477 -37.960268 -74.730811 2017 01 23 08 40 33.622873 4687.1  
1000 MGL1701MC13 033848 002478 -38.074326 -74.179385 2017 01 23 15 11 35.546874 682.4  
Number of shots on TAPE0044.REEL: 1000

TAPE: TAPE0045.REEL

1 MGL1701MC13 033849 002480 -38.074544 -74.178277 2017 01 23 15 12 20.438873 680.9  
1000 MGL1701MC13 034848 003484 -38.187640 -73.623912 2017 01 23 21 34 20.869872 93.7  
Number of shots on TAPE0045.REEL: 1000

TAPE: TAPE0046.REEL

1 MGL1701MC13 034849 003485 -38.187687 -73.623337 2017 01 23 21 34 43.374880 94.0  
27 MGL1701MC13 034875 003511 -38.185688 -73.607407 2017 01 23 21 45 05.361873 87.2  
Number of shots on TAPE0046.REEL: 27

TAPE: TAPE0047.REEL

1 MGL1701MC14 034876 000946 -38.137140 -73.755062 2017 01 24 03 22 26.162872 254.6  
1000 MGL1701MC14 035875 001945 -38.583525 -73.827248 2017 01 24 09 48 24.362875 76.6  
Number of shots on TAPE0047.REEL: 1000

TAPE: TAPE0048.REEL

1 MGL1701MC14 035876 001946 -38.583971 -73.827323 2017 01 24 09 48 48.729872 77.1  
1000 MGL1701MC14 036875 002961 -39.037374 -73.902178 2017 01 24 17 13 02.632872 819.5  
Number of shots on TAPE0048.REEL: 1000

TAPE: TAPE0049.REEL

1 MGL1701MC14 036876 002962 -39.037824 -73.902225 2017 01 24 17 13 30.858873 805.3  
596 MGL1701MC14 037471 003565 -39.307204 -73.946487 2017 01 24 21 30 15.601873 552.3  
Number of shots on TAPE0049.REEL: 596

TAPE: TAPE0050.REEL

1 MGL1701MC15 037472 001379 -39.277826 -73.745165 2017 01 24 23 39 02.835873 131.1  
582 MGL1701MC15 038053 001960 -39.184180 -73.430870 2017 01 25 03 13 12.335800 44.0  
Number of shots on TAPE0050.REEL: 582

TAPE: TAPE0051.REEL

1 MGL1701MC16 038054 000982 -39.111240 -73.557082 2017 01 25 05 33 44.769872 77.0  
1000 MGL1701MC16 039053 001981 -39.102125 -74.134446 2017 01 25 11 56 37.479874 1479.6  
Number of shots on TAPE0051.REEL: 1000

TAPE: TAPE0052.REEL

1 MGL1701MC16 039054 001982 -39.102113 -74.135023 2017 01 25 11 56 59.153871 1476.7  
1000 MGL1701MC16 040053 002984 -39.090219 -74.713954 2017 01 25 18 00 41.319881 2697.3  
Number of shots on TAPE0052.REEL: 1000

TAPE: TAPE0053.REEL

1 MGL1701MC16 040054 002985 -39.090201 -74.714530 2017 01 25 18 01 02.904872 2693.0  
526 MGL1701MC16 040579 003510 -39.082780 -75.017777 2017 01 25 21 17 27.331875 4394.3  
Number of shots on TAPE0053.REEL: 526

TAPE: TAPE0054.REEL

1 MGL1701MC16A 040580 003109 -39.088492 -74.786160 2017 01 26 10 41 48.042875 3297.5  
1000 MGL1701MC16A 041579 004109 -39.073950 -75.363712 2017 01 26 16 44 44.562864 4311.9  
Number of shots on TAPE0054.REEL: 1000

TAPE: TAPE0055.REEL

1 MGL1701MC16A 041580 004110 -39.073926 -75.364289 2017 01 26 16 45 07.118861 4304.0  
120 MGL1701MC16A 041699 004229 -39.077916 -75.433283 2017 01 26 17 31 18.284874 3680.6  
Number of shots on TAPE0055.REEL: 120

TAPE: TAPE0056.REEL

1 MGL1701MC18 041700 000982 -39.208803 -75.272537 2017 01 26 21 13 19.202874 4333.5  
1000 MGL1701MC18 042699 001982 -39.223499 -74.693890 2017 01 27 03 55 21.728872 2523.2  
Number of shots on TAPE0056.REEL: 1000

TAPE: TAPE0057.REEL

1 MGL1701MC18 042700 001983 -39.223515 -74.693309 2017 01 27 03 55 48.143873 2519.3  
1000 MGL1701MC18 043699 002982 -39.235267 -74.115008 2017 01 27 10 52 27.092875 1120.6  
Number of shots on TAPE0057.REEL: 1000

TAPE: TAPE0058.REEL

1 MGL1701MC18 043700 002983 -39.235266 -74.114428 2017 01 27 10 52 49.902875 1120.2  
1000 MGL1701MC18 044699 003986 -39.245075 -73.533669 2017 01 27 17 01 43.343873 69.2  
Number of shots on TAPE0058.REEL: 1000

TAPE: TAPE0059.REEL

1 MGL1701MC18 044700 003987 -39.245102 -73.533090 2017 01 27 17 02 06.293872 69.4  
97 MGL1701MC18 044796 004083 -39.247112 -73.477519 2017 01 27 17 38 40.619873 50.7  
Number of shots on TAPE0059.REEL: 97

TAPE: TAPE0060.REEL

1 MGL1701MC18T 044797 001211 -39.138699 -73.594422 2017 01 27 20 25 45.721903 92.8  
549 MGL1701MC18T 045345 001760 -39.093818 -73.906551 2017 01 27 23 52 42.698873 200.3  
Number of shots on TAPE0060.REEL: 549

TAPE: TAPE0061.REEL

1 MGL1701MC19 045346 000921 -39.204276 -73.932222 2017 01 28 01 53 08.139881 420.9  
1000 MGL1701MC19 046345 001920 -39.653242 -73.969736 2017 01 28 09 08 59.861870 140.3

Number of shots on TAPE0061.REEL: 1000

TAPE: TAPE0062.REEL

1 MGL1701MC19 046346 001921 -39.653693 -73.969762 2017 01 28 09 09 26.516874 143.1  
103 MGL1701MC19 046448 002023 -39.699521 -73.973791 2017 01 28 09 53 29.117872 129.9  
Number of shots on TAPE0062.REEL: 103

