MARINE TAIGER* CRUISE REPORT April – July 2009

*Taiwan Integrated GEodyamics Research

9/23/2011
Kirk McIntosh
University of Texas Institute for Geophysics

Table of Contents

Introduction

Ship Name: ***R/V Langseth***

Area of Operations: **Northeast part of South China Sea**
Manila Trench, Bashi Strait, Bataan Islands
Taiwan Strait
Western Philippine Sea
Southwest Ryukyu Trench

Operating Institution: Columbia University

This cruise report describes the activities and products of four separate cruises of the R/V Langseth, all of which were part of the Taiwan-U.S. collaborative TAIGER Project. Below I include a summary list of the cruises and their dates. Subsequently, each of these legs is further described and a list of the respective science participants is included.

Cruise ID	Start Port	End Port	Dates	Chief/co-Chief Scientist
MGL0905	Kaohsiung	Kaohsiung	4/01/09-4/29/09	C-S Liu/FT Wu
MGL0906	Kaohsiung	Kaohsiung	5/04/09-6/04/09	K McIntosh/C-S Liu
MGL0907	Kaohsiung	Kaohsiung	6/07/09-6/14/09	W-C Chi/Y Nakamura
MGL0908	Kaohsiung	Kaohsiung	6/22/09-6/25/09 6/28/09-7/25/09	S-K Hsu/K McIntosh

Description of Scientific Program:
These cruises were focused on marine seismic acquisition. Legs MGL0905, MGL0906, and MGL0908 used the seismic source array on the R/V Langseth to acquire deep-penetration seismic reflection data and to provide seismic source signals to be recorded by ocean bottom seismographs (OBSs) and seismic instruments on land in Taiwan. The OBSs which recorded the seismic signals during these legs were deployed by various Taiwanese ships and operated by Taiwanese groups and an OBS group from Scripps Institution of Oceanography (the U.S. OBS pool). Leg MGL0907 was dedicated to recovering broadband OBSs, previously deployed in May 2008 (cruise MGLN-38MV of the R/V Melville).

This report is organized below in four parts covering each of the four TAIGER Legs on the R/V Langseth. In addition there are further supporting documents after each of these sections that show the operational information for data acquisition.

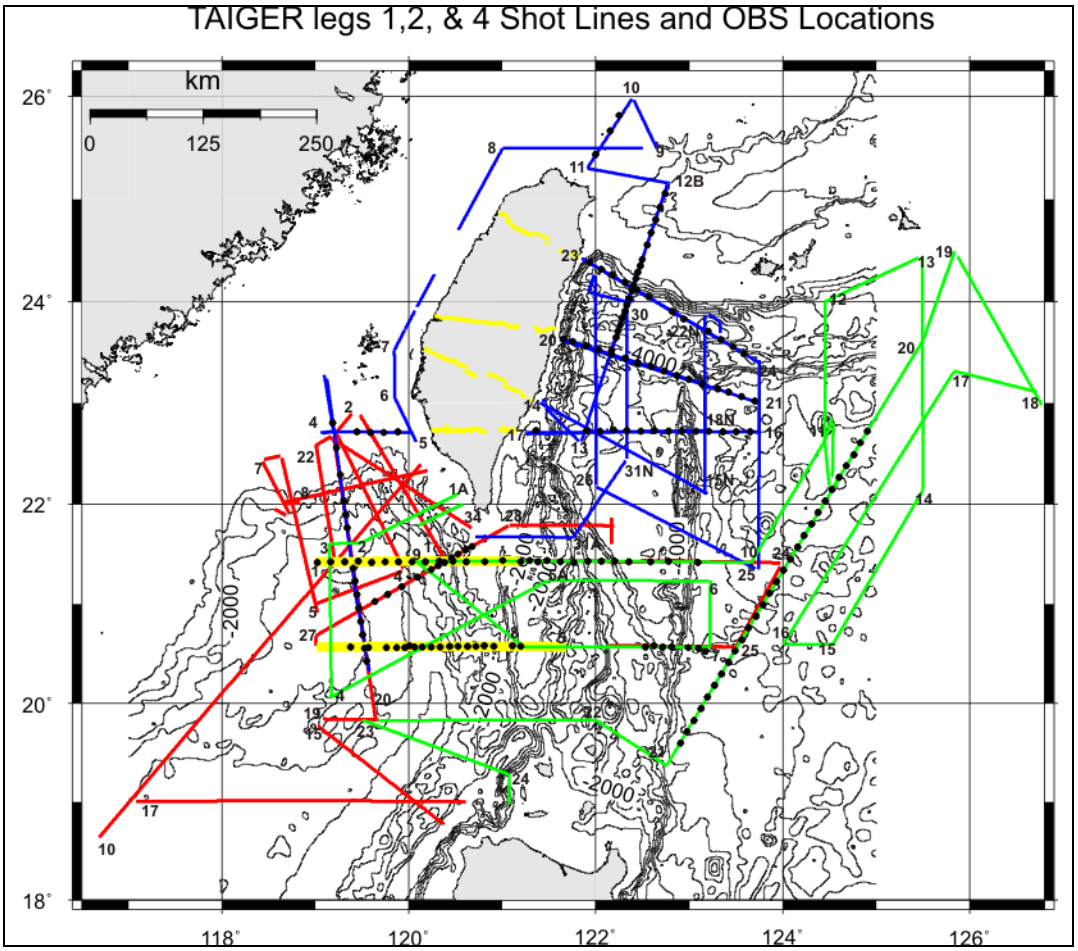


Figure 1. Map showing seismic source lines during the TAIGER active-source cruises aboard the R/V Langseth. The track lines are color coded as follows: MGL0905 = red; MGL0906 = blue; MGL0908 = green and MGL0908 OBS-only = yellow. Active-source OBS locations are shown as black circles and land stations (the main subset) for the onshore/offshore program are shown in yellow. Note: There are some OBS stations from MGL0905 not shown.

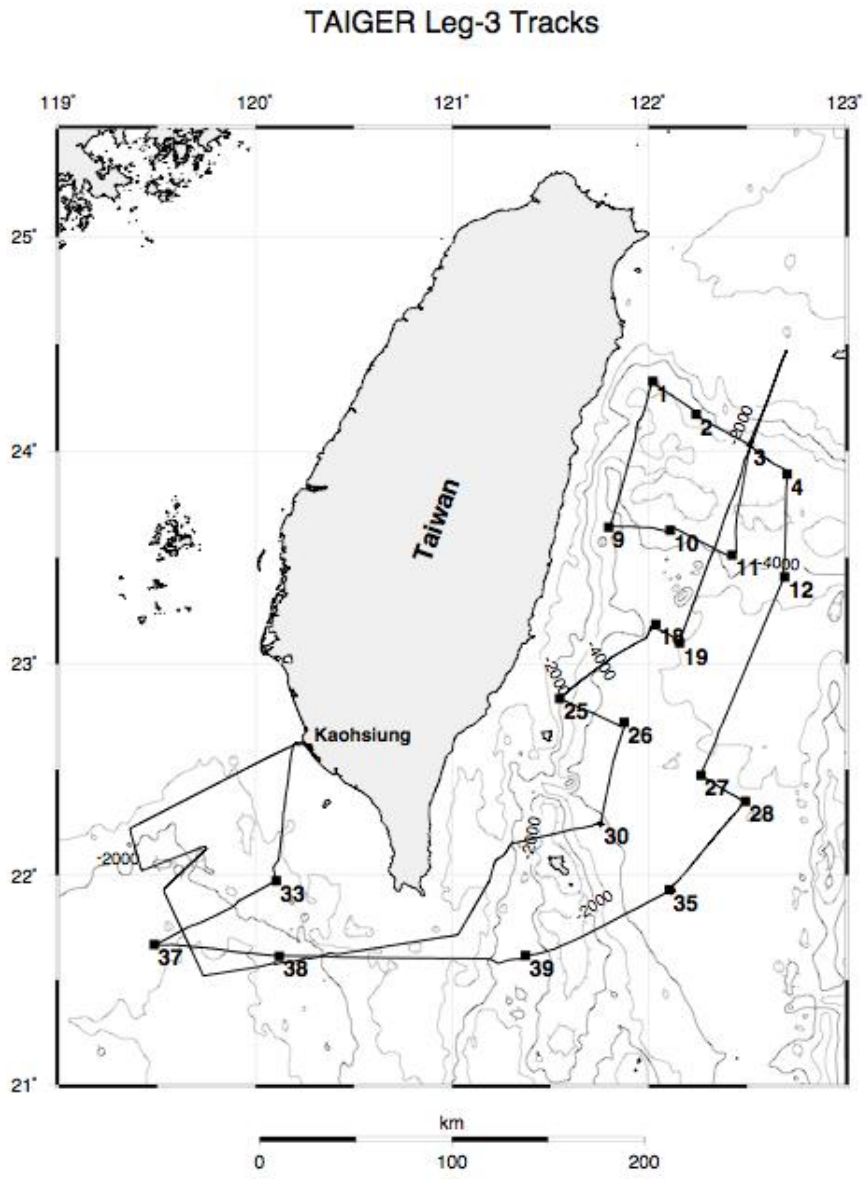


Figure 2. Ship tracks of R/V Langseth Cruise MGL0907, TAIGER leg 3, with locations of recovered BBOBS stations (solid squares). BBOBS at stations 3 and 30 (crosses) were not recovered.

General Acquisition Parameters

The TAIGER cruises were focused on both seismic reflection (MCS) data acquisition and on wide-angle seismic data acquisition. For reflection acquisition we balanced the desire for high stacking fold with the need to wait long enough after each shot to record arrivals from the entire crust and the upper mantle. The other variable in this case is ship speed; in order to cover the desired area and keep adequate tension on the streamer the ship speed was typically aimed at 4.5-5.0 kts. At this speed it was necessary to shoot at every 50 m and record for ~15 seconds. For the most part, these were the nominal MCS acquisition parameters.

For lines that were instrumented with OBSs we used three approaches depending on the priority of the MCS or wide-angle data:

--On profiles with lower wide-angle priority, including all those during Leg 1 (MGL0905), we stayed with optimal MCS parameters (50 m shot spacing).

--On profiles with high wide-angle priority we shot at 100-125 m spacing to avoid previous shot noise on the OBS records and settled for lower fold in the MCS data.

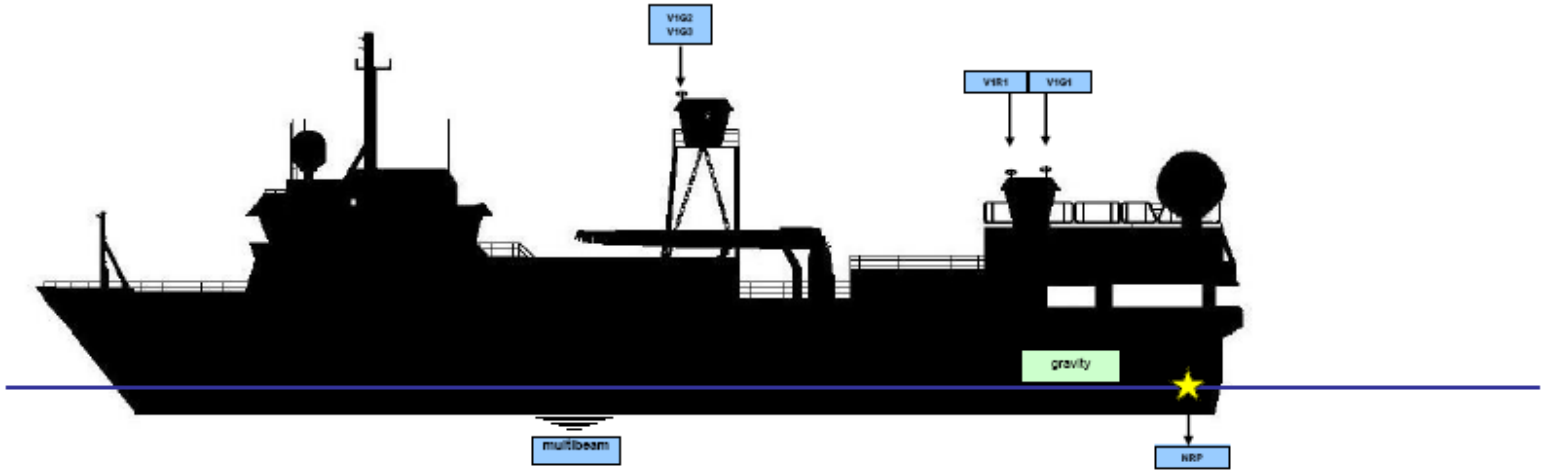
--Profiles with high MCS and OBS priority were shot two times—once at 50 m spacing for MCS and again at 120 -150 m spacing for superior OBS data. In some of these cases the OBSs and land stations recorded during both shooting passes providing additional wide-angle data for modeling.

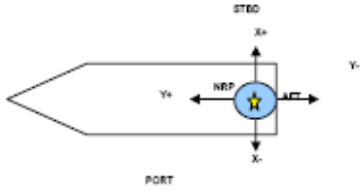
Because our primary goals involved crustal structure of the Taiwan area, we used the full source array available on the R/V Langseth. This consists of 4 strings of 9 airguns each, with one available spare on each string. The strings were spaced at ~8 m and the elements in each string were spaced at ~2 or 3 m. The strings are composed of a combination of Bolt 1500LL and 1900LL airguns. The chamber sizes range from 40 cu. in. to 360 cu. in. and include pairs of the larger airguns at the front and rear of each string.

In general, broader band signal with a flatter amplitude spectrum is produced and recorded with the source array and streamer towed relatively shallowly in the water. However, shallow towing, especially with the streamer tends to increase noise levels. Towing deeper can reduce noise, and it can also boost the level of the lowest frequencies recorded. However, this comes at the expense of higher frequencies, due to notches in the spectrum produced by surface ghosts. We sought to achieve a reasonable compromise by towing the streamer at 9 m and the source array at 8 m. This seemed to be a successful combination with good deep reflections, including coherent Moho reflections at 20+ km depth and onshore/offshore wide-angle recordings at > 200 km offset.

In the subsequent pages we include diagrams provided by the R/V Langseth staff showing the configuration of the source array and streamer and showing the ship's antenna locations and other key points. We also include a layout of the source array.

r/v Marcus G. Langseth





Note: All Echosounders are used in Spectra with 6.6m ship's draft correction applied.

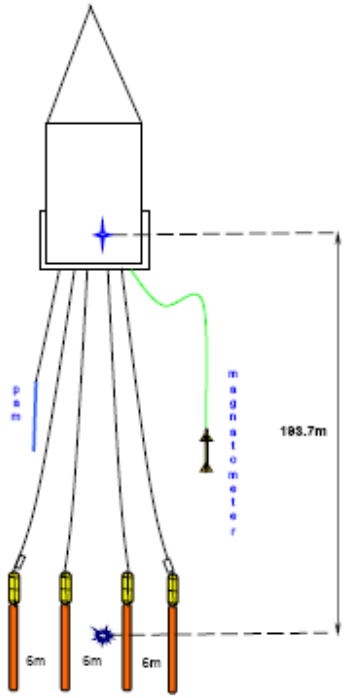
All measurements in meters

		FORE/AFT (Y)	STBD/PORT (X)	UP/DOWN (Z)
NRP	NAVIGATION REFERENCE POINT	0.00	0.00	0.00
V1G1	C-Nav	8.06	4.87	14.50
V1G2	SeaPath 200	25.30	1.50	16.90
V1G3	Pos MV	22.30	8.50	16.90
V1G4	PosNet	10.45	4.87	14.50
V1R1	PosNet	10.45	4.87	14.50
EM120	Multibeam	49.70	8.50	-5.60
BGM-3	Gravity	12.20	4.20	-3.49

rv Marcus G. Langseth - Tow Configuration

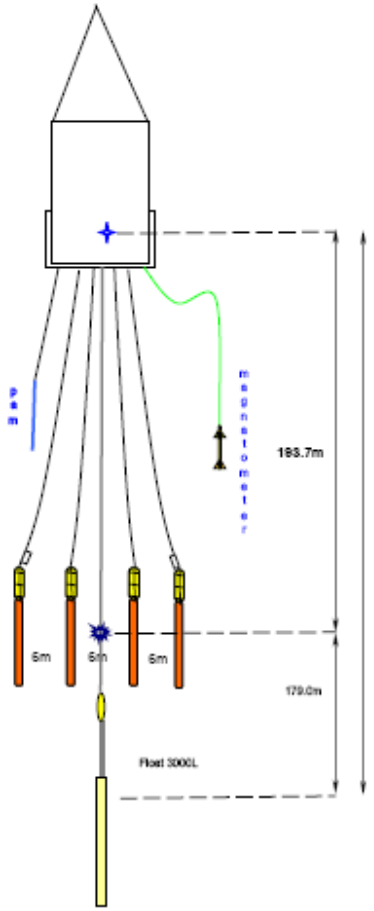
Source only

Sequences 001 - 002					
NRP-Stern	4.20	m		NRP	Nav Reference Point
NRP-COS	193.70	m		COS	Centre of Source
			Layback		
NRP-MAG	100	m	X = -20m		
NRP-PAM	70	m	X = 20m		