TAPE: TAPE0063.REEL

1 MGL1701MC20 046449 001005 -39.701197 -73.974130 2017 01 28 09 55 04.790872 129.0  
248 MGL1701MC20 046696 001255 -39.812240 -73.998181 2017 01 28 11 45 12.908874 190.5  
Number of shots on TAPE0063.REEL: 248

TAPE: TAPE0064.REEL

1 MGL1701MC20A 046697 001397 -39.875319 -74.011787 2017 01 28 12 59 45.800872 238.3  
1000 MGL1701MC20A 047696 002397 -40.319424 -74.108688 2017 01 28 19 43 41.773874 239.6  
Number of shots on TAPE0064.REEL: 1000

TAPE: TAPE0065.REEL

1 MGL1701MC20A 047697 002398 -40.319870 -74.108780 2017 01 28 19 44 04.781872 238.3  
893 MGL1701MC20A 048589 003290 -40.716476 -74.191781 2017 01 29 02 45 07.374874 168.4  
Number of shots on TAPE0065.REEL: 893

TAPE: TAPE0066.REEL

1 MGL1701MC30 048590 000995 -40.607014 -73.994892 2017 01 29 07 57 58.853871 156.6  
1000 MGL1701MC30 049589 001997 -40.556388 -74.582898 2017 01 29 14 21 14.952881 1756.3  
Number of shots on TAPE0066.REEL: 1000

TAPE: TAPE0067.REEL

1 MGL1701MC30 049590 001998 -40.556336 -74.583484 2017 01 29 14 21 38.409873 1758.0  
1000 MGL1701MC30 050589 002997 -40.502913 -75.168819 2017 01 29 21 26 45.398873 4122.6  
Number of shots on TAPE0067.REEL: 1000

TAPE: TAPE0068.REEL

1 MGL1701MC30 050590 002998 -40.502851 -75.169409 2017 01 29 21 27 09.994874 4124.5  
772 MGL1701MC30 051361 003769 -40.462317 -75.620976 2017 01 30 02 48 56.358872 3929.3  
Number of shots on TAPE0068.REEL: 772

TAPE: TAPE0069.REEL

1 MGL1701MC28 051362 000975 -40.385039 -75.447322 2017 01 30 06 13 03.348871 4050.0  
1000 MGL1701MC28 052361 001974 -40.437047 -74.862805 2017 01 30 13 18 58.436874 2564.0  
Number of shots on TAPE0069.REEL: 1000

TAPE: TAPE0070.REEL

1 MGL1701MC28 052362 001975 -40.437054 -74.862204 2017 01 30 13 19 25.091874 2582.9  
1000 MGL1701MC28 053361 002974 -40.485875 -74.276748 2017 01 30 20 49 27.806873 585.0  
Number of shots on TAPE0070.REEL: 1000

TAPE: TAPE0071.REEL

1 MGL1701MC28 053362 002975 -40.485933 -74.276181 2017 01 30 20 49 54.084873 584.8  
624 MGL1701MC28 053985 003599 -40.516067 -73.910227 2017 01 31 01 06 15.386872 151.1  
Number of shots on TAPE0071.REEL: 624

TAPE: TAPE0072.REEL

1 MGL1701MC20B 053986 003201 -40.677026 -74.182562 2017 01 31 10 19 10.142872 161.9  
1000 MGL1701MC20B 054985 004200 -41.120788 -74.279393 2017 01 31 17 42 40.799874 301.5  
Number of shots on TAPE0072.REEL: 1000

TAPE: TAPE0073.REEL

1 MGL1701MC20B 054986 004201 -41.121230 -74.279496 2017 01 31 17 43 05.878874 303.9  
818 MGL1701MC20B 055803 005018 -41.484073 -74.359380 2017 01 31 23 27 13.947879 1105.6  
Number of shots on TAPE0073.REEL: 818

TAPE: TAPE0074.REEL  
1 MGL1701MC21 055804 001009 -41.487589 -74.359622 2017 01 31 23 30 30.166872 1121.8  
1000 MGL1701MC21 056803 002008 -41.936335 -74.399268 2017 02 01 06 49 20.056872 148.8  
Number of shots on TAPE0074.REEL: 1000

TAPE: TAPE0075.REEL  
1 MGL1701MC21 056804 002009 -41.936794 -74.399305 2017 02 01 06 49 46.513873 148.1  
1000 MGL1701MC21 057803 003009 -42.385929 -74.439754 2017 02 01 14 25 06.722869 161.1  
Number of shots on TAPE0075.REEL: 1000

TAPE: TAPE0076.REEL  
1 MGL1701MC21 057804 003010 -42.386377 -74.439800 2017 02 01 14 25 33.598840 160.5  
1000 MGL1701MC21 058803 004011 -42.835914 -74.480816 2017 02 01 21 29 18.572872 105.5  
Number of shots on TAPE0076.REEL: 1000

TAPE: TAPE0077.REEL  
1 MGL1701MC21 058804 004012 -42.836365 -74.480871 2017 02 01 21 29 45.035875 105.1  
1000 MGL1701MC21 059803 005011 -43.284954 -74.522347 2017 02 02 04 50 19.106865 81.6  
Number of shots on TAPE0077.REEL: 1000

TAPE: TAPE0078.REEL  
1 MGL1701MC21 059804 005012 -43.285404 -74.522386 2017 02 02 04 50 43.361869 83.8  
1000 MGL1701MC21 060803 006012 -43.742309 -74.396618 2017 02 02 12 11 33.540876 215.6  
Number of shots on TAPE0078.REEL: 1000

TAPE: TAPE0079.REEL  
1 MGL1701MC21 060804 006013 -43.742759 -74.396619 2017 02 02 12 11 56.517871 216.4  
547 MGL1701MC21 061350 006559 -43.989156 -74.392092 2017 02 02 15 31 26.435874 149.1  
Number of shots on TAPE0079.REEL: 547

TAPE: TAPE0080.REEL  
1 MGL1701MC22 061351 000961 -44.000224 -74.558936 2017 02 02 17 10 35.205872 107.5  
1000 MGL1701MC22 062350 001960 -43.998647 -75.181706 2017 02 03 00 22 57.749881 231.6  
Number of shots on TAPE0080.REEL: 1000

TAPE: TAPE0081.REEL  
1 MGL1701MC22 062351 001961 -43.998644 -75.182329 2017 02 03 00 23 19.791872 232.1  
1000 MGL1701MC22 063350 002960 -43.997585 -75.805086 2017 02 03 06 37 03.117874 3534.2  
Number of shots on TAPE0081.REEL: 1000

TAPE: TAPE0082.REEL  
1 MGL1701MC22 063351 002961 -43.997547 -75.805723 2017 02 03 06 37 27.521874 3531.8  
632 MGL1701MC22 063982 003592 -43.996256 -76.199023 2017 02 03 10 52 13.412875 3412.5  
Number of shots on TAPE0082.REEL: 632

TAPE: TAPE0083.REEL  
1 MGL1701MC23 063983 001291 -43.867773 -76.200729 2017 02 03 12 47 38.832873 3444.7  
1000 MGL1701MC23 064982 002290 -43.424397 -76.098202 2017 02 03 19 10 21.308872 3552.8  
Number of shots on TAPE0083.REEL: 1000

TAPE: TAPE0084.REEL  
1 MGL1701MC23 064983 002291 -43.423956 -76.098098 2017 02 03 19 10 45.587873 3552.6  
1000 MGL1701MC23 065982 003290 -42.980468 -75.997098 2017 02 04 02 01 01.422872 3705.1  
Number of shots on TAPE0084.REEL: 1000

TAPE: TAPE0085.REEL  
1 MGL1701MC23 065983 003291 -42.980023 -75.997021 2017 02 04 02 01 27.107892 3707.8  
210 MGL1701MC23 066192 003500 -42.887295 -75.975606 2017 02 04 03 32 45.003873 3719.9  
Number of shots on TAPE0085.REEL: 210

TAPE: TAPE0086.REEL  
1 MGL1701MC26 066193 000963 -42.854584 -75.759227 2017 02 04 06 07 50.101873 3728.8  
1000 MGL1701MC26 067192 001962 -42.786572 -75.155485 2017 02 04 12 54 42.808853 1127.4

Number of shots on TAPE0086.REEL: 1000

TAPE: TAPE0087.REEL

1 MGL1701MC26 067193 001963 -42.786509 -75.154881 2017 02 04 12 55 06.754882 1124.8  
1000 MGL1701MC26 068192 002963 -42.714753 -74.551930 2017 02 04 19 29 28.743873 153.5  
Number of shots on TAPE0087.REEL: 1000

TAPE: TAPE0088.REEL

1 MGL1701MC26 068193 002964 -42.714680 -74.551329 2017 02 04 19 29 51.742872 149.9  
397 MGL1701MC26 068589 003360 -42.677952 -74.314676 2017 02 04 22 02 26.140873 67.3  
Number of shots on TAPE0088.REEL: 397

TAPE: TAPE0089.REEL

1 MGL1701MC042 068590 001379 -42.514628 -74.290411 2017 02 05 00 18 57.433874 83.3  
373 MGL1701MC042 068962 001751 -42.347736 -74.271584 2017 02 05 02 42 28.673873 86.7  
Number of shots on TAPE0089.REEL: 373

TAPE: TAPE0090.REEL

1 MGL1701MC41 068963 000983 -42.333309 -74.391951 2017 02 05 04 04 17.417872 151.2  
1000 MGL1701MC41 069962 001982 -42.335334 -74.998014 2017 02 05 10 54 27.899872 976.7  
Number of shots on TAPE0090.REEL: 1000

TAPE: TAPE0091.REEL

1 MGL1701MC41 069963 001983 -42.335325 -74.998621 2017 02 05 10 54 51.812872 983.4  
1000 MGL1701MC41 070962 002982 -42.334176 -75.604699 2017 02 05 17 20 25.785873 3828.6  
Number of shots on TAPE0091.REEL: 1000

TAPE: TAPE0092.REEL

1 MGL1701MC41 070963 002983 -42.334174 -75.605310 2017 02 05 17 20 49.889873 3826.8  
506 MGL1701MC41 071468 003488 -42.332910 -75.911674 2017 02 05 20 43 04.112873 3787.3  
Number of shots on TAPE0092.REEL: 506

TAPE: TAPE0093.REEL

1 MGL1701MC43 071469 001115 -42.454092 -75.796426 2017 02 05 23 11 41.021872 3788.9  
1000 MGL1701MC43 072468 002114 -42.570292 -75.209265 2017 02 06 05 38 43.728873 1489.2  
Number of shots on TAPE0093.REEL: 1000

TAPE: TAPE0094.REEL

1 MGL1701MC43 072469 002115 -42.570419 -75.208679 2017 02 06 05 39 08.527877 1476.5  
88 MGL1701MC43 072556 002202 -42.579313 -75.157057 2017 02 06 06 14 40.399873 1330.2  
Number of shots on TAPE0094.REEL: 88

TAPE: TAPE0095.REEL

1 MGL1701MC27 072557 000923 -42.465911 -75.107499 2017 02 06 07 58 24.148866 1528.2  
1000 MGL1701MC27 073556 001922 -42.022954 -75.003283 2017 02 06 14 37 28.182873 1259.5  
Number of shots on TAPE0095.REEL: 1000

TAPE: TAPE0096.REEL

1 MGL1701MC27 073557 001923 -42.022510 -75.003195 2017 02 06 14 37 52.580873 1258.5  
1000 MGL1701MC27 074556 002922 -41.579431 -74.900212 2017 02 06 21 19 23.585874 1398.3  
Number of shots on TAPE0096.REEL: 1000

TAPE: TAPE0097.REEL

1 MGL1701MC27 074557 002923 -41.578986 -74.900125 2017 02 06 21 19 45.966873 1403.2  
1000 MGL1701MC27 075556 003922 -41.135791 -74.798571 2017 02 07 03 23 07.771873 1593.4  
Number of shots on TAPE0097.REEL: 1000

TAPE: TAPE0098.REEL

1 MGL1701MC27 075557 003923 -41.135356 -74.798445 2017 02 07 03 23 28.732873 1594.7  
987 MGL1701MC27 076543 004909 -40.697780 -74.699674 2017 02 07 09 28 34.372874 1397.8  
Number of shots on TAPE0098.REEL: 987

TAPE: TAPE0099.REEL  
1 MGL1701MC31 076544 001006 -40.695676 -74.699419 2017 02 07 09 30 28.925870 1392.6  
1000 MGL1701MC31 077543 002005 -40.248500 -74.635402 2017 02 07 15 53 45.216873 2001.6  
Number of shots on TAPE0099.REEL: 1000

TAPE: TAPE0100.REEL  
1 MGL1701MC31 077544 002006 -40.248049 -74.635316 2017 02 07 15 54 06.903873 2001.5  
1000 MGL1701MC31 078543 003005 -39.800801 -74.572358 2017 02 07 22 04 11.350874 1740.3  
Number of shots on TAPE0100.REEL: 1000