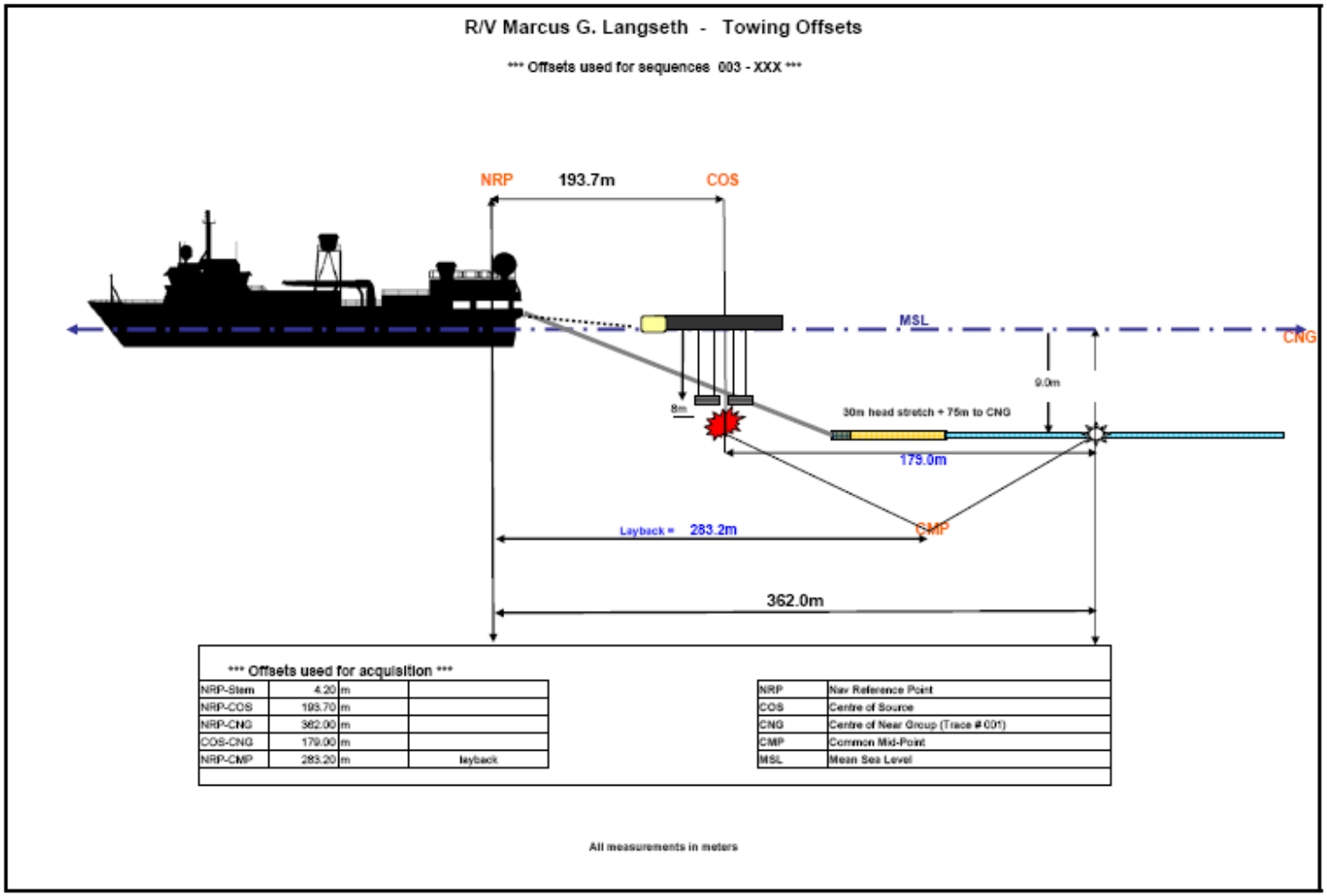


Source/Streamer

Sequences 003 - xxx					
NRP-Stern	4.20	m		NRP	Nav Reference Point
NRP-COS	193.70	m		COS	Centre of Source
NRP-CNG	362.00	m		CNG	Centre of Near Group (Trace # 465)
COS-CNG	179.00	m		CMP	Common Mid-Point
NRP-CMP	283.20	m	Layback		
NRP-MAG	100	m	X = -20m		
NRP-PAM	70	m	X = 20m		

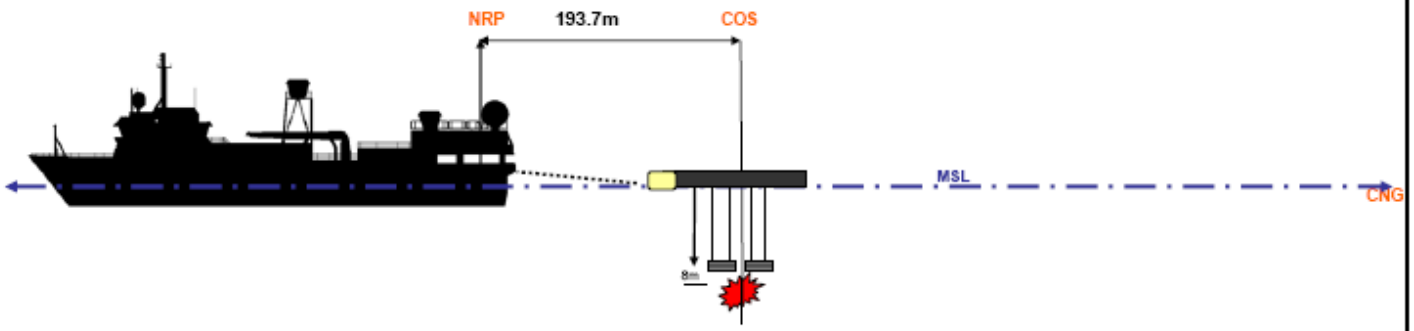


NOT to Scale


R/V Marcus G. Langseth - Towing Offsets
*** Offsets used for sequences 003 - XXX ***
NRP
193.7m
COS
MSL
CNG
9.0m
8m
30m head stretch + 75m to CNG
179.0m
Layback = 283.2m
CMP
362.0m
*** Offsets used for acquisition ***
NRP-Stern 4.20 m
NRP-COS 193.70 m
NRP-CNG 362.00 m
COS-CNG 179.00 m
NRP-CMP 283.20 m layback
NRP Nav Reference Point
COS Centre of Source
CNG Centre of Near Group (Trace # 001)
CMP Common Mid-Point
MSL Mean Sea Level
All measurements in meters

R/V Marcus G. Langseth - Towing Offsets

*** Offsets used for sequences 001 - 002 ***

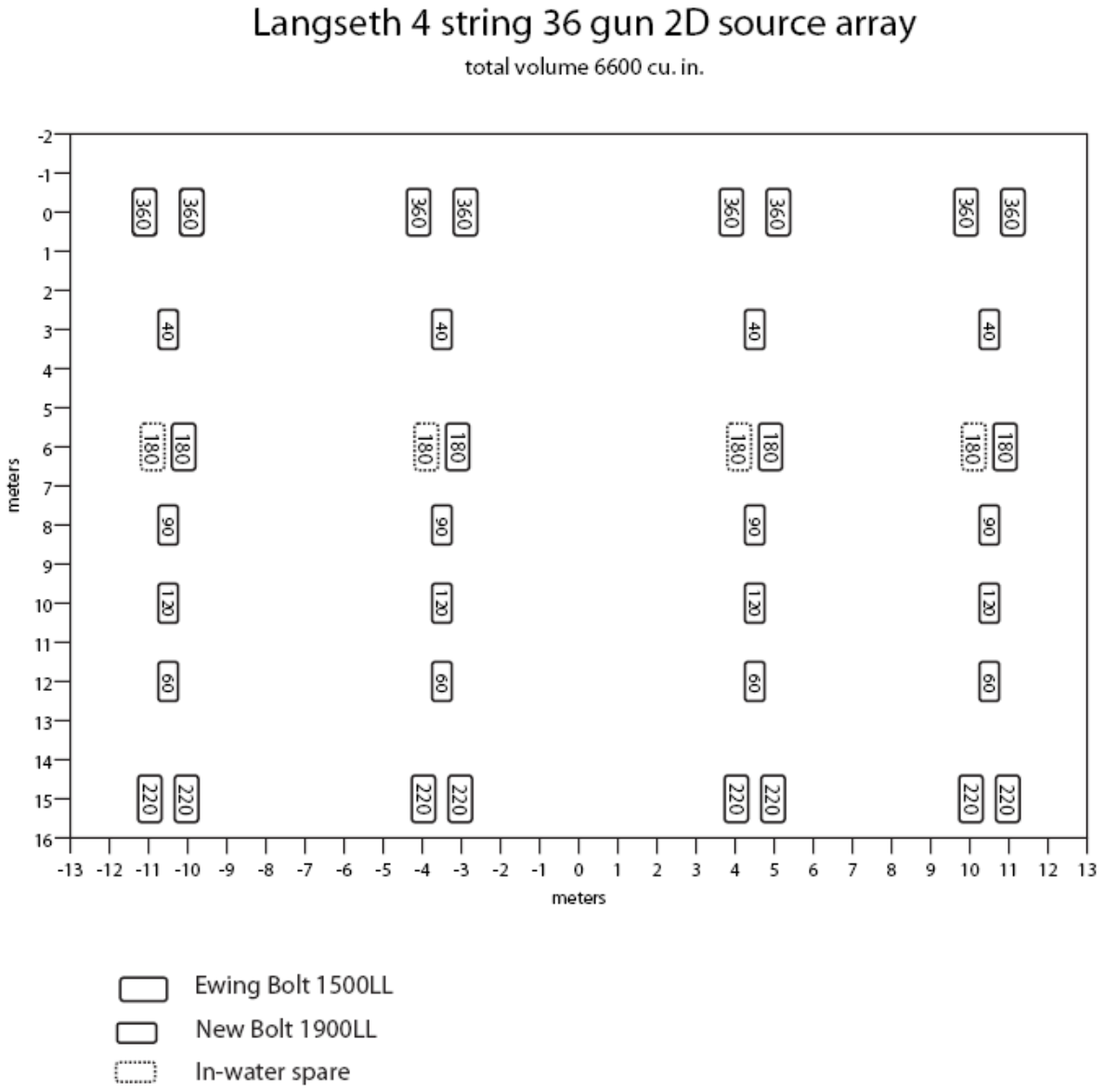


*** Offsets used for acquisition ***

NRP-Stern	4.20	m	
NRP-COS	193.70	m	
NRP-CNG			
COS-CNG			
NRP-CMP			

NRP	Nav Reference Point
COS	Centre of Source

All measurements in meters


Langseth 4 string 36 gun 2D source array
total volume 6600 cu. in.
meters
meters
360
40
180
90
120
60
220
Ewing Bolt 1500LL
New Bolt 1900LL
In-water spare

Part I: MGL0905: TAIGER LEG 1

1 April 2009 to 29 April 2009

MGL0905 4/01/09-4/29/09

This cruise was originally intended to focus on the area southwest of Taiwan, extending to the vicinity of Pratas (Dongsha) Islands, considered by Taiwan to be one of their possessions. Work in this area was cut short after the Langseth was intercepted by a Chinese government vessel and asked to leave Chinese waters. After this incident, work was restricted to areas east of 119° and prompted early acquisition of MCS data along primary TAIGER transects, T1 and T2, east-west profiles across the Manila trench and Luzon volcanic arc. Our Taiwanese collaborators deployed 73 OBS stations during this leg to record the seismic sources. The tracks associated with this leg are shown in **RED** on the map in Figure 1. A total of ~4165 km of MCS data were acquired during this cruise.

Participants:

Liu, Char-Shine	Co-Chief Scientist	National Taiwan University, Taipei, Taiwan
Wu, Francis Taming	Co-Chief Scientist	Binghamton University, Binghamton NY, USA
Schnürle, Philippe	Researcher	National Taiwan University, Taipei, Taiwan
Hao, Kuo-Chen	Graduate Student	Binghamton University, Binghamton NY, USA
Saustrup, Steffen	Processing Technician	University of Texas, Austin TX, USA
Yeh, Yi-Ching	Graduate Student	National Central University, Zhongli, Taiwan
Liao, Shih-Wei	Graduate Student	National Taiwan University, Taipei, Taiwan
Hsu, Ho-Han	Graduate Student	National Taiwan University, Taipei, Taiwan
Hung, Hao-Ting	Graduate Student	National Taiwan University, Taipei, Taiwan
Chen, Cheng-Yi	Graduate Student	National Taiwan University, Taipei, Taiwan
Hsieh, Chi-Hsun	Graduate Student	National Taiwan University, Taipei, Taiwan
Chung, San-Hsiung	Geologist	
Chen, Mei-Yu	Research Assistant	National Taiwan University, Taipei, Taiwan
Tsai, Po-An	Military Observer	Taiwan

Science Technical Staff

Robert Steinhaus	Science Officer
Robbie Gunn	Chief Source Tech
Mike Tatro	Data Acquisition Tech
Michael Martello	Navigation Tech
David Martinson	Acquisition and Navigation Tech
Zhang	IT and Navigation Tech
Ryan Eaton	Data Acquisition Tech
Carlos Gutierrez	Source Technician
Brian Goodick	Source Technician
Donald Cucchiara	Source Technician
Richard Harpour	Source Technician

Marine Mammal Observers

Bradley Dawe
G. Calvaturo
Brendan Hurley
Ming-Chang Liu
I. MacTavish

Cruise Narrative (created mainly from daily reports for this leg)

31 MAR 2009
We continued final system configuration and testing. Continued staging and securing equipment for oncoming science party equipment. Complete securing vessel for departure and conducted safety briefing/orientation for Science Party and new Science Crew.

Continue Standing by for the IHA/ITS most of the day which was received at ~23:00 GMT.

1 April 2009
Reviewed IHA/ITS with Science Party, Captain, TIC, Jeff R., and Meagan C. Left Port and transited to deployment area and once on site started deploying the streamer. Once the streamer was deployed we determined the weather was too rough to deploy the PV3000 head float, so we had to do some maneuvering to get around and still stay within the survey area. Once turned around to head seas the lead was recovered and PV3000 installed and the lead-in was deployed onto the soft tow. Directly after that the PAM was deployed and shortly after that deployment of the source commenced, which continued to the end of the day.

2 April 2009
We completed the deployment of the towed equipment – in less than ideal condition (WX) and made our way towards our first production line (MGL0905_01) which started at 04:21 GMT. We continued on line until a failure of the streamer cable telemetry lines cause us to shut down at ~22:49 GMT. At which time we began maneuvering out of the southern part of the Taiwan Straits (high traffic) so we could safely began the recovery of the towed equipment.

3 April 2009
The first half of the day was spent picking up the towed equipment to repair the telemetry problem with streamer #1, which was found to be in active section 4 and module 3. Once the repairs were complete we redeployed the streamer and other towed equipment to re-start production on line MGL0905_01R. We completed this line and moved on to MGL0905_02, which was a shorter line, before moving on to line MGL0905_03 to finish out the day.

4 April 2009
Good day of production; completed line MGL0905_03 and got started on MGL0905_04. No problems to report.

5 April 2009
Good day of production complete line MGL0905_04 and got started on MGL0905_05. No problems to report.

6 April 2009
We had an ok day of production-- completed lines MGL0905_05, MGL0905_06, MGL0905_07, MGL0905_T07A, and got started on MGL0905_08. Line MGL0905_08 was aborted early due to data telemetry problems on streamer #1. Once the source and the front of the streamer were onboard we began to trouble-shoot the problem, which continue through the end of day.

7 April 2009
The day started out with us trouble-shooting a streamer #1 telemetry failure. When all the trouble-shooting was done, we found that we had been fighting two issues. Active section #40 had been stuck by something while under tow and had multiple areas of skin damage where possible sea water intrusion had occurred. The second issue was that the streamer reel slip ring failed as well.

After figuring out the streamer issues, we were attempting to re-deploy when the hydraulic system #1 failed. With no chance of repair the engineer manufactured a cross over from system #3 to system #1 to allow us to continue to deploy. We redeployed all towed equipment and restarted production on line MGL0905_08R. However, shortly after restart an air leak developed on Sub-Array #2. The Line was aborted and the vessel started to circle around to pick up the line back up after repairs were made. Sub-Array #2 was repaired and the line (MGL0905_08R1) restarted which continued through the end of the day.

8 April 2009
We started the day out in production on MGL0905_08R1. Towards the end of that line we lost all telemetry on streamer #1 again. We continued down line shooting to the remaining OBS on the line. Once that was complete we turned offshore to begin picking up the towed equipment and started trouble-shooting streamer telemetry issues again. The problem was found to be the newly repaired module, which was installed in module 39's position yesterday, had failed. All towed equipment was then re-deployed, and then the vessel resumed production on MGL0905_10, which continued throughout the end of day. One note: due to delays in getting the survey started & equipment issues since getting to sea MGL0905_09 has been skipped.

9 April 2009
We had a very good day of production as we started the day out in production on MGL0905_10 and that is the way we finished it. No problems to report. The slip ring on streamer Reel #1 was changed and will be connected into the system on the next line change.