TAPE: TAPE0101.REEL  
1 MGL1701MC31 078544 003006 -39.800339 -74.572298 2017 02 07 22 04 34.385874 1733.1  
1000 MGL1701MC31 079543 004005 -39.353049 -74.510045 2017 02 08 04 16 13.038868 1874.7  
Number of shots on TAPE0101.REEL: 1000

TAPE: TAPE0102.REEL  
1 MGL1701MC31 079544 004006 -39.352602 -74.509985 2017 02 08 04 16 34.934862 1867.5  
1000 MGL1701MC31 080543 005005 -38.905207 -74.448663 2017 02 08 10 36 22.019873 2447.6  
Number of shots on TAPE0102.REEL: 1000

TAPE: TAPE0103.REEL  
1 MGL1701MC31 080544 005006 -38.904789 -74.448604 2017 02 08 10 36 47.367874 2362.1  
1000 MGL1701MC31 081543 006014 -38.453291 -74.387301 2017 02 08 17 45 54.210896 2922.9  
Number of shots on TAPE0103.REEL: 1000

TAPE: TAPE0104.REEL  
1 MGL1701MC31 081544 006015 -38.452844 -74.387252 2017 02 08 17 46 16.619850 2917.0  
1000 MGL1701MC31 082543 007043 -37.992347 -74.325559 2017 02 09 00 31 22.395874 2173.1  
Number of shots on TAPE0104.REEL: 1000

TAPE: TAPE0105.REEL  
1 MGL1701MC31 082544 007044 -37.991901 -74.325483 2017 02 09 00 31 47.461872 2180.7  
429 MGL1701MC31 082972 007472 -37.800151 -74.300091 2017 02 09 03 30 00.062868 1864.7  
Number of shots on TAPE0105.REEL: 429

TAPE: TAPE0106.REEL  
1 MGL1701MC32 082973 001003 -37.796976 -74.300298 2017 02 09 03 32 49.729873 1847.3  
1000 MGL1701MC32 083972 002002 -37.349008 -74.354552 2017 02 09 10 02 33.795872 3505.0  
Number of shots on TAPE0106.REEL: 1000

TAPE: TAPE0107.REEL  
1 MGL1701MC32 083973 002003 -37.348562 -74.354629 2017 02 09 10 02 57.295871 3505.1  
1000 MGL1701MC32 084972 003004 -36.899629 -74.408310 2017 02 09 16 10 35.323874 4620.7  
Number of shots on TAPE0107.REEL: 1000

TAPE: TAPE0108.REEL  
1 MGL1701MC32 084973 003005 -36.899196 -74.408376 2017 02 09 16 10 56.769871 4625.4  
1000 MGL1701MC32 085972 004004 -36.451111 -74.461405 2017 02 09 22 04 17.323873 4875.6  
Number of shots on TAPE0108.REEL: 1000

TAPE: TAPE0109.REEL  
1 MGL1701MC32 085973 004005 -36.450652 -74.461459 2017 02 09 22 04 38.913873 4870.3  
1000 MGL1701MC32 086972 005004 -36.003705 -74.529472 2017 02 10 04 13 40.149874 4734.1  
Number of shots on TAPE0109.REEL: 1000

TAPE: TAPE0110.REEL  
1 MGL1701MC32 086973 005005 -36.003262 -74.529591 2017 02 10 04 14 03.910876 4737.7  
17 MGL1701MC32 086989 005021 -35.996130 -74.530995 2017 02 10 04 20 31.363883 4774.3  
Number of shots on TAPE0110.REEL: 17

TAPE: TAPE0111.REEL  
1 MGL1701MC33 086990 000990 -36.000678 -74.346984 2017 02 10 06 52 15.884874 4935.7  
1000 MGL1701MC33 087989 001989 -36.114058 -73.810458 2017 02 10 13 31 34.176873 2457.0

Number of shots on TAPE0111.REEL: 1000

TAPE: TAPE0112.REEL

1 MGL1701MC33 087990 001990 -36.114171 -73.809921 2017 02 10 13 31 56.392874 2457.9  
1000 MGL1701MC33 088989 002989 -36.222756 -73.271139 2017 02 10 20 15 54.209873 116.5  
Number of shots on TAPE0112.REEL: 1000

TAPE: TAPE0113.REEL

1 MGL1701MC33 088990 002990 -36.222866 -73.270603 2017 02 10 20 16 20.753873 116.1  
492 MGL1701MC33 089481 003481 -36.277054 -73.005790 2017 02 10 23 49 08.458876 92.7  
Number of shots on TAPE0113.REEL: 492

TAPE: TAPE0114.REEL

1 MGL1701MC35 089482 001248 -36.351754 -73.314803 2017 02 11 04 45 46.190890 115.4  
1000 MGL1701MC35 090481 002247 -36.248560 -73.856132 2017 02 11 11 17 26.207872 2249.2  
Number of shots on TAPE0114.REEL: 1000

TAPE: TAPE0115.REEL

1 MGL1701MC35 090482 002248 -36.248458 -73.856675 2017 02 11 11 17 50.604874 2258.6  
1000 MGL1701MC35 091481 003255 -36.138263 -74.399719 2017 02 11 18 02 34.622872 4935.8  
Number of shots on TAPE0115.REEL: 1000

TAPE: TAPE0116.REEL

1 MGL1701MC35 091482 003256 -36.138161 -74.400258 2017 02 11 18 02 57.727873 4937.9  
326 MGL1701MC35 091807 003581 -36.101669 -74.575068 2017 02 11 20 09 38.921874 4779.6  
Number of shots on TAPE0116.REEL: 326

TAPE: TAPE0117.REEL

1 MGL1701MC36 091808 000972 -36.146054 -74.416253 2017 02 12 01 38 47.380873 4928.7  
1000 MGL1701MC36 092807 001971 -35.728973 -74.207940 2017 02 12 08 20 46.531874 4981.7  
Number of shots on TAPE0117.REEL: 1000

TAPE: TAPE0118.REEL

1 MGL1701MC36 092808 001972 -35.728562 -74.207729 2017 02 12 08 21 11.621872 4985.2  
1000 MGL1701MC36 093807 002971 -35.311073 -74.001644 2017 02 12 15 19 42.339881 5038.0  
Number of shots on TAPE0118.REEL: 1000

TAPE: TAPE0119.REEL

1 MGL1701MC36 093808 002972 -35.310658 -74.001431 2017 02 12 15 20 07.401876 5036.0  
1000 MGL1701MC36 094807 003974 -34.891563 -73.796760 2017 02 12 21 46 25.812873 5083.2  
Number of shots on TAPE0119.REEL: 1000

TAPE: TAPE0120.REEL

1 MGL1701MC36 094808 003975 -34.891147 -73.796554 2017 02 12 21 46 48.546872 5082.5  
607 MGL1701MC36 095414 004583 -34.636299 -73.674531 2017 02 13 01 35 08.787874 5137.9  
Number of shots on TAPE0120.REEL: 607

TAPE: TAPE0121.REEL

1 MGL1701MC37 095415 000971 -34.718374 -73.736281 2017 02 13 06 21 16.352874 4997.3  
1000 MGL1701MC37 096414 001984 -34.888555 -73.222654 2017 02 13 13 33 29.585879 2412.6  
Number of shots on TAPE0121.REEL: 1000

TAPE: TAPE0122.REEL

1 MGL1701MC37 096415 001985 -34.888725 -73.222142 2017 02 13 13 33 53.927872 2418.2  
1000 MGL1701MC37 097414 002986 -35.054677 -72.712483 2017 02 13 19 49 26.882874 531.8  
Number of shots on TAPE0122.REEL: 1000

TAPE: TAPE0123.REEL

1 MGL1701MC37 097415 002987 -35.054858 -72.711991 2017 02 13 19 49 49.012875 531.3  
509 MGL1701MC37 097923 003514 -35.140137 -72.442267 2017 02 13 23 08 42.786873 113.0  
Number of shots on TAPE0123.REEL: 509

TAPE: TAPE0124.REEL  
1 MGL1701MC39 097924 000968 -34.777273 -72.497538 2017 02 14 05 55 34.804873 644.5  
1000 MGL1701MC39 098923 001967 -34.608338 -73.002849 2017 02 14 12 19 26.740874 2629.9  
Number of shots on TAPE0124.REEL: 1000

TAPE: TAPE0125.REEL  
1 MGL1701MC39 098924 001968 -34.608149 -73.003347 2017 02 14 12 19 51.014879 2702.4  
162 MGL1701MC39 099085 002129 -34.580743 -73.084599 2017 02 14 13 26 01.116884 2838.8  
Number of shots on TAPE0125.REEL: 162

TAPE: TAPE0126.REEL  
1 MGL1701MC39A 099086 002280 -34.555080 -73.160805 2017 02 14 14 28 00.115873 3431.7  
1000 MGL1701MC39A 100085 003289 -34.382204 -73.668680 2017 02 14 21 08 27.506876 4697.0  
Number of shots on TAPE0126.REEL: 1000

TAPE: TAPE0127.REEL  
1 MGL1701MC39A 100086 003290 -34.382028 -73.669178 2017 02 14 21 08 50.957897 4726.4  
81 MGL1701MC39A 100166 003370 -34.368431 -73.709482 2017 02 14 21 40 25.159873 4829.8  
Number of shots on TAPE0127.REEL: 81

TAPE: TAPE0128.REEL  
1 MGL1701MC37R 100168 000922 -34.710083 -73.761053 2017 02 15 04 37 26.976870 4995.8  
1000 MGL1701MC37R 101167 001922 -34.878191 -73.254141 2017 02 15 10 49 34.209875 2638.2  
Number of shots on TAPE0128.REEL: 1000

TAPE: TAPE0129.REEL  
1 MGL1701MC37R 101168 001923 -34.878362 -73.253637 2017 02 15 10 49 54.946873 2631.4  
617 MGL1701MC37R 101784 002541 -34.980536 -72.939006 2017 02 15 14 33 46.370874 1734.5  
Number of shots on TAPE0129.REEL: 617

TAPE: TAPE0130.REEL  
1 MGL1701MC39R 101785 001942 -34.612795 -72.990331 2017 02 15 21 40 07.456872 2546.3  
1000 MGL1701MC39R 102784 002946 -34.441435 -73.496404 2017 02 16 04 01 44.913872 5262.9  
Number of shots on TAPE0130.REEL: 1000

TAPE: TAPE0131.REEL  
1 MGL1701MC39R 102785 002947 -34.441266 -73.496908 2017 02 16 04 02 07.838872 5265.2  
298 MGL1701MC39R 103082 003244 -34.390188 -73.646223 2017 02 16 05 56 56.647872 5125.2  
Number of shots on TAPE0131.REEL: 298

## Appendix C - Irregularities in the shot sequence

Note: Shots were searched and presented acquisition line by line. There are irregularities only where noted. Many acquisition lines have no irregularities. Most or all are related to PSO related shutdowns. These data are helpful to identify shots that were never recorded.

### Line: 001

First ffid and shot: 1,601  
Last ffid shot: 2343, 2943  
shots counted = 2343  
ffids listed = 2343  
shots listed = 2343

### Line: 002

First ffid and shot: 2344,763  
Last ffid shot: 3773, 2192  
shots counted = 1430  
ffids listed = 1430  
shots listed = 1430

### Line: 003

First ffid and shot: 3774,998  
Last ffid shot: 5766, 2990

shots counted = 1993  
ffids listed = 1993  
shots listed = 1993

**Line: 004**

First ffid and shot: 5767,914  
Irregular shot sequence between ffids and shots - 5952,5953 1099,1101 | shots missing: 1  
Irregular shot sequence between ffids and shots - 6006,6007 1154,1156 | shots missing: 1  
Last ffid shot: 8223, 3372  
shots counted = 2457  
ffids listed = 2457  
shots listed = 2459

**Line: 005**

First ffid and shot: 8224,927  
Last ffid shot: 9881, 2584  
shots counted = 1658  
ffids listed = 1658  
shots listed = 1658

**Line: 006**

First ffid and shot: 9882,946  
Irregular shot sequence between ffids and shots - 11126,11127 2190,2194 | shots missing: 3  
Irregular shot sequence between ffids and shots - 11178,11179 2245,2249 | shots missing: 3  
Irregular shot sequence between ffids and shots - 12310,12311 3380,3382 | shots missing: 1  
Irregular shot sequence between ffids and shots - 13212,13213 4283,4285 | shots missing: 1  
Irregular shot sequence between ffids and shots - 13242,13243 4314,4316 | shots missing: 1  
Last ffid shot: 13967, 5040  
shots counted = 4086  
ffids listed = 4086  
shots listed = 4095