10 April 2009
We had another very good day of production. The day started with us continuing production on Line MGL0905_10, which lasted throughout the day. No problems to report.

11 April 2009
We had good day of production as the day started with continuing production on Line MGL0905_10 which we had done the previous two days. A couple of hours before the end of Line MGL0905_10 we noticed a ship closing on our position. The bridge hailed the vessel and it responded by asking for our clearance to work in PRC waters. In short, the discussion continued until they stated we were in violation of the Law of Sea Convention by working in their waters without a permit from PRC. It was then decided that as soon as Line MGL0905_10 ended, we would make a 180 deg turn and head back the way we came. We continued back up to the northeast until we intersected with MGL0905_17, which we turned on, and again began production to the east on a course of 090 Deg through the rest of the day. At the time of writing this report the PRC Vessel was still shadowing us about 3 miles off our port quarter.

Additional notes from **Char-Shine Liu**: "As the Langseth was surveying near the end of MGL0905-10 (approaching wp#12 at 116 deg 40' E, 18 deg 37' N) around noon time today (04/11), a Chinese naval vessel appeared (中國海監 81號, or China Sea Surveillance No. 81). She asked for the Langseth to provide permission from the Chinese government for surveying in this area. When Langseth said that she had obtained permission from the US State Department and the Taiwanese government to conduct the survey, the Chinese Navy ship began to claim that the Langseth entered Chinese water and violated the United Nation's Law of the Sea. The Langseth has sent message to the US State Department, and we have changed our survey plan by not going toward wp#14 (which is in the direction of the mainland China), instead turning back along MGL0905-10 and then at the intersection of line MGL0905-17 at a new waypoint 17A (117 deg 1' E and 19 deg N), we will turn east and begin seismic survey along MGL0905-17 toward wp#17 (i.e. heading eastward toward Philippines). We hope this will make the Chinese naval vessel go away and buy us some time for the U.S. State Department to sort out things. I also hope that our government (Taiwan) could obtain some understandings with the Chinese government regarding the Langseth survey around Tung-Sha area (since the Chinese have notified us through the "Mainland Affairs Council" regarding their intention to conduct geophysical survey in the area east and southeast of the Tung-Sha (aka Dongsha/Pratas) island)".

"Our plan is that we will reverse the seismic survey order by shooting along the eastern half of MGL0905-17 (from wp#17A to wp#17), then continue to MGL0905-15 (from wp#16 to wp#15, this is an OBS line), and then to MGL0905-14 (wp#15 to wp#14), and then back to MGL0905-12 (from wp#14 to wp#12) to pick up what we have left (i.e. the western part of MGL0905-17). We are not sure if further intervention by the Chinese Navy ship will occur, especially when the Langseth sails toward the South China Sea continental margin area again on MGL0905-15. Hope MOI and other administrations in Taiwan could help on solving things."

On a good note, the replacement slip ring in streamer reel #1 is up and fully operational.

12 April 2009
We had another good day of production as we started with continuing production on Line MGL0905_17 and continued that way throughout the day. No problems to report.

Note: China Sea Surveillance No. 81 is still following us. The vessel has been staying further then 2 miles away from us except one time yesterday when she came within 0.2 nm of our port side. Contact was made; she was asked to give us more room, which she did. Also ~12:00 local time yesterday a sea surveillance aircraft made some flybys on the vessel.

13 April 2009
We had another good day of production as we day started with continuing production on Line MGL0905_17. We completed MGL0905_17 and made a turn to the south towards line MGL0905_15, during the transit to this line we picked up Source Sub-arrays 1, 2, & 3 to perform some maintenance. The Sub-Arrays were redeployed and we continued the line change to MGL0905_15, which we started production on in the evening. No problems to report.

During the morning time the PRC vessel stopped following us. No other information to report on that.

14 April 2009
We had another good day of production as we continued on Line MGL0905_15. We shot line MGL0905_15 until we were about 2 miles from 119° E and started a turn to the north. We intersected with line MGL0905_19 in the middle of the planned line and shot it back to the east. On completion of MGL0905_19 we made an outside turn and headed to the North on MGL0905_20 which we continued through the end of the day.

Note: During the day we received new orders from OMO stating that we were not to go west of 119° E. This meant that we would not be able to finish any of the remaining lines to the west of 119° E. The PI's have chosen some new lines for us to shoot to fill up the remainder to the cruise. These new lines were originally scheduled to be acquired in MGL0906 and MGL0908, but have now been allocated to MGL0905

15 April 2009
We had another very good day of production as we continued production on Line MGL0905_20 throughout the day.

At ~00:00 Local time the PRC Vessel Sea Surveillance 83 took up station about 5 miles behind us. If followed us throughout the night until shortly after dawn it picked up speed (15+ kts) and moved up our starboard side about 2 miles off the streamer. It has now taken up station ~1 nm off the Stbd side of the vessel where it is pacing us. We have tried to contact him via VHF ch16, to make sure he gives a good CPA but there has been no response.

16 April 2009
We had another very good day of production as we continued production on Line MGL0905_20. Before midday we made a line change on to MGL0905_21 which was a short line. MGL0905_21 was completed just after midday and we started production on line MGL0905_22 which lasted throughout the day.

At ~20:25 it was observed by the bridge that the PRC Vessel Sea Surveillance 83 had changed in course was heading towards the streamer. At 20:33 the Captain gave the order for the streamer cable to be dived to let the PRC vessel pass safely over it. During this time the bridge crew had been trying to make radio contact with the vessel. Just before crossing the streamer the PRC Vessel made a sharp 180 deg turn and maneuvered away from the streamer in the direction it had come. Once the PRC vessel was well clear the streamer was brought back up to operational depth. During the entire time the PRC Vessel did not respond to the hails of the captain on the radio.

17 April 2009
We continued production on Line MGL0905_22 at start of the day, which was complete at 03:47. We continued to the south while doing source maintenance. All four Sub-Arrays were tested and repaired as needed. At 13:00 we started production on Line MGL0905_23 to the east which last throughout the day.

PRC Vessel Sea Surveillance 83 continued to follow us throughout the day; still no radio communication.

18 April 2009
We continued production on Line MGL0905_23 at start of the day. As our speed over ground was slow so we requested a switch of the seismic recording length from 15sec to 18 sec. We ended line MGL0905_23 and started MGL0905_23A with the seismic recording at 18 sec. Later in the evening the vessel speed over ground started to pickup and as such the seismic recording length needed to be lowered back to 15 sec to avoid missing shot points. MGL0905_23A was ended and a new line MGL0905_23B was started; this line continued throughout the day at a seismic recording length of 15 Sec.

PRC Vessel Sea Surveillance 83 continued to following us throughout the day without radio communication. The ROC Coast Guard vessel that is following the PRC Vessel was changed out with a ROC Navy vessel.

19 April 2009
We continued production on Line MGL0905_23B at start of the day. At 12:26 while on Line MGL0905_23B we encountered a very strong current which pushed the vessel offline very fast. This current also caused source sub-arrays 2 & 3 to become entangled. These two Sub-Arrays were disabled so they could be retrieved, while data was still being acquired with a reduced source volume (sub-arrays 1 & 2). After 1.5 hours of trying to get them untangled the line was called so we could maneuver the vessel and other towed gear around to try and untangle them. After another 3 hours we were finally able to get sub-arrays 2 & 3 untangled and onboard. As soon as the strings 2 & 3 were onboard we started a turn back to the west to circle around on the line and pick up where we had left off. Strings 2 & 3 had quite a bit of damage from the tangle, mostly firing line jumpers and ropes. The noticeable damage was to the string #3 float. The section right behind the nose piece had sustained a few holes and would have to be replaced.

All repairs were not completed by the time we circled around and were back online, so the line, MGL0905_23C, was started with a reduced volume while repairs to string #3 were still ongoing. However, shortly after the start of line string #3 was deployed and the source was brought up to full volume and production continued on Line MGL0905_23C; this line continued into the new day.

PRC Vessel Sea Surveillance 83 & ROC Navy Vessel both departed the area.

20 April 2009
We continued production on Line MGL0905_23B at start of the day. Once completed, we made a short line change onto MGL0905_24. String #2 was brought onboard at the start of Line MGL0905_24 to do some maintenance work related to the strings tangling the night before. Once the maintenance was complete the string #2 was redeployed and the source brought up to full volume. No other problems to report.

21 April 2009

We continued production on Line MGL0905_24 at start of the day. Once completed, we made a line change onto MGL0905_25 which continued throughout the day. No other problems to report.

22 April 2009
We continued production on Line MGL0905_25 at start of the day. However shortly after the start of day we ended Line MGL0905_25 so as to comply with IHA Section 10 Paragraph r, which restricted the acquisition of seismic data in the area of Bataan Island in the Luzon Straits during the months of February to April. We transited through the area with our sound source secured until we were on the West Side of the Luzon Straits and restarted the Line MGL0905_25A. No problems to report.

23 April 2009
We continued production on Line MGL0905_25A at start of the day, which we completed after midday. We picked up a short transit line (MGL0905_26) on our way to MGL0905_27. We continued production on MGL0905_27 throughout the rest of the day. No problems to report.

24 April 2009
We continued production on Line MGL0905_27 at start of the day, which we completed late in the evening. We made a line change to MGL0905_28, which continued production the rest of the day. No problems to report.

25 April 2009
We continued production on Line MGL0905_28 at start of the day, which we completed late in morning. We conducted an outside turn to do some maintenance on source sub-arrays 1 & 2 and once complete we started on line MGL0905_29. Throughout the day the weather had been increasing. During Line MGL0905_29 due the sea condition both outboard sub-arrays broke their separation ropes causing them to fall in and tangle with the sub-array strings. After a short time we were able to get them untangled and began retrieving all sub-arrays onboard due to the still worsening weather. The sub-arrays were retrieved onboard (very little damage) and at the end of day were maneuvering the vessel southwest to get around to the west side of Taiwan to get on leeward side of the island. The forecast is for the seas to increase throughout the day and into tomorrow.

26 April 2009
We started the day down for weather and transiting to the west side of Taiwan to get in some calmer waters to work. Before the sun went down we wanted to get a mitigation gun in the water, because it was clear that we would make it to our intended line before sunrise. Source sub-array #4 was deployed and as soon as it was aired up to operational pressure, the hose bundle failed. The failure point was ~183m from the sea end termination and 127m from the ships end termination. Source sub-array #4 was retrieved and source sub-array #1 was deployed. We continued transiting to the west side of Taiwan throughout the evening and shortly before day change we deployed source sub-array #2 & #3 to begin production on Line MGL0905_34, which we did at 21:04. No other major problems to report.

27 April 2009

We started the day on Line: MGL0905_34, which continued until 21:59, where we made a line change to Line MGL0905_35. Shortly after starting line MGL0905_35 a PRC fishing trawler made contact with the streamer, which caused the streamer to part ~1.6km from the stern of vessel. Line MGL0905_35 was ended and the towed equipment retrieval began.

28 April 2009

We started the day retrieving the remainder of the towed equipment still attached to the vessel. Once onboard we made our way over to the chase vessel that was tied off to the tailbuoy. He made his way over to us and passed a line over. We got the tailbuoy onboard and then started retrieving the streamer, it was shortly clear that we did not have the entire streamer attached. We retrieved ~600m that was still attached to the tailbuoy. We gave instruction to the chase vessel to move to the east and see if they could see any of the SRD's on the surface. They shortly came back and said they had the SRD bags in site. We made our way over toward their location. We launch the MOB to attach a rope to the steamer and return to the ship. They did this and passed the line to the streamer deck and we began retrieving this portion of the streamer. It was clear from the start this was a much longer length of streamer, and when all was said and done all the streamer and attached devices (bird, and acoustics pods) were recovered onboard.

Summary:

Streamer: All 6km back onboard. It looks like we had about 8 sections that were damaged and will need to be scrapped. The rest look mechanically sound. There is 4200m on the reel backward, so we will have to wait until we can get it on the reel the right way before we can test and check it electrically.

Bird: 22 of 22 birds back, but some are damaged and we will have to test them all to see what their status is.

Acoustic Pods: 5 out of 5 back onboard, 1 with a damaged latch assembly.

SRD's: We had ~ 18 go off out of the 22 we had on the streamer and only one was lost at sea.

Tailbuoy: In good shape and will be ready to deployed on leg #2

Lead, Head Stretch, and STU: All are in good working order

Tail Stretch & Tail Swivel: Both are in good working order.

We are currently underway towards port and will pick up the Pilot at ~00:00 GMT tomorrow morning.

Leg 1 (MGL0905) Line List

Line	Shot	Year	JDay	Time	Latitude	Longitude	Depth
MGL0905_01	1055	2009	92	03:39	21.405581	120.410956	2797
MGL0905_01	4560	2009	92	22:49	22.769453	119.549361	95
MGL0905_01R	4072	2009	93	10:38	22.580128	119.670986	353
MGL0905_01R	4852	2009	93	15:47	22.883006	119.477192	91
MGL0905_02	1159	2009	93	16:47	22.896097	119.391111	82
MGL0905_02	1685	2009	93	20:10	22.715117	119.225144	77
MGL0905_03	1021	2009	93	20:24	22.700911	119.222661	79
MGL0905_03	4348	2009	94	16:33	21.355947	119.940272	3079
MGL0905_04	1060	2009	94	17:03	21.327578	119.926111	3141
MGL0905_04	3122	2009	95	05:14	20.998622	118.997292	2689
MGL0905_05	813	2009	95	09:09	20.915519	119.019250	2742
MGL0905_05	4310	2009	96	05:47	22.454164	118.640628	79
MGL0905_06	1032	2009	96	06:14	22.478019	118.621047	75
MGL0905_06	1389	2009	96	08:36	22.443094	118.451867	74
MGL0905_07	1045	2009	96	09:03	22.421153	118.433158	80
MGL0905_07	2305	2009	96	17:04	21.915658	118.712875	1498
MGL0905_T7A	1167	2009	96	17:50	21.886381	118.681867	1568
MGL0905_T7A	1442	2009	96	19:30	21.947800	118.566286	1567
MGL0905_08R	1402	2009	97	07:57	22.002758	118.690736	1135
MGL0905_08R	1694	2009	97	09:46	22.016617	118.831728	1364
MGL0905_8R1	1367	2009	97	14:07	22.017353	118.672692	1196
MGL0905_8R1	4598	2009	98	08:38	22.330747	120.197642	569
MGL0905_10A	1230	2009	98	17:14	22.395828	120.128919	3799
MGL0905_10	12194	2009	101	05:46	18.640894	116.688069	6463
MGL0905_15	9913	2009	103	17:49	18.770128	120.374731	3363
MGL0905_15	6324	2009	104	12:52	19.766903	119.028469	2595
MGL0905_17	8538	2009	101	14:01	19.003100	117.085064	3725
MGL0905_17	1120	2009	103	08:59	19.001783	120.607792	3415
MGL0905_19	9549	2009	104	14:09	19.840453	119.078239	3327
MGL0905_19	10796	2009	104	20:20	19.833028	119.673358	3447
MGL0905_20	985	2009	104	22:24	19.826150	119.644833	3414
MGL0905_20	7332	2009	106	09:57	22.661694	119.196075	79
MGL0905_21	1076	2009	106	09:56	22.670497	119.163361	73
MGL0905_21	1450	2009	106	12:16	22.584044	119.007058	70
MGL0905_22	1007	2009	106	12:17	22.582756	119.006186	70
MGL0905_22	3685	2009	107	03:47	21.389517	119.212761	2960
MGL0905_23	881	2009	107	13:00	21.416528	119.148511	2844
MGL0905_23	2997	2009	108	04:44	21.428081	120.169008	2840
MGL0905_23A	3000	2009	108	04:46	21.428078	120.170442	2836
MGL0905_23A	4870	2009	108	17:21	21.433486	121.072358	1377
MGL0905_23B	4874	2009	108	17:22	21.433656	121.074314	1393
MGL0905_23B	7905	2009	109	14:07	21.420400	122.536878	4800

Line	Shot	Year	JDay	Time	Latitude	Longitude	Depth
MGL0905_23C	7797	2009	109	22:31	21.432778	122.484144	4786
MGL0905_23C	10890	2009	110	17:20	21.410864	123.976133	5458
MGL0905_24	1113	2009	110	17:47	21.374022	123.974753	5423
MGL0905_24	3140	2009	111	05:12	20.573119	123.502592	5555
MGL0905_25	1013	2009	111	05:17	20.568758	123.496019	5552
MGL0905_25	3837	2009	112	00:09	20.579828	122.141803	2655
MGL0905_25A	4884	2009	112	07:12	20.581689	121.638894	1621
MGL0905_25A	10341	2009	113	13:19	20.567211	119.022869	2765
MGL0905_26	1028	2009	113	13:36	20.577439	119.004231	2767
MGL0905_26	1252	2009	113	14:51	20.678275	119.003483	2572
MGL0905_27	1252	2009	113	14:55	20.682142	119.006992	2572
MGL0905_27	5937	2009	114	21:26	21.782336	121.065239	807
MGL0905_28	1026	2009	114	21:32	21.785544	121.076606	879
MGL0905_28	3341	2009	115	09:09	21.783272	122.196072	4836
MGL0905_29	601	2009	115	14:07	21.600933	122.166369	4802
MGL0905_29	1177	2009	115	18:35	21.860861	122.165417	4833
MGL0905_34	747	2009	116	21:03	21.762333	120.666756	906
MGL0905_34	4453	2009	117	21:59	22.662761	119.150367	73
MGL0905_35	1309	2009	117	23:03	22.709336	119.198069	74
MGL0905_35	1390	2009	117	23:35	22.711953	119.237386	79

Part II MGL0906: TAIGER LEG 2

4 May 2009 to 4 June 2009

Cruise Participants

Char-Shine Liu	Co-Chief Scientist	National Taiwan University
Kirk McIntosh	Co-Chief Scientist	Univ. of Texas Inst. For Geophysics
Wu-Cheng Chi	Researcher	Academia Sinica, Taipei
Takeshi Matsumoto	Professor	University of the Ryukyus, Japan
W. Ryan Lester	Graduate Student	Univ. of Texas Inst. For Geophysics
Ho-Han Hsu	Graduate Student	National Taiwan University
Jih-Hsin Chang	Graduate Student	National Taiwan University
Chia-Chun Ko	Graduate Student	National Taiwan University
Hao-Ting Hung	Graduate Student	National Taiwan University
Shye-Dong Chiou	Technician	National Taiwan University
Mei-Yu Chen	Research Assistant	National Taiwan University
Wan-Jou Chen	Research Assistant	Academia Sinica, Taipei
Chi-Chin Tsai	Graduate Student	National Taiwan University
Shu-Lin Tu	Graduate Student	National Taiwan University
Jei-Wei Yan	Military Observer	

Science Technical Staff

Anthony Johnson	Science Officer
Tom Spoto	Chief Source Tech
Bern McKiernan	Data Acquisition Tech
Ted Koczynski	Data Acquisition Tech
Michael Martello	Navigation Tech
David Ng	IT and Navigation Tech
Della Grallert	Data Acquisition Tech
Brian Goodick	Source Technician
Donald Cucchiara	Source Technician
Richard Harpour	Source Technician
Allen Ruttan	Source Technician

Marine Mammal Observers

Bradley Dawe	
Brendan Hurley	
Meike Holst	LGL Inc.
Claudio Fossati	
Hsin-Yi Yu	National Taiwan University

Cruise Objectives

Leg 2 of the TAIGER project was focused on recording data to determine the crustal structure of the Taiwan orogeny. The first line was shot to OBSs across the passive margin just southwest of Taiwan. This is considered to represent the "before collision structure", or input, to the collision. The second line, also offshore southwest Taiwan was an east-west, onshore/offshore line, recorded by OBSs and land instruments. This turned out to be the only onshore/offshore line in which land instruments recorded airgun shots from both sides of Taiwan. This transect is also in the critical early collision zone, which is important for fully understanding the transition from subduction to collision. The lines in the Taiwan Strait were originally meant to be the western parts of three more onshore/offshore transects. However, failure to get clearance from Mainland China, due to a conflict with their conditions and conditions imposed by Taiwan, resulted in no perpendicular offset in the Taiwan Strait. For this reason, we simply shot the source array for land recording. A relatively short onshore/offshore transect was added north of Taiwan. The source signals were recorded by OBSs and land instruments in an island-parallel array. This may provide an important view from less deformed continental crust in the north to the interior of the collision in the south. The profiles east of Taiwan also provide sources for key onshore/offshore transects. From south to north, the structures they reveal will help document the evolution of the Taiwan arc-continent collision. Another objective was to further study the characteristics of the Ryukyu arc/trench system and their relation to the Taiwan orogeny. We acquired one OBS line here, in cooperation with a French group, and we made four other Ryukyu trench crossings for MCS imaging.

Cruise Narrative

Note: Times are UTC unless otherwise noted.

4 May 2009
The R/V Langseth left Kaohsiung at ~10:00 (local) to start cruise MGL0906. We headed toward WP-1 initially and then took some time to acquire multibeam data on the trench slope SW of Taiwan. Due to a number of factors, the OBS ship, OR-2, was unable to leave before us to deploy OBSs along transect T3 (MGL0906-01), so Langseth had time for the multibeam acquisition. Due to restrictions on multibeam acquisition this activity started once the ship crossed the 24 nm line. The multibeam surveying lasted for a total of 15.5 hours.

5 May 2009
After recording two long swaths of multibeam, Langseth broke away and headed again for WP-1. During the transit MGL briefly lost steering, but this was corrected in about 15 minutes. The seismic source array was deployed between 08:31 and 15:44. This included a break to repair a leak in the hydraulic system. The first line, MGL0906-1 was started at 17:48. This line re-occupied MGL0905-20, which acquired MCS data during Leg1. For MGL0906-1, this is strictly an OBS line. The acquisition parameters are: Use full, 36 unit array and shoot at 150 m spacing to achieve ~60 s interval between shots.

6 May 2009

Shooting on MGL0906-1 continued until 07:21, when several guns went out on source string2. We decided to stop shooting for repair rather than use spare guns, which were not the same as the "bad" guns. Unfortunately, the repair did not go smoothly due to both hardware and software problems. Finally source only work resumed at 15:49 on MGL0906-01A and continued thru the day.

7 May 2009
Shooting on MGL0906-1A continued until 22:38. Progress was slowed on this line by currents. The general limits are a maximum speed of 5 kts through the water. At this point we turned to retrace our path south back to WP-3.

8 May 2009
Today we finished MGL0906-2 and made the short trip west to WP4 (MGL0906-3). After turning, we began MGL0906-4, shooting to OBSs and land instruments on the onshore/offshore profile T4Awest. This is the only remaining onshore/offshore transect that will be shot from both sides. This line was acquired from 10:13 to 21:29. At the end of this line we did an outside turn to the south to shoot through the endpoint and to perform source maintenance.

9 May 2009
This day was spent on coast parallel track segments moving north in the Taiwan Strait. This included lines MGL0906-5, -6, -6A, -7, and -7A. This area was also of major concern for marine mammal safety due to proximity of the near-coastal habitat of the endangered hump-back dolphin. Several extra precautions were exercised to prevent any effects on this species:

- Sound level in habitat (3-5 km from the coast) was to remain below 160 dB rms
- We tried to maintain a 20 km offset from the coast, except the pass between Penghu Islands and coast where the distance narrowed to ~17.5 km.
- Boats with acoustic monitoring equipment took up ~5 km offshore positions several places along the coast. The monitors measured peak to peak sound levels, with 180 dB the maximum allowable sound level.

The monitors measured no excess sound levels until MGL0906-7 segment, which included work in shallower water. At ~16:40 we reduced the source by turning off one of the 4 source strings. Shortly thereafter a compressor failure occurred and we reduced the source to a single airgun firing at <= 8 minute intervals. When compressor function was restored minutes later we ramped up the array to two strings. At 22:56 these two strings were shut down as monitors measured sound levels approaching 180 dB (peak to peak) at distances > 17 km. Again this was an area of shallow water and assumed hard bottom.

10 May 2009
This day started as transit along line MGL0906-7. At 04:18 ramp up for MGL0906-7B was initiated as water depth slightly increased, distance from the coast increased, and the most sensitive area for the endangered dolphin was passed. This line was continued north, still shooting only to the land stations, until waypoint 8. At 15:37 we turned east on MGL0906-8, shooting at 100 m interval to land stations with the full array.

11 May 2009

We continued shooting along MGL0906-8 until 09:20. At this point the source was shut down due to marine mammal presence. We decided to perform source maintenance during the shutdown. This continued until 14:22. We shot at 100 m spacing with the full array on MGL0906-9 from 14:22 until 21:35, when we turned on to MGL0906-10.

12 May2009
Shooting continued on MGL0906-10 until 11:01 when we turned to MGL0906-11. We maintained the same source parameters on this line, shooting through the day. During the day we got news of naval exercises to be held over the next several days in the area south of our current position and along our intended path. We determined that we would be unable to acquire data along MGL0906-12 until ~01:00 14 May (09:00 local) due to the exercises. Thus we made plans to deploy the streamer through the day on 13 May and do any necessary maintenance on the streamer and source array.

13 May 2009
Line MGL0906-11 was finished at 01:21. At that point we started to do the streamer deployment. This process continued throughout the day as two bad streamer sections were replaced and there was some difficulty in isolating data and/or power problems. Some delay occurred as part of the operation needed to be repeated because a bad section was not identified until it was already in the water.

14 May 2009
When streamer operations were completed we deployed the source array. The array was nearly complete, but one of the 360 cu. in. airguns failed. These are key components of the source array, so we decided to repair this airgun before starting a 2-day line. The airgun was repaired and the array was redeployed. However, at this time strings 1 and 2 became very unreliable, typically firing only part of their strings each time. Many hours were spent trying to isolate a software or configuration problem, but there was no breakthrough. This even included using a spare system on a different server with the same results. At this time the source strings 1 and 2 were recovered. No obvious problems were observed but many items were unplugged and replugged and power cycled. After passing click tests strings 1 and 2 were redeployed. This proved to be successful, even though the solution remains unclear. Unfortunately this took all day—shooting and MCS acquisition was initiated at 13:48, starting MGL0906-12.

The MCS acquisition on this line was short-lived; at around 15:39 the Spectra system stopped firing, and, due to the long space between shots and deep water, the lack of firing went undetected for 10 minutes. This occurred during the nighttime, so we were unable to resume shooting. Data acquisition did not resume until about 23:43; about 9 hours of data acquisition time was lost.

15 May 2009
We restarted line MGL0906-12 after daylight allowed MMO inspection. During the night the ship had drifted north, so this resulted in a nearly full reshoot of the original start of line 12. However, once finally started, we proceeded to acquire data on this line (now MGL0906-12B) for the full day.

16 May 2009
Due to strong northward current (Kuroshio current), our progress on MGL0906_12B was quite slow, typically less than 4 kts over the ground. This line was finally completed at 21:58 and we turned onto MGL0906_13. Shortly after completion, the M/V Yu-Yin 2, with OBS teams from NTOU, Scripps, and IFREMER, started recovery of the French and Taiwanese OBSs on MGL0906_12B.

17 May 2009
Acquisition on MGL0906_13 continued until 04:07. At this time we changed course to the north in preparation for our turn onto MGL0906_14. By initially turning north and then turning to the south to start 180˚ turn, the current carried the streamer to the north, helped to keep it straighter, and kept it away from the coast. At 06:20 we started MGL0906_14 to the southeast (127˚), shooting at 50 m intervals for optimal MCS acquisition. Acquisition on this line continued for the remainder of the day.

18 May 2009
MGL0906_14 was completed at 05:27. At this time we made an outside turn and source maintenance was performed. The turn and maintenance were completed in about 3 hours, and we started MGL0906_15N at 09:41. This line was not in the original plan, but allows for MCS acquisition on a profile just east of Gagua ridge and saves significant time by shortening the MCS portion (50 m shot spacing) of all the east Taiwan lines. This plan, however, also allowed us to shoot the full length of the lines for OBS recording. Land recorders benefit from this plan because the combination of reshooting these lines means that most parts of them are shot at night, during either the westward or the eastward shooting.

MGL0906_15N was completed at 23:56, after a brief equipment (Spectra) failure at 14:22-14:26.

19 May 2009
At completion of MGL0906_15N, we made an outside turn to allow source maintenance. After maintenance we turned on MGL0906_19N at 03:05. This line was continued until 23:08, near the central, east coast of Taiwan. After the turn we started MGL0906_20, shooting at 125 m spacing for OBS recording.

20 May 2009
Acquisition on MGL0906_20 continued throughout the day. The FRC (small boat) was launched two times today for streamer maintenance and successfully removed tangled fishing gear from the streamer.

21 May 2009
MGL0906_20 was completed at 04:50. We made an inside turn to the south onto MGL0906_21, shooting at 50 m intervals for this short segment. This line was completed at 09:19. We made an extended outside turn to MGL0906_16 to perform source maintenance and to time daytime arrival near the coast at the end of this line. We started MGL0906_16 at 12:19 and continued west throughout the day, shooting at 125 m spacing.

22 May 2009
Acquisition continued throughout the day on MGL0906_16. Our speed was rather slow, typically between 3 and 4 kts due to strong currents. The FRC (small boat) was launched once today for streamer maintenance and successfully removed tangled fishing gear from the streamer.

23 May 2009
Acquisition on MGL0906_16 continued to 05:23. Before this we passed Lu Tao. Unfortunately the NTU sound level monitoring boat drifted into our path and would not move (its engines were off to provide quiet), so Langseth had to make sharp turn to avoid this boat! Toward the end of the planned line, just offshore from Taitung, we encountered traffic and lots of fishing gear. A fast ferry between Lu Tao and Taitung actually crossed our streamer two times, coming and going, during this approach. The ferry did not respond to radio calls. The chase boats escorting us helped identify the extent of fishing long-lines and we attempted to avoid them. Unfortunately, this meant that we had to turn to the south rather than the north. We also had to shorten the line by turning back at this point. Our original plan had been to veer to the north first and then turn back to the south in a 180˚ to get on the line as far west as possible—this did not happen. The situation became somewhat worse because we experienced source trouble near the completion of the turn. One of the airguns severely malfunctioned and was auto-firing about every second. This continued for 10-15 minutes as the two strings were recovered. MGL0906_17 was started at 05:39, reshooting the line to the east, and continued through the remainder of the day. This line was shot at 50 m shot interval.

24 May 2009
Acquisition continued on MGL0906_17 until 08:02 when we turned north onto MGL0906_18N. The new line was started at 08:06 and continued until 22:53. This line continued line MGL0906_15N, east of Gagua ridge, extending across the Ryukyu trench to the east Nanao basin. We turned SE at WP 18A, about 8 nm past T6E.

25 May 2009
We went SE to WP 18B about 10 nm and then turned south. Source maintenance was done during this segment. We turned onto MGL0906_22N at 03:51, shooting at 50 m spacing for MCS. We experienced a compressor failure between 11:39 and 11:57, but were able to continue with one airgun for marine mammal mitigation. A ramp-up was initiated and acquisition continued throughout the rest of the day.

26 May 2009
Line MGL0906_22N was completed at 00:23. We then turned through 180˚ off the coast of Hoping. Source maintenance was performed during this turn and MM mitigation procedures took place after sightings of spinner dolphins. Data acquisition resumed at 02:07 with the start of MGL0906_23. This line was shot at 125 m spacing for OBS recording. At 12:03 a compressor failure occurred, but pressure was rapidly restored and full array acquisition resumed at 12:11, continuing throughout the rest of the day.

27 May 2009

Acquisition continued on MGL0906_23 until 05:41. We made an outside turn to perform source maintenance. MGL0906_24 started at 08:34, heading south. We had further difficulty with the source array but initially used spare guns to replace the troublesome 360 cu. in. airgun. After coming across the trench we decided to shoot with 2 strings while maintenance was done on the other two strings. Eventually full power was restored. This line continued through the end of the day.

28 May 2009
MGL0906_24 was completed at 11:06. We made an inside turn to line MGL0906_25, heading northwest, with start of line at 11:30. This line continued throughout the day.

29 May 2009
While crossing Gagua ridge or just after we were snagged by fishing gear on bird #16. This caused the far third of the streamer to come very shallow. Through persistent effort Ted and Anthony were able to get the surrounding birds down into the acceptable zone and pull bird 16 down to about 3-4 m. This is a somewhat unstable situation, as it requires relatively high streamer tension and speed through the water to keep this configuration. However, the seas have proven to be too choppy to launch the boat for in situ streamer maintenance. Line MGL0906_25 was completed at **10:30 and we turned north onto MGL0906_26. This turn was problematic due to the expected current flowing the same northerly direction combined with our need for speed through the water to keep the streamer down. We compromised by increasing the shot interval to 75 m. This speed allows us to go > 7 kts without missing shots and still leaves us with ~40 fold data.

30 May 2009
Because we were headed close to the coast it was deemed unsafe to have the fouled bird/shallow streamer. We had to recover the source and streamer to clear off the fishing gear. This started at 00:00 and continued through 5:56. Once the fouled bird was cleared we reversed the process and redeployed. Despite additional maintenance required for string 2, the process was completed at about 12:00. Ramp-up was started before full source deployment to allow MMO visual inspection, and it was completed at 12:08. Line MGL0906_26A was started south of the end of MGL0906_26 and continued north for the remainder of the day.

31 May 2009
MGL0906_26A was completed at 00:14. We turned south on MGL0906_27; this is a short connector line to WP28. We turned onto MGL0906_28 at 03:17. This line crosses the Hoping basin and approaches the Nanao basin heading ENE. At 09:08 MGL0906_28 was completed. We did an outside turn from WP29 to WP30 (a very short distance) and started MGL0906_30 at 11:13. We acquired MCS data on MGL0906_30 until 18:54 when there was a power failure. This was a full power failure for several minutes with the ship “dead in the water”—only emergency lighting, no propulsion and no shooting. Fortunately, the power was restarted fairly quickly and mitigation shooting started in less than 8 minutes. As the power came on line the ship resumed propulsion and prevented the streamer from sinking too far. Power was fully restored by 19:46 and the acquisition hardware and software was restarted and/or checked out by 20:23, when ramp-up was initiated. Data acquisition was resumed on MGL0906_30A at 21:29. This line was continued the rest of the day.