**Line: 006A**

First ffid and shot: 13968,5088  
Irregular shot sequence between ffids and shots - 14054,14055 5174,5176 | shots missing: 1  
Irregular shot sequence between ffids and shots - 14055,14056 5176,5178 | shots missing: 1  
Irregular shot sequence between ffids and shots - 14204,14205 5326,5328 | shots missing: 1  
Last ffid shot: 14645, 5768  
shots counted = 678  
ffids listed = 678  
shots listed = 681

**Line: 006B**

First ffid and shot: 14647,6587  
Irregular shot sequence between ffids and shots - 16423,16424 8363,8365 | shots missing: 1  
Last ffid shot: 16460, 8401  
shots counted = 1814  
ffids listed = 1814  
shots listed = 1815

**Line: 007**

First ffid and shot: 16461,1005  
Irregular shot sequence between ffids and shots - 18921,18922 3465,3467 | shots missing: 1  
Irregular shot sequence between ffids and shots - 18939,18940 3484,3486 | shots missing: 1  
Irregular shot sequence between ffids and shots - 18957,18958 3503,3506 | shots missing: 2  
Irregular shot sequence between ffids and shots - 19088,19089 3636,3639 | shots missing: 2  
Last ffid shot: 19217, 3767  
shots counted = 2757  
ffids listed = 2757  
shots listed = 2763

**Line: 008**

First ffid and shot: 19218,1007  
Irregular shot sequence between ffids and shots - 19222,19223 1011,1013 | shots missing: 1  
Irregular shot sequence between ffids and shots - 19270,19271 1060,1062 | shots missing: 1  
Last ffid shot: 19323, 1114  
shots counted = 106  
ffids listed = 106  
shots listed = 108

**Line: 008R**

First ffid and shot: 19324,977  
Irregular shot sequence between ffids and shots - 21487,21488 3140,3143 | shots missing: 2  
Irregular shot sequence between ffids and shots - 21500,21501 3155,3157 | shots missing: 1  
Irregular shot sequence between ffids and shots - 21850,21851 3506,3508 | shots missing: 1  
Irregular shot sequence between ffids and shots - 21860,21861 3517,3519 | shots missing: 1  
Irregular shot sequence between ffids and shots - 21940,21941 3598,3600 | shots missing: 1  
Irregular shot sequence between ffids and shots - 22095,22096 3754,3756 | shots missing: 1  
Irregular shot sequence between ffids and shots - 22426,22427 4086,4088 | shots missing: 1  
Irregular shot sequence between ffids and shots - 22465,22466 4126,4128 | shots missing: 1  
Last ffid shot: 26720, 8382  
shots counted = 7397  
ffids listed = 7397  
shots listed = 7406

**Line: 009**

First ffid and shot: 26721,1005  
Irregular shot sequence between ffids and shots - 27951,27952 2235,2237 | shots missing: 1  
Irregular shot sequence between ffids and shots - 28958,28959 3243,3245 | shots missing: 1  
Irregular shot sequence between ffids and shots - 28994,28995 3280,3282 | shots missing: 1  
Last ffid shot: 29282, 3569  
shots counted = 2562  
ffids listed = 2562  
shots listed = 2565

**Line: 010**

First ffid and shot: 29284,1098  
Last ffid shot: 29739, 1553  
shots counted = 456  
ffids listed = 456  
shots listed = 456

**Line: 011**

First ffid and shot: 29740,971  
Irregular shot sequence between ffids and shots - 30417,30418 1648,1650 | shots missing: 1  
Irregular shot sequence between ffids and shots - 30441,30442 1673,1675 | shots missing: 1  
Irregular shot sequence between ffids and shots - 30827,30828 2060,2062 | shots missing: 1  
Irregular shot sequence between ffids and shots - 30882,30883 2116,2119 | shots missing: 2  
Last ffid shot: 32280, 3516  
shots counted = 2541  
ffids listed = 2541  
shots listed = 2546

**Line: 013**

First ffid and shot: 32281,909  
Irregular shot sequence between ffids and shots - 32849,32849 1477,1477 | shots missing: -1  
Irregular ffid sequence between ffids and shots - 32849,32849 1477,-1 | shots missing: -1  
Irregular shot sequence between ffids and shots - 33559,33560 2187,2189 | shots missing: 1  
Irregular shot sequence between ffids and shots - 33572,33573 2201,2203 | shots missing: 1  
Irregular shot sequence between ffids and shots - 33848,33849 2478,2480 | shots missing: 1  
Irregular shot sequence between ffids and shots - 33887,33888 2518,2520 | shots missing: 1  
Irregular shot sequence between ffids and shots - 33910,33911 2542,2544 | shots missing: 1  
Irregular shot sequence between ffids and shots - 33921,33922 2554,2556 | shots missing: 1  
Irregular shot sequence between ffids and shots - 34248,34249 2882,2884 | shots missing: 1  
Irregular shot sequence between ffids and shots - 34260,34261 2895,2897 | shots missing: 1  
Last ffid shot: 34875, 3511  
shots counted = 2596  
ffids listed = 2595  
shots listed = 2603

**Line: 014**

First ffid and shot: 34876,946  
Irregular shot sequence between ffids and shots - 35969,35970 2039,2041 | shots missing: 1  
Irregular shot sequence between ffids and shots - 36005,36006 2076,2078 | shots missing: 1  
Irregular shot sequence between ffids and shots - 36321,36322 2393,2395 | shots missing: 1  
Irregular shot sequence between ffids and shots - 36343,36344 2416,2424 | shots missing: 7  
Irregular shot sequence between ffids and shots - 36378,36379 2458,2461 | shots missing: 2  
Irregular shot sequence between ffids and shots - 36744,36745 2826,2828 | shots missing: 1  
Irregular shot sequence between ffids and shots - 36756,36757 2839,2841 | shots missing: 1  
Irregular shot sequence between ffids and shots - 36785,36786 2869,2871 | shots missing: 1  
Irregular shot sequence between ffids and shots - 36822,36823 2907,2909 | shots missing: 1  
Irregular shot sequence between ffids and shots - 37103,37104 3189,3191 | shots missing: 1  
Irregular shot sequence between ffids and shots - 37160,37161 3247,3249 | shots missing: 1  
Irregular shot sequence between ffids and shots - 37232,37233 3320,3322 | shots missing: 1  
Irregular shot sequence between ffids and shots - 37235,37236 3324,3329 | shots missing: 4  
Irregular shot sequence between ffids and shots - 37271,37272 3364,3366 | shots missing: 1  
Last ffid shot: 37471, 3565  
shots counted = 2596  
ffids listed = 2596  
shots listed = 2620