01 June 2009
MGL0906_30A continued to the south until 19:54. The speed was quite slow, around 3 kts, so we decided to terminate the line and take a shortcut to the southwest. We started MGL0906_30N at 20:08 and continued through the day.

02 June 2009
MGL0906_30N intersected the planned line MGL0906_31 in the Luzon arc. We terminated 30N at 10:39 and turned onto MGL0906_31 at 10:41. We continued on this line through the day.

03 June 2009
We continued on MGL0906_31 until 05:39. This marked the end of data acquisition for MGL0906. The source array, PAM, and streamer were subsequently recovered. We transited to Kaohsiung and arrived outside the port at 23:42.

04 June 2009
The ship arrived at pier at 00:56 marking the end of MGL0906.

Leg 2 (MGL0906) Line List

Line	Shot	Year	JDay	Time	Latitude	Longitude	W_Depth
MGL0906_01	927	2009	125	17:48	20.325150	119.574292	3245
MGL0906_01	1619	2009	126	07:56	21.249689	119.406075	3059
MGL0906_01A	1391	2009	126	15:48	20.943622	119.454197	2928
MGL0906_01A	3103	2009	127	22:38	23.243156	119.121903	46
MGL0906_02	962	2009	127	23:40	23.280636	119.093756	45
MGL0906_02	1377	2009	128	07:32	22.725711	119.193292	70
MGL0906_03	1008	2009	128	07:37	22.721128	119.190089	70
MGL0906_03	1083	2009	128	09:03	22.705200	119.079622	57
MGL0906_04	971	2009	128	10:13	22.713978	119.051339	52
MGL0906_04	1636	2009	128	21:29	22.713369	120.022267	173
MGL0906_05	886	2009	128	23:57	22.618647	120.076133	270
MGL0906_05	1415	2009	129	06:19	23.048444	119.851181	146
MGL0906_06	1003	2009	129	06:21	23.050056	119.850658	154
MGL0906_06	1522	2009	129	11:52	23.518617	119.843078	109
MGL0906_06A	1006	2009	129	11:55	23.522992	119.843386	108
MGL0906_06A	1258	2009	129	13:59	23.725747	119.955728	52
MGL0906_07	1002	2009	129	14:00	23.726767	119.956300	52
MGL0906_07	1237	2009	129	16:40	23.913642	120.065242	20
MGL0906_07A	1279	2009	129	17:41	23.947039	120.084728	25
MGL0906_07A	1682	2009	129	22:56	24.267889	120.271742	43
MGL0906_07B	2232	2009	130	04:18	24.705300	120.528658	59
MGL0906_07B	3231	2009	130	15:36	25.497828	121.002483	94
MGL0906_08	1007	2009	130	15:37	25.498364	121.004100	95
MGL0906_08	2517	2009	131	09:20	25.501167	122.505931	465
MGL0906_09	1001	2009	131	14:22	25.498678	122.651553	765
MGL0906_09	1575	2009	131	21:35	25.966492	122.405131	103
MGL0906_10	1025	2009	131	21:56	25.976558	122.385294	105
MGL0906_10	1908	2009	132	11:01	25.306272	121.909772	158
MGL0906_11	1018	2009	132	11:03	25.303492	121.910119	161
MGL0906_11	1899	2009	133	01:21	25.161703	122.769594	1483
MGL0906_12	982	2009	134	12:44	25.178231	122.777425	1484
MGL0906_12	1005	2009	134	13:34	25.158086	122.771583	1492
MGL0906_12A	1009	2009	134	13:42	25.155083	122.769083	1492
MGL0906_12A	1175	2009	134	18:30	25.011083	122.721703	1495
MGL0906_12B	1026	2009	134	23:44	25.140389	122.764056	1477
MGL0906_12B	3968	2009	136	21:59	22.621622	121.844739	4440
MGL0906_13	1069	2009	136	22:24	22.620931	121.821017	4392
MGL0906_13	2079	2009	137	04:07	22.943625	121.473117	1352
MGL0906_13A	2211	2009	137	05:00	23.023050	121.467514	1493
MGL0906_13A	2285	2009	137	05:41	23.030525	121.422367	656
MGL0906_14	1005	2009	137	06:20	23.003181	121.402386	188
MGL0906_14	5207	2009	138	05:27	22.099469	123.197908	5598

Line	Shot	Year	JDay	Time	Latitude	Longitude	W_Depth
MGL0906_15N	963	2009	138	09:40	22.094378	123.167192	5596
MGL0906_15N	3406	2009	138	23:56	23.197392	123.167025	5008
MGL0906_16	986	2009	141	12:15	22.718028	123.770117	5998
MGL0906_16	3054	2009	143	05:23	22.708100	121.252703	1044
MGL0906_17	1123	2009	143	05:39	22.694744	121.257839	1128
MGL0906_17	5032	2009	144	08:02	22.729767	123.160750	5778
MGL0906_18N	1032	2009	144	08:06	22.734381	123.164469	5784
MGL0906_18N	3542	2009	144	22:53	23.867667	123.168361	3504
MGL0906_18A	1111	2009	144	23:29	23.874139	123.210403	3330
MGL0906_18A	1400	2009	145	01:23	23.800756	123.328472	4218
MGL0906_18B	1011	2009	145	01:27	23.796725	123.331175	4228
MGL0906_18B	1241	2009	145	02:46	23.693131	123.332967	4557
MGL0906_19N	898	2009	139	03:05	23.171692	123.216381	5055
MGL0906_19N	4331	2009	139	23:06	23.643608	121.614311	814
MGL0906_20	998	2009	139	23:29	23.627567	121.615225	536
MGL0906_20	2826	2009	141	04:50	23.005047	123.745756	6312
MGL0906_21	1031	2009	141	04:58	22.996261	123.749739	6317
MGL0906_21	1703	2009	141	09:19	22.692844	123.750008	5974
MGL0906_22N	1104	2009	145	03:51	23.647286	123.290825	4522
MGL0906_22N	4521	2009	146	00:33	24.428592	121.843014	237
MGL0906_23	1073	2009	146	02:07	24.390861	121.912261	1905
MGL0906_23	2808	2009	147	05:40	23.399753	123.748806	4062
MGL0906_24	939	2009	147	08:33	23.428783	123.750300	4392
MGL0906_24	5546	2009	148	11:06	21.347803	123.741903	5391
MGL0906_25	1102	2009	148	11:30	21.352717	123.707947	5393
MGL0906_25	5065	2009	149	10:37	22.169592	122.003178	4585
MGL0906_26	1039	2009	149	10:49	22.190614	122.000164	4603
MGL0906_26	2730	2009	149	22:54	23.335947	122.000383	4847
MGL0906_26A	3190	2009	150	12:14	23.155025	122.000100	4253
MGL0906_26A	5635	2009	151	00:14	24.257486	121.999761	3116
MGL0906_27	987	2009	151	00:34	24.261406	121.980353	2960
MGL0906_27	1355	2009	151	03:03	24.102153	121.923333	2259
MGL0906_28	939	2009	151	03:17	24.089344	121.934908	2397
MGL0906_28	1877	2009	151	09:07	23.989078	122.382858	3566
MGL0906_29	952	2009	151	09:22	23.997814	122.404611	3561
MGL0906_29	1144	2009	151	10:36	24.073936	122.357206	3061
MGL0906_30	936	2009	151	11:04	24.064325	122.335178	3436
MGL0906_30	1737	2009	151	21:27	23.702836	122.333778	3173
MGL0906_30A	1738	2009	151	21:29	23.702378	122.333811	3167
MGL0906_30A	4515	2009	152	19:54	22.448492	122.331775	4814
MGL0906_30N	1050	2009	152	20:08	22.433306	122.320978	4801
MGL0906_30N	3102	2009	153	10:39	21.668300	121.759339	1457
MGL0906_31N	1018	2009	153	10:42	21.667342	121.756261	1451
MGL0906_31N	3190	2009	154	05:39	21.671889	120.707011	709

Part III MGL0907: TAIGER LEG 3

7 June 2009 to 14 June 2009

MGL0907 6/07/09-6/14/09

The purpose of this leg was to recover broadband OBSs that were deployed south and west of Taiwan in May 2008. These instruments have been recording earthquakes for over one year and some source signals from the R/V Langseth during MGL0905 and MGL0906. Of the 20 OBSs deployed, 18 of them were recovered and 14 successfully recorded data. In addition to the two OBSs that were not recovered, three OBSs experienced water leakage into the sensor package before recording began and one instrument recorded data without signal. The track followed by the R/V Langseth during this recovery cruise is shown in Figure 2 with the black line and OBS locations are the numbered black squares.

Participants:

Chi, Wu-Cheng	Co-Chief Scientist	Academia Sinica, Taipei, Taiwan
Nakamura, Yosio	Co-Chief Scientist	University of Texas, Austin TX, USA
Wu, Francis Taming	Professor	Binghamton University, Binghamton NY, USA
Lester, W. Ryan	Graduate Student	University of Texas, Austin TX, USA
Hao, Kuo-Chen	Graduate Student	Binghamton University, Binghamton NY, USA
Ziminsky, Mark	Undergraduate Student	Binghamton University, Binghamton NY, USA
Van Avendonk, Harm	Researcher	University of Texas, Austin TX, USA
Barclay, Andrew	Researcher	Columbia University, Palisades, NY, USA
Gassier, David	Marine Engineer	Columbia University, Palisades, NY, USA
Pugsley, Stephen	Marine Technician	Columbia University, Palisades, NY, USA
Lozefski, George	Marine Technician	Columbia University, Palisades, NY, USA
Jian, Shuen-Jung	Researcher	National Taiwan University, Taipei, Taiwan
Chen, How-Wei	Professor	National Central University, Zhongli, Taiwan
Chang, Emmy T.Y.	Professor	National Taiwan University, Taipei, Taiwan
Yu, Shang-Hsueh	Researcher	National Taiwan University, Taipei, Taiwan
Hsu, Di-Yao	Military Observer	Taiwan

Cruise Narrative

07 Jun 2009
Depart Kaohsiung for MGL0907. Begin OBS recovery, recover instruments at site BBOBS33, BBOBS37.

08 Jun 2009
Recover OBS instruments at sites BBOBS38, BBOBS39, BBOBS35, BBOBS28.

09 Jun 2009
Recover OBS instruments at sites BBOBS27, BBOBS12, BBOBS04.

10 Jun 2009
Recover OBS instruments at sites BBOBS02, BBOBS01, BBOBS09, BBOBS10, BBOBS11. Transit to BBOBS03 for second recovery attempt.

11 Jun 2009
Abandon second attempt at BBOBS03, continue to point north, BBOBS03N, to search for OBS. Abandon BBOBS03N. Continue planned OBS recovery at BBOBS19, recover BBOBS19, BBOBS 18.

12 Jun 2009
Recover BBOBS25, BBOBS26. Attempt recovery BBOBS30, abandon instrument. Begin transit to Multibeam area.

13 Jun 2009
Surveyed multibeam area SW of Taiwan. Transit in to Kaohsiung.

Table 1. Coordinates of BBOBS deployment, ranged and MGL0907 recovery locations.

Sta.	Deployed[1]	Ranged[2,3]	Recovered[4]
1	24°19.215'N 122°00.884'E	24°19.298'N 122°01.067'E, 2878 m	24°19.605'N 122°01.240'E
2	24°09.630'N 122°14.150'E	24°09.876'N 122°14.374 E, 2312 m	24°10.361'N 122°14.474'E
3	24°01.439'N 122°30.612'E	24°01.660'N 122°30.937 E, 3632 m	Not recovered
4	23°53.110'N 122°42.017'E	23°53.066'N 122°42.398 E, 3659 m	23°53.548'N 122°42.251'E
9	23°37.820'N 121°48.007'E	23°38.213'N 121°48.118 E, 3710 m	23°38.574'N 121°47.802'E
10	23°36.700'N 122°06.328'E	23°37.062'N 122°06.247 E, 3175 m	23°37.752'N 122°06.544'E
11	23°30.290'N 122°24.910'E	23°30.389'N 122°24.773 E, 3352 m	23°30.763'N 122°25.401'E
12	23°24.305'N 122°41.413'E	23°24.352'N 122°41.230 E, 4139 m	23°24.551'N 122°41.496'E
18	23°10.039'N 122 00.851'E	23°10.409'N 122°00.821 E, 4248 m	23°11.204'N 122°02.159'E
19	23°05.228'N 122 09.206'E	23°05.486'N 122°09.048 E, 4966 m	23°05.897'N 122°09.407'E
25	22°50.128'N 121 32.539'E	22°50.110'N 121°32.593 E, 1755 m	22°50.188'N 121°32.829'E
26	22°42.308'N 121 51.272'E	22°42.488'N 121°51.325 E, 4379 m	22°43.439'N 121°52.505'E
27	22°28.198'N 122 15.874'E	22°28.354'N 122°15.847 E, 4714 m	22°28.387'N 122°15.970'E
28	22°20.675'N 122 29.073'E	22°20.794'N 122°28.958 E, 4876 m	22°20.984'N 122°29.511'E
30	22°14.693'N 121 45.279'E	22°14.572'N 121°45.327 E, 3834 m	Not recovered
33	21°58.234'N 120 06.238'E	21°58.186'N 120°06.332 E, 1243 m	21°58.359'N 120°06.331'E
35	21°55.190'N 122 06.296'E	21°55.379'N 122°06.429 E, 4794 m	21°55.803'N 122°06.315'E
37	21°40.156'N 119 29.824'E	21°40.189'N 119°29.725 E, 2785 m	21°40.129'N 119°29.098'E
38	21°36.603'N 120 07.769'E	21°36.570'N 120°07.728 E, 2738 m	21°36.760'N 120°07.266'E
39	21° 35.658'N 121 21.715'E	21°35.984'N 121°21.844 E, 2508 m	21°36.983'N 121°22.384'E

[1]From cruise report for R/V Melville Cruise MGLN-38MV by Kirk McIntosh, 3 April 2009.

Part IV MGL0908: TAIGER LEG 4

22 June 2009 to 25 July 2009

MGL0908 6/22/09-7/25/09

One purposes of this leg was to acquire OBS data along the primary TAIGER transects T1 and T2 south of Taiwan (long, east-west lines on the map in Figure 1). Due to typhoons and mechanical problems on the R/V Langseth, this activity took place in two stages, with a short port call in between. The trackline for the first part is shown in **YELLOW** and the track for the remainder of the cruise is shown in **GREEN** on the map in Figure 1. Work in this area also included additional MCS profiles across the Manila trench and Luzon volcanic arc. The other primary purpose was to acquire MCS, OBS, and potential field data across the poorly-surveyed northwestern portion of the Philippine Sea tectonic plate. We accomplished this by acquiring four, long northeast-southwest-oriented seismic profiles, including one instrumented with OBSs. We also took this opportunity to image the northern boundary of the Philippine Sea plate where it subducts beneath the Eurasia plate along the Ryukyu trench. We acquired four lines crossing this plate boundary zone. The total shotline length during this cruise was ~4570 km, of which ~4064 km of MCS data were acquired. There were 91 OBS stations deployed during this cruise.

Participants:

Hsu, Shu-Kun	Co-Chief Scientist	National Central University, Zhongli, Taiwan
McIntosh, Kirk	Co-Chief Scientist	University of Texas, Austin TX, USA
Tsai, Ching-Hui	Postdoc	National Central University, Zhongli, Taiwan
Yeh, Yi-Ching	Post-Doc	National Central University, Zhongli, Taiwan
Doo, Wen-Bin	Graduate Student	National Central University, Zhongli, Taiwan
Ku, Chia-Yen	Graduate Student	National Central University, Zhongli, Taiwan
Chen, Kuan-Ting	Graduate Student	National Central University, Zhongli, Taiwan
Sibuet, Jean-Claude	Professor	IFREMER, Brest, France
Eakin, Daniel H.	Graduate Student	University of Texas, Austin TX, USA
Reece, Robert	Graduate Student	University of Texas, Austin TX, USA
Marquez, Edanjarlo J.	Professor	Univ. of the Philippines, Quezon City, Philippines
Ramos, Estephanie	Graduate Student	Univ. of the Philippines, Quezon City, Philippines
Gabo, Jillian Aira S.	Graduate Student	Univ. of the Philippines, Quezon City, Philippines
Armada, Leo T.	Graduate Student	Univ. of the Philippines, Quezon City, Philippines
Lien, Wei-Chih	Military Observer	Taiwan

Cruise Narrative

18 June 2009
The original sailing time was set for 02:00 UTC. However, our departure from Kaohsiung has been delayed due to Tropical Storm Linfa which is located ~350 nm WSW of Kaohsiung. Over the last 24 hours the center of TS Linfa has hardly moved. It is predicted to start moving to the NW – WNW and will begin to pickup wind speed. The current track takes the storm center very near to Kaohsiung on the 21st of June. The sail date will likely be after the 21st of June. This time will be adjusted accordingly with the Storm track and speed. Also a problem was detected in the starboard engine; there is a problem with system that governs the speed of the engine.

19 June 2009
We continued to stand by due to the approaching tropical storm. The technical staff completed repairs on the source GPS and acoustics—all four are now working. The engineers have continued trouble shooting the starboard engine governor. They have isolated the problem to the electrical side of the governor control.

20 June 2009
We continued to stand by due to the approaching tropical storm. The technical staff began repairs of all streamer birds that had developed issues during MG0905 and MGL0906. Robert Steinhaus conducted Science Party Orientation for watch standing and logging procedures.

21 June 2009
We continued to stand by due to the approaching typhoon Linfa. Preparing to leave on 22 June.

22 June 2009
We left port at 01:05 UTC (09:05 local time). Seas were somewhat rough and slowed progress to the survey area. By late afternoon (08:00 UTC) we started deploying the source array. We reached the starting waypoint MGL0908-1 at 19:43 and turned onto the first line. This line was populated by 12 Scripps OBSs on the west half of the line. We shot source-only, using a 150 m shot interval and a target speed of 5 kts, for ~1 minute shot time intervals.

23 June 2009
We continued shooting to the OBSs on line MGL0908-01 until 20:23. This point was ~60 km past the last OBS—a distance selected to provide some deeper/farther arrivals to instruments on the east side of this array. We plan to return to this line with NTOU OBS to shoot the east side of the line and the east part of MGL0908-5. Over the final 13 hours of this line we used only 3 array strings due to failure of string 4. At 20:23 we turned south-southeast headed for a point on MGL0908-5. This point was ~36 km east of the last OBS deployed on the west part of MGL0908-5.

24 June 2009
The source tech team was still working on string four as we approached line MGL0908-05. This caused a delay in starting on MGL0908-05. We turned onto this line at 20:23 and continued through the remainder of the day.

25 June 2009
We continued to shoot to the OBSs on line MGL0908-05 until we reached the end of the line at 19:00. We immediately turned north and shortly started to recover the source array. By 21:00 the array was recovered and we were transiting at ~10 kts toward Kaohsiung. At this point we were trying to outrun tropical storm Nangka. Seas became somewhat rougher through the end of the day, but were not severe.

26 June 2009
Still in transit back to Kaohsiung. We hope to make the engine repairs quickly and leave as soon as weather permits. By 12:47 we were secured at the pier in Kaohsiung. The engine technician started work right away.

27 June 2009
Most of the day was spent finishing engine repairs and testing. We departed Kaohsiung harbor at 22:00 (06:00 local) and headed for the deployment area. In transit at the end of the day.

28 June 2009
We arrived southwest of the first line at 02:17 and started to deploy the streamer heading southeast. As the streamer was about halfway deployed we turned to the northeast at a distance of about 14 km from the intended line. We deployed the airguns and finished ramp up at 10:36. There were many errors and line starts and restarts. Acquisition finally settled down at 12:31. Line MGL0908_1A was started at 16:07, but during the line change source string 2 failed catastrophically with a bundle blowout. We shot the remainder of the line with 3 source strings. Line MGL0908_1A was shot the remainder of the day. In addition, preparations were made to use the old string 2, which had been used in leg 2, to replace the blown string.

29 June 2009
We finished line MGL0908_1A at 06:17. After this some repairs were required on the air lines. We elected to continue traveling on the short connector line while the repair was being made. After the repair we acquired MGL0908_2 for a length of ~10 km. This line was finished and we turned onto MGL0908_3 at 10:03. Data on MGL0908_3 was acquired throughout the rest of the day.

30 June 2009
Line MGL0908_3 was completed at 07:11. We turned directly onto MGL0908_4 (inside turn) and continued on this line throughout the day. This line is oriented SW to NE to cross the accretionary prism at ~perpendicular orientation.

1 July 2009
We continued shooting MGL0908_4 until 13:33. We turned directly onto MGL0908_5A and continued shooting throughout the rest of the day. This line crossed the volcanic arc, the southernmost Huatung basin, and the Gagua ridge.

2 July 2009

At the start of the day we were continuing to shoot MGL0908_5A. We finished this line at 10:48 and turned on to MGL0908_6, headed south, about 30 km east of Gagua ridge. While we were on line MGL0908-06 we picked up Source Sub-Arrays 1 & 2 to make repairs on S1G02 and to do other preventative maintenance. Once Sub-Arrays 1 & 2 were re-deployed and in operation, we retrieved Sub-Array 3 to change out the nose piece on the float as it had a small whole and had been taking on water. With these repairs most of MGL0908_06 was acquired with a less than full volume source. On completion of MGL0908_06 we made another short line change onto MGL0908_07 at 18:52, which was continued through the day.

3 July 2009
We completed MGL0908_07 at 17:40 and turned northwest onto MGL0908_08. This line was shot with MCS parameters but with a relatively unfavorable orientation to the prism structure. We continued on this line throughout the rest of the day. Weather was excellent.

4 July 2009
No fireworks for the Langseth, but another good day of acquisition with excellent weather. We continued with MGL0908_08 until starting the turn onto MGL0908_09 at 12:28. This new line is the continuation of transect T2, and we should be shooting to ~21 OBSs from the Hengchun ridge to east of the Gagua ridge. We continued on MGL0908_09 through the day with some variations in speed due to variations in the currents.

5 July 2009
We started the day on MGL0908_09 headed east. Again we experienced significant variations in current speed and direction. Near mid-day we were getting a strong current from the SW giving us good speed over the ground but extreme streamer feathering of nearly 45˚. We also experience some interesting results with the XBTs at this time, with multiple layers of water clearly visible.

6 July 2009
Unfortunately the currents seemed to be largely against us with our speed over the ground under 4 kts for long periods. We eventually finished MGL0908_09 at 08:02 and we turned northeast onto MGL0908_10. This line will investigate structure and stratigraphy of the northwest part of the Philippine Sea plate. We continued on this line through the rest of the day.

7 July 2009
We completed MGL0908_10 at 01:53 and turned north onto MGL0908_11. This line crosses the Ryukyu trench where it reaches ~6500 m depth. We completed MGL0908_11 at 19:37, turning east-northeast onto MGL0908_12. This line crosses the landward part of the forearc basin along the Ryukyu arc-trench system. Along this line the MMO's spotted a group of sperm whales. They were out of the safety radius so no shutdown was necessary. However, due to the fact that these whales were seen within the 160 dB zone (6 km in the deep water area), this was considered a take X 5 (whales). This meant that we had now exceeded our take limit, which had been set ridiculously low at 4! We now had to get instructions from Lamont and NMFS about how to continue.

8 July 2009

We continued along MGL0908_12. We experienced source problems on this line and decided to continue with partial source to avoid using time for source maintenance on the turn. This line progressed along the landward part of the forearc basin. We completed the line at 07:25 and turned south onto MGL0908_13. This line crosses the forearc again and continues south to the trench and far beyond. Source sub-array 2 developed a leak, but was still maintaining pressure so we decided to continue on until the end of the line, south of 23˚N, or catastrophic failure.

As the sperm whale story played out we were instructed to treat the 160 dB radius as the shutdown radius for sperm whales. We have not been given further information about whether the take number will be increased.

9 July 2009
We continued on MGL0908_13 until 22:07 and turned SW to MGL0908_14. The previous line took longer than expected due to strong current with a northward component. We also experienced somewhat rougher seas than we have had for a while. There is a tropical depression northeast of Luzon (headed northwest) that is stirring things up. We don't expect an interruption in the work for this storm. At the end of MGL0908_13 we finally brought in source string 2 to repair the leak. Unfortunately, the leak was a catastrophic failure to the source bundle—a big hole in it. We have gone through all the spares and now we will have to continue on 3 strings.

10 July 2009
We proceeded along MGL0908_14 most of the day, finishing at 21:39, turning onto MGL0908_15 at 21:42. We had some more bad news today with the source bundles; string 3 has a significant rip in the outer covering, thus it is expected to blow at any time. There is some good news in this area, however. The new bundle, which had previously gotten its bell housing flooded, has now been rewired and the culprit pressure-relief valve has been plugged to avoid a repeat. This bundle will be tested on 11 July, hopefully in time to replace string 3, or even before it fails, getting us back to 4 strings again.

11 July 2009
We have been working with the MMOs to push Lamont to request an increase in the take numbers of sperm whales. As we are returning to near the previous sighting location, we would like to have an increased take number before we get back there. We are suggesting an increase by 16, which with the original 4, would equal 20 total takes. Our acquisition continued on MGL0908_15 until 04:26 when we turned onto MGL0908_16. This new line is headed northeast and will extend to the Ryukyu trench. Amazingly, the repaired source bundle has worked well since deployment AND the damaged bundle still has not ruptured, so we have been working with 4 strings again for much of the day. The other issue today has been the deteriorating weather. We were aware of a tropical depression to our southeast, but it was not flagged as being a serious problem in any of the weather information sources. However, the wind has continued to increase to 20+ kts and wave height is in the 2+ m range.

12 July 2009
As noted, the weather has deteriorated a bit further, with winds now reaching 30+ kts and some significant waves at times. The going has been a little tough and all moveable items have had to be secured. In the mean time the Joint Typhoon Warning Center has now upgraded this storm to

be favorable for tropical cyclone development. It is still located to our southeast, but sometime today should approach a due south position. Impressively, we have been able to continue data acquisition through this, as our line is oriented away from the storm path and has continued to be an acceptable direction with regard to winds and waves.

We continued on MGL0908_16 through most of the day, finishing at 21:49. Our turn onto MGL0908_17 is to the southeast. For the last part of line 16 we have been mostly in the trough of the swells, getting rolled a fair amount. Now we will be going almost straight into the swells giving us a strong pitch. To make this transition we lowered the streamer to 15 m. Even so, part of the streamer came to near the surface and Robert had serious doubts about whether we would be able to acquire data in this orientation. As we finished the turn, the streamer stabilized at 15 m, although there was still some significant noise. We decided to leave the streamer at that depth for the entire line due to the large swells.

13 July 2009
We continued acquiring data on MGL0908_17 until 11:29 when we turned to the northwest onto MGL0908_18. This new line will be the easternmost crossing of the Ryukyu trench in our project, and it will be the end member of a huge range varying transects along the arc-trench system. The turn onto this line finally gave us relief from the swells. At this orientation the swells came from the port/stern quarter resulting in much milder movements. By this time the storm was also moving well to the west of us also reducing its impact.

The data processing has been going well and we have been able to keep up with the incoming data sets. The west Philippine basin (WPB) lines have proven to be fairly difficult so far. They have generally rough seafloor with minimal sedimentary cover and there are many seamounts. MGL0908_14 has not revealed a clear Moho reflection, nor much in the way of clear crustal reflectors. Instead we are mostly limited to the rough seafloor and lots of diffractions.

14 July 2009
Acquisition on MGL0908_18 continued until 11:03, when we started the turn to a SSW direction onto MGL0908_19. This line crosses the forearc, a 2000-m-deep, terrace-like morphology, largely devoid of significant sediment accumulation. This line will then cross the trench-slope obliquely, intersecting our previous line, MGL0908_13, at about 4000 m depth on the way to the trench at > 7000 m. We continued MGL0908_19 through the rest of the day.

15 July 2009
At 00:12 we ended MGL0908_19 and made a small turn (about 15 degrees) onto MGL0908_20. This line change occurred in the middle of the trench slope at ~4000m depth. This line continued across the deep trench and encountered the first OBS at ~22.75˚N. This line is being shot at 100 m spacing as a compromise for OBS and MCS acquisition. Timing between shots is expected to be between 35 and 55 seconds depending on whether the currents are with us or against us.

The major issue facing us now is a new tropical depression building to the southeast of us. This large system had been moving west heading for the southern Philippines, but it made a turn to the northwest and is now predicted to shoot the gap between Philippines and Taiwan—also our

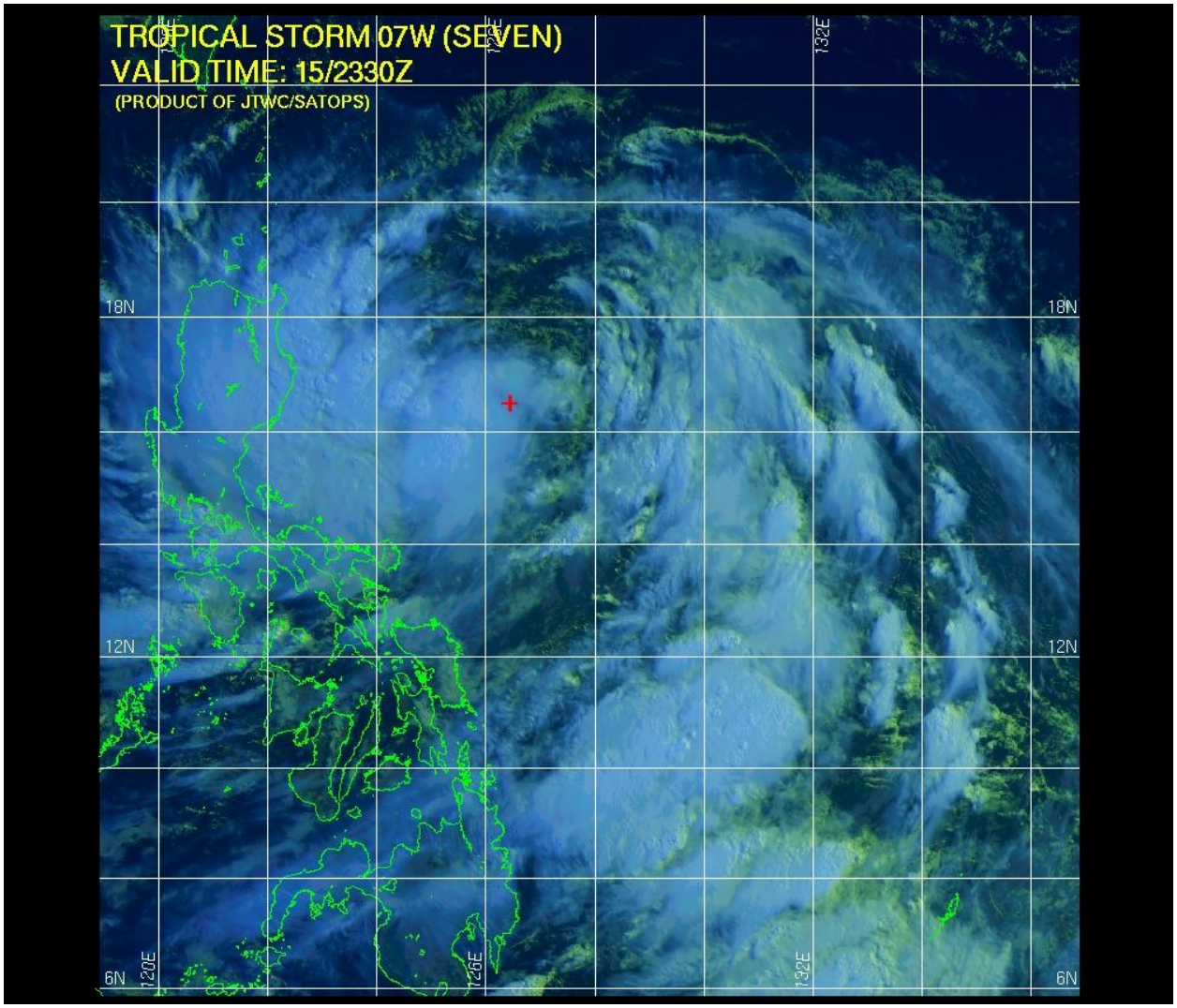
target area. We have now decided to break off the data acquisition at 22:09 (6:00 am local, 16 July), recover the airguns and streamer and head northeast to wait out the storm.

The plan was reconsidered and instead of recovering the equipment, we simply turned north from the vicinity of OBS5 and set a course for waypoint 11. This occurred at 22:09 and marked the start of MGL0908_10A.

16 July 2009
Our intention, after discussions with Shu-Kun, was to take a NNE course after WP11 and head for a point on previously acquired MGL0908_12 at 125˚E. If we made it that far then we would presumably turn back on a meridian course (125˚E) and subsequently rejoin MGL0908_20 after the storm, now #07, passed.

We arrived at WP11 at 04:40 and made a starboard turn onto MGL0908_11A, headed for WP12A. We continued this course for only about 4 hours. At 08:28 tropical storm #07 was due south of us and headed west. It was decided to turn back and attempt to resume OBS line MGL0908_20. We headed SSE on MGL0908_32 starting at 09:21 and continued until intersecting MGL0908_20 at 18:01. As we got on line again we started MGL0908_20A at 18:57.