**Line: 015**

First ffid and shot: 37472,1379  
Last ffid shot: 38053, 1960  
shots counted = 582  
ffids listed = 582  
shots listed = 582

**Line: 016**

First ffid and shot: 38054,982  
Irregular shot sequence between ffids and shots - 39250,39251 2178,2180 | shots missing: 1  
Irregular shot sequence between ffids and shots - 39293,39294 2222,2224 | shots missing: 1  
Irregular shot sequence between ffids and shots - 40021,40022 2951,2953 | shots missing: 1  
Last ffid shot: 40579, 3510  
shots counted = 2526  
ffids listed = 2526  
shots listed = 2529

**Line: 016A**

First ffid and shot: 40580,3109  
Irregular shot sequence between ffids and shots - 41021,41022 3550,3552 | shots missing: 1  
Last ffid shot: 41699, 4229  
shots counted = 1120  
ffids listed = 1120  
shots listed = 1121

**Line: 018**

First ffid and shot: 41700,982  
Irregular shot sequence between ffids and shots - 42127,42128 1409,1411 | shots missing: 1  
Irregular shot sequence between ffids and shots - 43966,43967 3249,3251 | shots missing: 1  
Irregular shot sequence between ffids and shots - 44005,44006 3289,3291 | shots missing: 1  
Irregular shot sequence between ffids and shots - 44027,44028 3312,3314 | shots missing: 1  
Irregular shot sequence between ffids and shots - 44076,44077 3362,3364 | shots missing: 1  
Last ffid shot: 44796, 4083  
shots counted = 3097  
ffids listed = 3097  
shots listed = 3102

**Line: 018T**

First ffid and shot: 44797,1211  
Irregular shot sequence between ffids and shots - 45227,45228 1641,1643 | shots missing: 1  
Last ffid shot: 45345, 1760  
shots counted = 549  
ffids listed = 549  
shots listed = 550

**Line: 019**

First ffid and shot: 45346,921  
Last ffid shot: 46448, 2023  
shots counted = 1103  
ffids listed = 1103  
shots listed = 1103

**Line: 020**

First ffid and shot: 46449,1005  
Irregular shot sequence between ffids and shots - 46496,46497 1052,1054 | shots missing: 1  
Irregular shot sequence between ffids and shots - 46563,46564 1120,1122 | shots missing: 1  
Irregular shot sequence between ffids and shots - 46588,46589 1146,1148 | shots missing: 1  
Last ffid shot: 46696, 1255  
shots counted = 248  
ffids listed = 248  
shots listed = 251

**Line: 020A**

First ffid and shot: 46697,1397  
Irregular shot sequence between ffids and shots - 47694,47695 2394,2396 | shots missing: 1  
Last ffid shot: 48589, 3290  
shots counted = 1893  
ffids listed = 1893  
shots listed = 1894

**Line: 020B**

First ffid and shot: 55804,1009  
Irregular shot sequence between ffids and shots - 57566,57567 2771,2773 | shots missing: 1  
Irregular shot sequence between ffids and shots - 58201,58202 3407,3409 | shots missing: 1  
Irregular shot sequence between ffids and shots - 58254,58255 3461,3463 | shots missing: 1  
Irregular shot sequence between ffids and shots - 60619,60620 5827,5829 | shots missing: 1  
Last ffid shot: 61262, 6471  
shots counted = 5459  
ffids listed = 5459  
shots listed = 5463

**Line: 021**

First ffid and shot: 55804,1009  
Irregular shot sequence between ffids and shots - 57566,57567 2771,2773 | shots missing: 1  
Irregular shot sequence between ffids and shots - 58201,58202 3407,3409 | shots missing: 1  
Irregular shot sequence between ffids and shots - 58254,58255 3461,3463 | shots missing: 1  
Irregular shot sequence between ffids and shots - 60619,60620 5827,5829 | shots missing: 1  
Last ffid shot: 61350, 6559  
shots counted = 5547  
ffids listed = 5547  
shots listed = 5551

**Line: 022**

First ffid and shot: 61351,961  
Last ffid shot: 63982, 3592  
shots counted = 2632  
ffids listed = 2632  
shots listed = 2632

**Line: 023**

First ffid and shot: 63983,1291  
Last ffid shot: 66192, 3500  
shots counted = 2210  
ffids listed = 2210  
shots listed = 2210

**Line: 026**

First ffid and shot: 66193,963  
Irregular shot sequence between ffids and shots - 67789,67790 2559,2561 | shots missing: 1  
Last ffid shot: 68546, 3317  
shots counted = 2354  
ffids listed = 2354  
shots listed = 2355

**Line: 027**

First ffid and shot: 72557,923  
Last ffid shot: 76543, 4909  
shots counted = 3987  
ffids listed = 3987  
shots listed = 3987

**Line: 028**

First ffid and shot: 51362,975  
Irregular shot sequence between ffids and shots - 53806,53807 3419,3421 | shots missing: 1  
Last ffid shot: 53985, 3599  
shots counted = 2624  
ffids listed = 2624  
shots listed = 2625

**Line: 030**

First ffid and shot: 48590,995  
Irregular shot sequence between ffids and shots - 49483,49484 1888,1890 | shots missing: 1  
Irregular shot sequence between ffids and shots - 49501,49502 1907,1910 | shots missing: 2  
Last ffid shot: 51215, 3623  
shots counted = 2626  
ffids listed = 2626  
shots listed = 2629