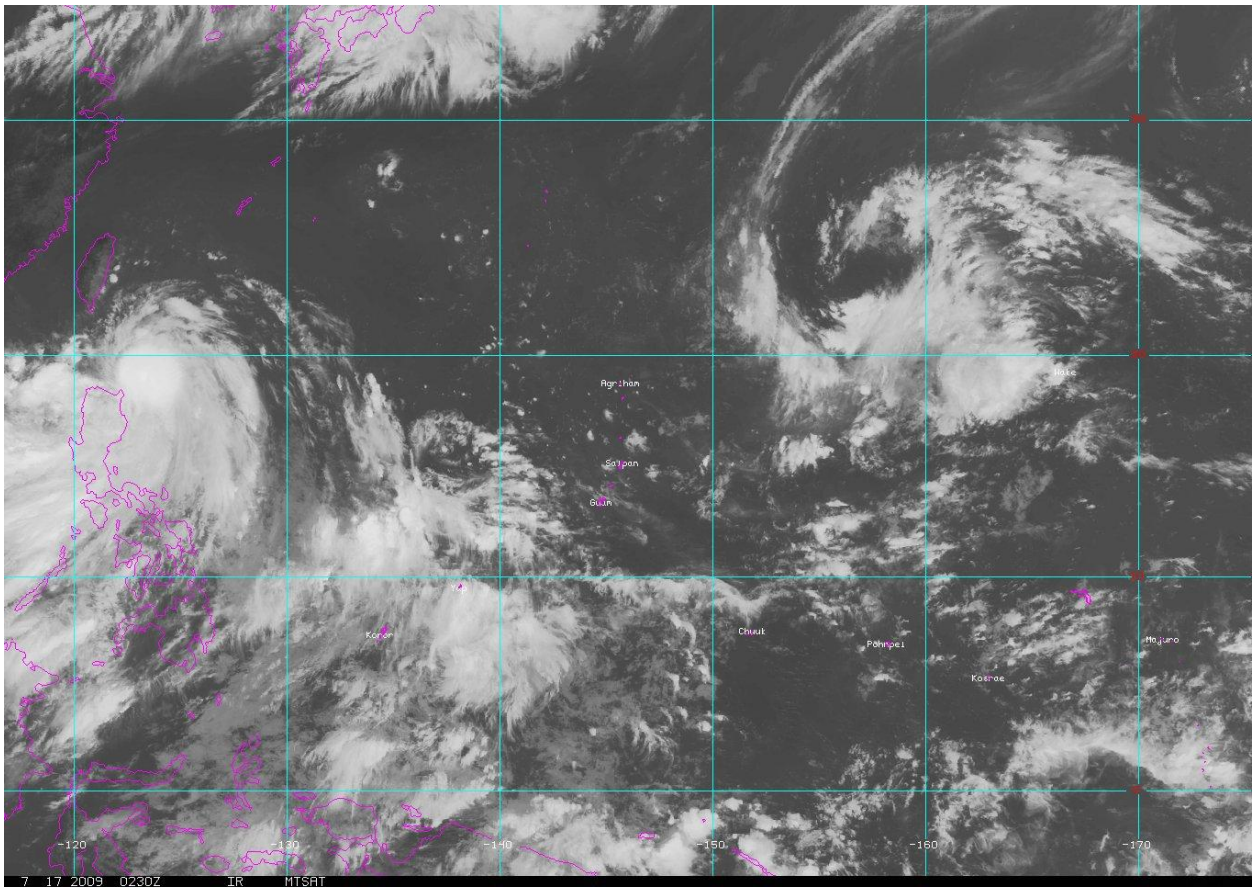
As we discovered later, we apparently turned back to the line prematurely. Tropical storm #7 continued to strengthen and became TS Molave, eventually becoming typhoon Molave. We continued acquiring data along MGL0908_20A even though conditions were quite poor: winds 30-45 kts and waves estimated as high as 9 m!



Satellite view of typhoon "Molave" on 16 July 2009. We were located in the far northeast part of our survey area along the Ryukyu trench (also northeast of the typhoon), but we were still pounded pretty hard.

17 July

Despite the conditions we continued acquiring data until 06:47. However, due to the increasing strength of Molave, it was clear that we could not continue acquiring data. Initially the plan was to bring in three source arrays and leave the streamer and one source array out so that we could resume acquisition when weather became more acceptable. During the source array retrieval the starboard engine experienced an emergency shutdown and killed the hydraulics being used. When the engine was restarted, the retrieval continued and strings 2, 3, and 4 were recovered. The PAM was not working at that time and when recovery was attempted it was no longer there and assumed lost at sea.



Satellite view of typhoon "Molave" on 17 July 2009. We were located in the far northeast part of our survey area along the Ryukyu trench (also northeast of the typhoon).

As the day continued the weather did not improve, so it was decided to also recover string 1. After this was completed there was another emergency engine shutdown, again related to an oil mist sensor. The engineers decided to recalibrate these sensors and kept the starboard engine off for about 1 hour. Unfortunately, there was more than a sensor problem. After the engine was put back online both main engines started experiencing cooling problems. We were forced to reduce speed through the water to avoid overheating the engines. The available speed was not sufficient to tow the streamer, so it was decided to recover the streamer. This process started at 15:41 and was completed at 18:58, despite the continuing rough weather. At the end of this recovery, when the head float was recovered, we discovered that the PAM had not been lost, but had become entangled on the streamer.

With the streamer in, the engineers were able to diagnose the cooling problem. It turned out that plastic material that had been in the seawater had been sucked into the system and was restricting water flow and cooling. Once the plastic was cleared the engines seemed to be back to normal.

18 July 2009
As the engine repairs seemed to solve the problem, we turned back to the north to ultimately resume MGL0908_20. The trip north was done at high speed to test the engines and they performed normally. The weather gradually improved as well. Tropical storm Molave was now west of Taiwan, although it had strengthened to just shy of typhoon strength.

At 06:30 we started to deploy the streamer and completed this by 13:25, with a few more sections swapped in the process. The source deployment started at that point. During deployment, string 3 blew a hole in the umbilical and had to be recovered. At this point there were no more spares, so we are down to three strings for the duration of the cruise. We got back on line and started acquiring MCS/OBS data at 14:48, the start of MGL0908_20B. This was at SP 3336, well NE of where we ended earlier, so we did infill (repeat shooting) from there to SP3511. At 17:22 we reached SP3512 and continued the line through the remainder of the day without incident. The seas were still a bit rough but continued to improve through the day. We kept the streamer at 10 m depth, at the start for swell noise reduction and later to maintain a consistent response.

19 July 2009
We continued acquiring MCS/OBS data along MGL0908_20B throughout the day without incident. The seas continued to diminish with winds finally coming below 20 kts. To save time it was decided to end the line somewhat north of the original waypoint, but past all the OBSs, and then simply turn to the NW. This way the planned east-west transect at 19˚ 51'N would be intersected near the crest of the volcanic arc.

20 July 2009
After three tries and many days we completed the WPB OBS line, the last segment being MGL0908_20B, at 08:39. We then turned to the west-northwest onto MGL0908_21. Currents were favorable; in fact we missed a number of shots when our speed over ground exceeded 6 kts on a few occasions. This line was completed at 18:18 as we turned due west onto MGL0908_22. At this point we were at the crest of the Luzon arc and headed for the Luzon trough forearc basin. We continued on this line through the remainder of the day.

The other activity that took place was to bring in source string 2 and swap it with string 3. Once the string 3 was connected to the old string 2 umbilical it was redeployed. This seems to have solved the communications problem that had been going on with string 2 for quite awhile. Subsequently the operation of the 3 source strings has been extremely consistent.

21 July 2009
Acquisition continued on MGL0908_22 throughout the day as we passed from the arc to the forearc, Manila trench, and imaged the subducting Eurasia plate. The 3 source strings worked well, but we will have to see how much the penetration has been reduced due to the lack of the full, 4-string array. Overall the currents were somewhat favorable and we were able to complete the line just at the end of the day.

22 July 2009

We turned back to the southeast onto MGL0908_23 at the start of the day. This line and the subsequent lines are intended to provide additional crossings of the Manila trench and to also attempt to identify deformation related to the continuation of the Philippine fault north of Luzon.

We had the additional excitement of experiencing a partial solar eclipse. Early in the day (about 9:30 am local time), we were able to view the eclipse through a sextant and with a pinhole projection. At our location the eclipse was about 2/3, although this was not enough to become very noticeably darker.

At 17:40 we turned south onto MGL0908_24. This line is along the margin of the volcanic arc, which is quite wide at this point.

MGL0908_24 was not destined to be a good line. This southward line passed not far west of two islands separated by ~14 km. MGL0908-24 was ended early due to the vessel & streamer hitting a very strong rip current (+4kts) from between the islands, which pushed the vessel off line ~2200m before it could be brought back. This same rip current cause the streamer to sink to ~80m at the tail before 4 SRD's (Streamer Recovery Devices) deployed and brought it back to the surface. See below picture which shows both the vessel being pushed of line as well as the streamer shape from the current pushing it.

Eventually the streamer straightened out and we were able to make it back close to the line. By this time we were nearly to waypoint 25 and subsequently turned onto MGL0908_25. This line could only be recorded well by the near ~5 km of the streamer as the SRDs had brought the far streamer section to the surface. We continued this line to the end of the day.

23 July 2009

We continued along MGL0908_25 until 06:05, reaching longitude of 120˚ 30'E, over a portion of the Luzon trough. Immediately the source strings were recovered. After a wait to avoid a fishing vessel, we started to recover the streamer at 08:13. This process went smoothly and was completed by 10:20. At this time we began our transit to Kaohsiung.

Leg 4 (MGL0908) Line List

Line	Shot	Year	JDay	Time	Latitude	Longitude	W_Depth
MGL0908_TST	2717	2009	179	10:38	21.787500	120.102667	1902
MGL0908_TST	3393	2009	179	16:07	21.997167	120.579000	408
MGL0908_1A	957	2009	179	17:40	22.100000	120.524000	481
MGL0908_1A	3401	2009	180	6:16	21.611167	119.487833	2906
MGL0908_2	1220	2009	180	7:36	21.610000	119.485000	2905
MGL0908_2	1677	2009	180	10:02	21.602667	119.158667	2715
MGL0908_3	1021	2009	180	10:03	21.610000	119.150000	2693
MGL0908_3	4400	2009	181	7:11	20.075733	119.169383	3020
MGL0908_4	1061	2009	181	7:13	20.055000	119.150000	2990
MGL0908_4	6531	2009	182	13:33	21.233500	121.489167	1180
MGL0908_5A	1009	2009	182	13:36	21.234000	121.489000	1183
MGL0908_5A	4586	2009	183	10:48	21.229350	123.215733	5656
MGL0908_6	1015	2009	183	10:51	21.234000	123.226000	5673
MGL0908_6	2453	2009	183	18:52	20.578333	123.219450	4946
MGL0908_7	1008	2009	183	18:55	20.566700	123.226000	4910
MGL0908_7	2388	2009	184	17:41	20.568167	121.232567	3673
MGL0908_8	1090	2009	184	18:07	20.566700	121.230000	3670
MGL0908_8	3996	2009	185	12:28	21.408883	120.102738	2873
MGL0908_9	1049	2009	185	12:32	21.424200	120.037000	2898
MGL0908_9	3504	2009	187	8:09	21.413483	123.658400	5477
MGL0908_10	1020	2009	187	8:12	21.408000	123.658000	5487
MGL0908_10	4154	2009	188	1:41	22.625767	124.449067	5789
MGL0908_11	1041	2009	188	1:54	22.625000	124.450000	5789
MGL0908_11	4040	2009	188	19:35	23.997033	124.454117	2226
MGL0908_12	1009	2009	188	19:37	24.000000	124.450000	2212
MGL0908_12	3260	2009	189	7:25	24.432650	125.456533	5760
MGL0908_13	1051	2009	189	7:51	24.450000	125.495750	5760
MGL0908_13	6125	2009	190	22:07	22.136650	125.498983	5475
MGL0908_14	1060	2009	190	22:28	22.136750	125.500117	5543
MGL0908_14	4955	2009	191	21:39	20.595533	124.537567	5564
MGL0908_15	1007	2009	191	21:42	20.591000	124.538000	5524
MGL0908_15	2039	2009	192	4:26	20.594733	124.040167	5789
MGL0908_16	1097	2009	192	4:53	20.591000	124.004000	5788
MGL0908_16	8110	2009	193	21:50	23.311550	125.830700	5977
MGL0908_17	1010	2009	193	21:51	23.320383	125.831533	5954
MGL0908_17	2939	2009	194	11:30	23.111700	126.717050	5608
MGL0908_18	1197	2009	194	12:23	22.984000	126.772000	5460
MGL0908_18	4724	2009	195	11:03	24.445267	125.870050	5766
MGL0908_19	1102	2009	195	11:44	24.495000	125.839000	5468
MGL0908_19	3064	2009	196	0:12	23.617317	125.499850	4295
MGL0908_20	1002	2009	196	0:12	23.617133	125.500000	4321
MGL0908_20	2888	2009	196	22:09	22.164100	124.539350	1866
MGL0908_10A	1010	2009	196	22:45	22.177967	124.498250	1876

Line	Shot	Year	JDay	Time	Latitude	Longitude	W_Depth
MGL0908_10A	2005	2009	197	4:37	22.625033	124.450350	3389
MGL0908_11A	1011	2009	197	4:44	22.629367	124.451233	3379
MGL0908_11A	1536	2009	197	8:28	22.855400	124.528233	1023
MGL0908_32	1010	2009	197	9:21	22.804950	124.541767	947
MGL0908_32	2250	2009	197	18:01	22.268000	124.531900	1872
MGL0908_20A	2751	2009	197	18:03	22.265950	124.615200	5671
MGL0908_20A	3511	2009	198	6:47	21.681433	124.229433	5750
MGL0908_20B	3336	2009	199	14:48	21.816683	124.316983	5734
MGL0908_20B	6486	2009	201	8:38	19.376600	122.762750	4370
MGL0908_21	1027	2009	201	8:46	19.364800	122.761000	4332
MGL0908_21	2900	2009	201	18:18	19.829033	121.999967	1832
MGL0908_22	1008	2009	201	18:20	19.830000	122.000000	1829
MGL0908_22	5895	2009	202	23:37	19.822783	119.664200	3440
MGL0908_23	1342	2009	203	7:02	19.830000	119.500000	4181
MGL0908_23	4515	2009	203	17:38	19.278400	121.069967	1422
MGL0908_24	1007	2009	203	17:40	19.279000	121.076000	1375
MGL0908_24	1658	2009	203	22:22	18.982017	121.069167	1239

OBS Location Listings By Transect:

Transect T1

T1_03	119.37505	20.56517
T1_05	119.56640	20.56358
T1_07	119.75745	20.56172
T1_08	119.86557	20.56363
T1_09	119.95748	20.56395
T1_10	120.05893	20.56683
T1_11	120.14502	20.56920
T1_12	120.23883	20.56967
T1_13	120.33325	20.57007
T1_14	120.43398	20.57627
T1_15	120.52320	20.57563
T1_16	120.62860	20.57295
T1_17	120.71540	20.57445
T1_18	120.80680	20.57988
T1_19	120.90825	20.57237
T1_20	120.00687	20.57760
T1_21	121.10530	20.57718
T1_22	121.19367	20.57677
T1_27	122.53242	20.56823
T1_28	122.62275	20.57708
T1_29	122.71706	20.56990
T1_30	122.80881	20.56891
T1_32	122.98683	20.55953
T1_33	123.09969	20.55659
T1_34	123.17497	20.52120

Transect T2

T2_16	120.617	21.4253	-648
T2_17	120.472	21.4309	-175
T2_18	120.325	21.4269	-2628
T2_19	120.176	21.424	-2808
T2_20	120.034	21.4243	-2928
T2_21	119.888	21.4224	-3071
T2_22	119.742	21.4192	-3242
T2_23	119.599	21.4188	-3130
T2_24	119.455	21.4254	-2994
T2_25	119.31	21.421	-2988
T2_26	119.165	21.419	-2791
T2_27	119.022	21.4146	-2893

NTOU_01	123.094	21.4188	-5604
NTOU_02	122.779	21.4288	-4200
NTOU_03	122.688	12.4263	-4473
NTOU_04	122.587	21.4243	-4776
NTOU_06	122.353	21.4227	-4821
NTOU_07	122.205	21.4273	-4494
NTOU_08	122.059	21.4284	-3269
NTOU_09	121.912	21.43	-3063
NTOU_10	121.766	21.4176	-2377
NTOU_11	121.623	21.4239	-1115
NTOU_12	121.478	21.4337	-1995
NTOU_13	121.382	21.4249	-2027
NTOU_14	121.29	21.433	-2316
NTOU_15	121.194	21.4231	-2276
NTOU_16	121.002	21.4357	-1317
NTOU_17	120.905	12.4323	-369
NTOU_18	120.811	21.4251	-466

Transect T3

T3_03	119.185	22.8041	
T3_06	119.221	22.5614	
T3_08	119.263	22.2939	
T3_10	119.304	22.0269	
T3_11	119.320	21.8947	
T3_12	119.342	21.7633	
T3_15	119.405	21.3598	
T3_16	119.426	21.2274	
T3_17	119.442	21.0924	
T3_18	119.463	20.9599	
T3_19	119.484	20.8241	
T3_20	119.503	20.6902	
T3_21	119.524	20.5574	
T3_22	119.543	20.4238	

Transect T4A

T4W_1	119.440000	22.715300	-152
T4W_2	119.587000	22.713000	-132
T4W_3	119.734000	22.712800	-274
T4W_4	119.879000	22.714900	-258
T4E_01	123.653	22.7182	-6003
T4E_02	123.501	22.7195	-5731
T4E_03	123.356	22.7193	-5520
T4E_04	123.209	22.7210	-5776