**Line: 031**

First ffid and shot: 76544,1006  
Irregular shot sequence between ffids and shots - 81116,81117 5578,5580 | shots missing: 1  
Irregular shot sequence between ffids and shots - 81285,81286 5748,5754 | shots missing: 5  
Irregular shot sequence between ffids and shots - 81289,81290 5757,5759 | shots missing: 1  
Irregular shot sequence between ffids and shots - 81335,81336 5804,5806 | shots missing: 1  
Irregular shot sequence between ffids and shots - 81372,81373 5842,5844 | shots missing: 1  
Irregular shot sequence between ffids and shots - 81550,81551 6021,6023 | shots missing: 1  
Irregular shot sequence between ffids and shots - 81571,81572 6043,6045 | shots missing: 1  
Irregular shot sequence between ffids and shots - 81657,81658 6130,6132 | shots missing: 1  
Irregular shot sequence between ffids and shots - 81670,81671 6144,6146 | shots missing: 1  
Irregular shot sequence between ffids and shots - 81753,81754 6228,6230 | shots missing: 1  
Irregular shot sequence between ffids and shots - 81757,81758 6233,6235 | shots missing: 1  
Irregular shot sequence between ffids and shots - 81775,81776 6252,6254 | shots missing: 1  
Irregular shot sequence between ffids and shots - 81779,81780 6257,6259 | shots missing: 1  
Irregular shot sequence between ffids and shots - 81783,81784 6262,6264 | shots missing: 1  
Irregular shot sequence between ffids and shots - 81819,81820 6299,6301 | shots missing: 1  
Irregular shot sequence between ffids and shots - 81906,81907 6387,6389 | shots missing: 1  
Irregular shot sequence between ffids and shots - 81950,81951 6432,6434 | shots missing: 1  
Irregular shot sequence between ffids and shots - 82043,82044 6526,6528 | shots missing: 1  
Irregular shot sequence between ffids and shots - 82232,82233 6716,6718 | shots missing: 1  
Irregular shot sequence between ffids and shots - 82273,82274 6758,6760 | shots missing: 1  
Irregular shot sequence between ffids and shots - 82445,82446 6931,6944 | shots missing: 12  
Irregular shot sequence between ffids and shots - 82521,82522 7019,7021 | shots missing: 1  
Irregular shot sequence between ffids and shots - 82529,82530 7028,7030 | shots missing: 1  
Last ffid shot: 82972, 7472  
shots counted = 6429  
ffids listed = 6429  
shots listed = 6467

**Line: 032**

First ffid and shot: 82973,1003  
Irregular shot sequence between ffids and shots - 84241,84242 2271,2273 | shots missing: 1  
Irregular shot sequence between ffids and shots - 84288,84289 2319,2321 | shots missing: 1  
Last ffid shot: 86989, 5021  
shots counted = 4017  
ffids listed = 4017  
shots listed = 4019

**Line: 033**

First ffid and shot: 86990,990  
Last ffid shot: 89399, 3399  
shots counted = 2410  
ffids listed = 2410  
shots listed = 2410

**Line: 035**

First ffid and shot: 89482,1248  
Irregular shot sequence between ffids and shots - 90659,90660 2425,2427 | shots missing: 1  
Irregular shot sequence between ffids and shots - 90783,90784 2550,2553 | shots missing: 2  
Irregular shot sequence between ffids and shots - 90846,90847 2615,2617 | shots missing: 1  
Irregular shot sequence between ffids and shots - 90882,90883 2652,2654 | shots missing: 1  
Irregular shot sequence between ffids and shots - 90890,90891 2661,2663 | shots missing: 1  
Irregular shot sequence between ffids and shots - 91102,91103 2874,2876 | shots missing: 1  
Irregular shot sequence between ffids and shots - 91175,91176 2948,2950 | shots missing: 1  
Last ffid shot: 91807, 3581  
shots counted = 2326  
ffids listed = 2326  
shots listed = 2334

**Line: 036**

First ffid and shot: 91808,972  
Irregular shot sequence between ffids and shots - 94244,94245 3408,3410 | shots missing: 1  
Irregular shot sequence between ffids and shots - 94344,94345 3509,3511 | shots missing: 1  
Irregular shot sequence between ffids and shots - 94421,94422 3587,3589 | shots missing: 1  
Irregular shot sequence between ffids and shots - 94920,94921 4087,4089 | shots missing: 1  
Irregular shot sequence between ffids and shots - 94959,94960 4127,4129 | shots missing: 1  
Last ffid shot: 95414, 4583  
shots counted = 3607  
ffids listed = 3607  
shots listed = 3612

**Line: 037**

First ffid and shot: 95415,971

Irregular shot sequence between ffids and shots - 96092,96093 1648,1650 | shots missing: 1  
Irregular shot sequence between ffids and shots - 96103,96104 1660,1671 | shots missing: 10  
Irregular shot sequence between ffids and shots - 96133,96134 1700,1702 | shots missing: 1  
Irregular shot sequence between ffids and shots - 96148,96149 1716,1718 | shots missing: 1  
Irregular shot sequence between ffids and shots - 96273,96274 1842,1844 | shots missing: 1  
Irregular shot sequence between ffids and shots - 96703,96704 2273,2275 | shots missing: 1  
Irregular shot sequence between ffids and shots - 96776,96777 2347,2349 | shots missing: 1  
Irregular shot sequence between ffids and shots - 97554,97555 3126,3145 | shots missing: 18  
Irregular shot sequence between ffids and shots - 97595,97596 3185,3187 | shots missing: 1  
Last ffid shot: 97923, 3514  
shots counted = 2509  
ffids listed = 2509  
shots listed = 2544

**Line: 037R**

First ffid and shot: 100168,922  
Irregular shot sequence between ffids and shots - 101149,101150 1903,1905 | shots missing: 1  
Irregular shot sequence between ffids and shots - 101477,101478 2232,2234 | shots missing: 1  
Irregular shot sequence between ffids and shots - 101535,101536 2291,2293 | shots missing: 1  
Last ffid shot: 101784, 2541  
shots counted = 1617  
ffids listed = 1617  
shots listed = 1620

**Line: 039**

First ffid and shot: 97924,968  
Last ffid shot: 99085, 2129  
shots counted = 1162  
ffids listed = 1162  
shots listed = 1162

**Line: 039A**

First ffid and shot: 99086,2280  
Irregular shot sequence between ffids and shots - 99672,99673 2866,2868 | shots missing: 1  
Irregular shot sequence between ffids and shots - 99845,99846 3040,3042 | shots missing: 1  
Irregular shot sequence between ffids and shots - 99846,99847 3042,3044 | shots missing: 1  
Irregular shot sequence between ffids and shots - 99898,99899 3095,3097 | shots missing: 1  
Irregular shot sequence between ffids and shots - 99994,99995 3192,3194 | shots missing: 1  
Irregular shot sequence between ffids and shots - 100000,100001 3199,3205 | shots missing: 5  
Last ffid shot: 100166, 3370  
shots counted = 1081  
ffids listed = 1081  
shots listed = 1091

**Line: 041**

First ffid and shot: 68963,983  
Last ffid shot: 71468, 3488  
shots counted = 2506  
ffids listed = 2506  
shots listed = 2506

**Line: 042**

First ffid and shot: 68590,1379  
Last ffid shot: 68962, 1751  
shots counted = 373  
ffids listed = 373  
shots listed = 373

**Line: 043**

First ffid and shot: 71469,1115  
Last ffid shot: 72556, 2202  
shots counted = 1088  
ffids listed = 1088  
shots listed = 1088