T4E_05	123.069	22.7222	-5586
T4E_06	122.923	22.7242	-3809
T4E_07	122.775	22.7252	-5099
T4E_08	122.627	22.7300	-5199
T4E_09	122.481	22.7242	-5289
T4E_10	122.335	22.7276	-5116
T4E_11	122.188	22.7344	-4897
T4E_12	122.043	22.7248	-4667
T4E_13	121.901	22.7310	-4366
T4E_17	121.360	22.7292	-1130

Transect T5

T5_K1	122.9977	23.2348	-6054
T5_K2	123.1372	23.1930	-5533
T5_K3	123.3045	23.1428	-6226
T5_K4	123.4207	23.1080	-6226
T5_K5	123.5555	23.0675	-6315
T5_K6	123.6996	23.0243	-6316
T5_1	122.8680	23.2770	-5456
T5_2	122.7290	23.3190	-4571
T5_3	122.5890	23.3609	-4433
T5_4	122.4490	23.4027	-4275
T5_5	122.3090	23.4443	-4539
T5_6	122.1690	23.4858	-4626
T5_7	122.0290	23.5272	-4072
T5_8	121.8890	23.5685	-4554
T5_9	121.7490	23.6096	-3796
T5_10	121.6560	23.6370	-1483

Transect T6

02	123.588	23.4904	-3705
03	123.466	23.5611	-2988
04	123.335	23.6294	-4302
05	123.201	23.7105	-4578
07	122.943	23.829	-3643
08	122.817	23.9044	-3618
10	122.567	24.0501	-3442
11	122.436	24.1185	-2239
12	122.31	24.1886	-1799
13	122.176	24.2635	-2691
14	122.059	24.3199	-3032
15	121.932	24.3873	-2124

MGL0906_12B

01	122.7408	25.0562
02	122.6848	24.9281
03	122.6384	24.8011
04	122.5922	24.6756
05	122.5506	24.5613
06	122.4968	24.4150
07	122.4730	24.3528
08	122.4508	24.2883
09	122.4278	24.2250
10	122.3984	24.1613
11	122.3840	24.1106
12	122.3574	24.0347
13	122.3340	23.9700
14	122.3094	23.9064
15	122.2850	23.8410
16	122.2640	23.7748
17	122.2390	23.7109
18	122.2150	23.6479
19	122.1708	23.5191

MGL0905_27

01	119.636000	21.024100	-3167
02	119.770000	21.095300	-3314
03	119.921000	21.173700	-3459
04	120.097000	21.265200	-2792
05	120.237000	21.344400	-2978
06	120.315000	21.385900	-2708
07	120.384000	21.417300	-2699
08	120.459000	21.458600	-1673
09	120.528000	21.497700	-1876
10	120.610000	21.541500	-1195
11	120.675000	21.578000	-1004

MGL0906_10

02	122.2520	25.8167	-110
03	122.1550	25.6697	-133
06	121.9990	25.4390	-147

MGL0908_20

P03	124.90614	22.72430
P04	124.83202	22.60847
P05	124.75918	22.49068
P06	124.68088	22.37798
P07	124.60661	22.26260
P08	124.52861	22.14514
P09	124.45251	22.02912
P10	124.37938	21.91604
P11	124.30775	21.80114
P12	124.23071	21.68606
P13	124.15747	21.56982
P14	124.08326	21.44966
P15	124.00665	21.33758
P16	123.93475	21.22326
P17	123.86032	21.10618
P18	123.78778	20.99289
P19	123.71225	20.87332
P20	123.63545	20.75847
P21	123.56473	20.64126
P22	123.49022	20.52804
P23	123.41817	20.41243
P24	123.34512	20.29445
P25	123.27082	20.17943
P26	123.19697	20.06339
P27	123.12446	19.94603
P28	123.05180	19.82725
P29	122.97853	19.71131
P30	122.90495	19.59698

Miscellaneous Acquisition and Processing Information

Lamont extended SEGD header information

Syntrak only:

`-port <number>` Selects the serial port from which to transmit the header, where `number` is from 0 to 6. If this option is omitted, the header is transmitted from the RTN⌠'s 'Header' port (port 0).

`-19200` Sets the baud rate to 19200. If this option is omitted, the header is transmitted at 9600 baud.

`-noraw` Tells the header to return only navigation data. The default is to look for gun data.

`-nodecode` Tells the header to skip the preprocessing of the gun data. This results in output identical to the `genhdr` process. See below for full details of output formats. The default is to process.

`-nowakeup` Tells the header not to produce headers when off-line. The default is to produce a navigation-only header approximately every 10 seconds.

Output formats

`Genhdr` 'local' output consists of the navigation section followed by the timing section (if requested) then the unformatted gun data. 'Remote' output consists of the navigation and timing data only. `Syntrak` outputs the 'local' header if the `-nodecode` option is used.

`Psihdr` and normal `syntrak` output consists of the navigation section followed by the formatted gun data sections. Only the navigation plus the first gun data section are transmitted for the 'remote' header.

`Psihdrds` output consists of the same as `genhdr`. Two complete headers are transmitted back to back every second shot.

An '`a`' represents a text character, an '`n`' represents a number.

Navigation Section:

Definition Format Description

Header ID aa '$1'
Length nnnn Length of header excluding this field
and the 'Header ID' field
Program Revision aaaa '0001' or '0002'
Line Status nn 01=Offline 02=Approach
03=Online 04=Runout
Shot Time: nn
nn
Hours

Minutes
General header/PSI Header/Syntrak Header Header Outputs Reference
10 SHARED/Headers/Acrobat9
nn
.nnnnnn
nnnn
nn
nn
Seconds
Microseconds (optional)
(see `-second` option)
Year
Month
Day
Time Ref aaa 'UTC'
Shot Number nnnnnn
Line Name aaaaaaaaaaaaaaa
Master Latitude nnnn.nnnnnn In degrees
Master Longitude nnnn.nnnnnn In degrees
Water Depth nnnn.n In metres
Source Latitude nnnn.nnnnnn In degrees
Source Longitude nnnn.nnnnnn In degrees
Master Gyro nnn.n In degrees
Master CMG nnn.n In degrees
Master Speed nn.n In knots
Total size of above is 122 bytes, or 115 bytes with the microseconds field omitted. See the `-second` command line option
Program Revision is '0002' if microseconds are present, '0001' otherwise.

Optional timing section:

The following section is repeated a minimum of 6 times and a maximum of 10 times if timing arguments are used (`-tr_time, -rawname, -ttname).`

Definition Format Description

Trigger Name aaaaaaaaa Truncated to 10 characters.
Trigger firing time nnnnnnnn Time of trigger realtive to the shot firing time – i.e. trigger firing time minus
actual shot time in microseconds.
Triggers that fire after the shot have a positive time and triggers that fire before the shot have a negative time. A value of –9999999 appears if any of the following are true:

- No/invalid data is available for that trigger.
- Data for that trigger is stale (it is an old shot).
- Shot time exceeds upper and lower limits of 99999999 and –9999999.

Total size of the above is 120 bytes, or 200 bytes if more than six triggers

are specified.

Formatted gun section:

Definition Format Description

Gun String ID aaaaaa '*GCS90'
Length nnnn Length of gun section including this field and the 'Gun String ID' field
Line name aaaaaa
Shot number nnnn
Active Array mask nn
Trigger Mode a I = internal E = external

Definition Format Description

Only present with V2 Syntron gun data
Sequence number nn
Number of subarrays nnn
Number of guns nnn
Number of active guns nnn
Number of delta errors nnn
Number of autofires nnn
Number of misfires nnn
Delta Spread nnn
Volume Fired nnnnnn
Spare nnn…nnn 22 zeroes with V1 Syntron Gun Data, I4 with V2
Manifold pressure nnnn Only present with V2 Syntron Gun Data
Deep tow nnnn Only present with V2 Syntron Gun Data
Subarray pressure nnnn Only present with V2 Syntron Gun Data, this field is repeated for the number of subarrays given above.

Total size of above is 70 bytes for V1 Syntron data, and 74 bytes plus (number of subarrays x 4) bytes for V2 data.

This section is repeated for each gun in the array and is not present in the 'remote' output:

Definition Format Description

Port number nn Physical Port (Gun) Number
Gun mode a 'A' = auto 'M' = manual 'S' = spare 'O' = off
Detect mode a 'P' = peak 'Z' = zero crossing
Sequence Number n
Autofire a 'Y' = yes 'N' = No
Spare a ' '
Static Offset nnn in tenths of milliseconds
Gun delay nnn in tenths of milliseconds

Fire time nnn in tenths of milliseconds
Delta error nnn in tenths of milliseconds
Depth nnn in tenths of metres
Total size of above is 22 bytes.
The size of the version 1 header can be computed from:
Size = 122[115] + 70 + (Num Guns x 22)
For the version 2 header, the size can be computed from:
Size = 122[115] + 74 + (N Sub-Array x 4) + (Num Guns x 22)
For example, for a gun controller configured with 4 sub-arrays and 32 guns, the version 2 header size would be:
122 +74 + (4x4) + (32x22) = 916 bytes.
If you also included the optional timing section for 6 triggers in the above example, the header size would be:
122 + 120 + 74 +(4x4) + (32x22) = 1036 bytes.

MGL0905 TAIGER Leg 1 Disc Organization
Steffen Saustrup

This file is /home/focus/DOCS/taiger_disks.doc

This is how internal and external disks are organized on machine "taiger" on board R/V Langseth:

taiger is on the Langseth computer network with fixed IP address 192.168.3.80. The only other host on Langseth that we really need to see is "nas", IP address 192.168.3.42, which holds all of the shared seismic data, nav data, logs, etc. These two machines are listed in /etc/hosts; the original UTIG hosts file is in /etc/hosts.bak.

root password is "taiger"; focus password is "seismic". All processing, etc. is being done as user "focus". There's no real need for individual users.

/home/focus
This is the home directory for user "focus", probably the only user you'll need to use. Subdirectories are:

DOCS: All spreadsheets and descriptive documents (including this one) live here.
Epos3: This is the Focus installation. All of Focus code lives here.
IMAGES: Any screencaps or other images I create.
JOBS: All Focus job decks and "badchan" files.
PNS3TE: The working Focus database.
PROGS: All shell scripts and programs.
SIO: sioseis jobs and plotfiles.

taiger has 8 1.5-Tbyte internal disks in a RAID configuration and mounted as 2 directories (/tg1 and /tg2) with just less than 4 Tbytes each. I'm using these disk thusly:

/tg1:

CruiseData: Copies of all shared Langseth logs, nav, documents, etc. These are copied automatically by script rsync.csh. A new subdirectory will be created for each leg, just update the leg in rsync.csh.

focus: Focus output seismic data. In Focus module DSOUT, choose DPINDEX 0 if you want to write to this directory. Choose DPINDEX 1 to write to a similar directory on /tg2. I'm keeping shotgathers (after resample, BP filter), brute stacks, velocity stacks, and fkmig datasets in this directory.

nav: Onboard navigation file processing. Contains "sources" and "stations" files extracted from P190 files by my shell scripts. So far I'm not using these files for Focus geometry, as the 50 meter geometry is accurate, but the sources files are a handy distillation of all source locations, times, water depth, etc. Also contains "cdpnav" files, which are cdp location files for processed SEGY files.

velocity: Text format Focus stacking velocities output via the Interactive SDB Utility.

root.taiger.0.dump: This file is a dump of all of the entire taiger system made at the start of Leg 1. It's an important backup if things go wrong.

SEGD: Not used at this time.

splice: Temporary space used by Focus jobs "splice*.dat" for intermediate *.dsk files to be spliced together. These files can be removed once the splice process is complete.

survey: Contains the entire Focus database for project taiger.

tmp: Temp spaced used by Focus jobs while running.

/tg2:

focus: Focus output seismic data. In Focus module DSOUT, choose DPINDEX 1 if you want to write to this directory. Choose DPINDEX 0 to write to a similar directory on /tg1. I'm keeping CDP sorts in this directory.

obstool_demo: Demo version of obstool.

root.taiger.0.dump: This file is a level 0 backup of the entire taiger system. Save it in case of problems.

PNS3TE: This is a backup of the Focus database. It's updated automatically by rsync.csh.

SEGY: All processed stacks and migrations in SEGY format. "*.tpf" files are created by Focus and may be deleted.

External USB Disks:

Things are set up right now to use 2 external USB disks at any one time, with the intention that these will be hand-carried home at the end of each leg and new USB disks will be substituted.

One of them receives all of the field SEGD data from segdget.csh. Individual SEGD files (one shot per file) are concatenated and stored. Set the environment variable in segdget.csh and in segdin.csh to point to this location. If you fill this disk up, mount a new USB disk and reset these environment variables to point to the new disk.

The second USB disk gets basically everything else. Field logs, navigation, documents, backups of programs, job decks, velocities, and miscellanea from the Langseth nas computer are written here by rsync.csh. Make sure you set the variable "OUTDISK2" in rsync.csh to point to this disk.

Information regarding duplicate data copies during Taiger Legs.

KM 14 July 2009

To help insure that all important data arrive safely back in Austin, we are making various duplicate copies of data. The primary data are the SEGD files. We are copying these initially onto the USB disk for use during the cruise and for
hand carrying back to Austin.

SEGD Data
After Leg 2 it was quite apparent that there would be sufficient space on the internal drives to also keep a copy of the SEGD data there. I copied all SEGD data from the USB drive to the /tg2 internal drive at the end of Leg 2. During Leg 4 I have regularly copied all new SEGD data from the USB disk to the /tg2 disk using rsync (in rsync_segd.csh).

Paradigm Format Data
During all the Taiger legs, all the processed data have gone to the internal
disk drives. This has worked well and there is plenty of space. Now that we are late in Leg 4, I have decided to make a copy of these data in case any problems crop up with the internal drives. The copied data include shots in Paradigm
format and stacks. I have copied the data as follows:

/tg1/focus/survey/taiger_gd/AAA* to /media/KM3/taiger_gd_AAA
/tg1/focus/survey/taiger_gd/AA[B*-J*] to /media/KM3/taiger_gd_AAB

This has left /media/KM3 essentially full.

The next disk I used for Paradigm backups was Sean's disk. This required a little work because it had been formatted for fat32 for Windows. I found this out because I could not copy any large files to it. With instructions from MarkW I removed the partitions and created a single partition and then, using the Fujitsu laptop, I created a new file system on the disk. This disk was able to hold just under a Tbyte of the Paradigm data.

/tg1/focus/survey/taiger_gd/AAB[K-Z] to /media/usbdisk/taiger_gd_AABK2Z ~465 Gbyte
/tg1/focus/survey/taiger_gd/AAC[A-Z] to /media/usbdisk/taiger_gd_AACA2Z ~450 Gbyte

Finally, since we are now done with acquisition and transiting back to Kaohsiung, I will use disk space on /media/KM1 to back up the rest of the Paradigm data. As of today, 24 July 2009, there is only about 181 Gbyte of data remaining not backed up.

/tg1/focus/survey/taiger_gd/AAD[A-M] to /media/KM1/taiger_gd_AADA2M ~181 Gbyte

This should be about it for this cruise. The backed up data actually includes data for all three legs.

The End

TAIGER 2009 PROCESSING SHELL SCRIPTS

This file is in /home/focus/PROGS/README.txt

These are shell scripts written for automated processing
of Taiger 2009 MCS data.
All scripts are in /home/focus/PROGS
4/09 Steffen Saustrup

ALIASES

jobs cd /home/focus/JOBS
progs cd /home/focus/JOBS
nav cd /tg1/nav/MGL0905
p190 /nas/data/CruiseData/MGL0905/processed
working cd /nas working/MGL0905 (seismic data directory on nas)
logs cd /nas/data/CruiseData/MGL0905/docs/operations/
ObserverLogs/CompletedLines
(directory for completed line logs)
sg3 cd /media/SG3
sg5 cd /media/SG5
sg6 cd /media/SG6

NOTE ON DECREASING LINES

Some lines are shot in decreasing shot order. The sort.csh script will fail for these lines. Instead, copy the sort.dat file for line MGL0905_17 or MGL0905_15 and substitute input data, shot numbers, etc.
Also, navmerge.csh will not correctly assign CDP numbers, so use navmerge_dec.csh

NOTE ON GEOMETRY AND NAVIGATION

Scripts for stripping source locations from processed P190 files and calculating Focus station numbers are included. However, the station calculation will accumulate error over long distances (10's of km). Using Focus LINE/PATTERN/SOURCE navigation at 50.0 meters is very accurate and will account for missing shots.

For post-processed navigation files, I've written scripts to generate a nav file that includes shotpoint, cdp, lat, lon, etc.

SCRIPTS:

rsync .csh

Copies new/updated files in onto taiger internal disks and onto external USB disks. This includes all nav files, XBT files, line logs, shotfiles, shell scripts, Focus jobs, etc, but does NOT include seismic data.
This script should be run daily while acquisition is going on.

NOTE: This script does NOT copy over knudsen, multibeam, serial, or spectra files.

Navigation Scripts:

p190strip.csh
Strips all source locations from a Langseth P190 nav file.
Writes linename, shot, lat, long, x, y, water depth, jd, gmt
into a file in /tg1/nav.
Usage: p190strip.csh linename
e.g. p190strip.csh MGL0905_01

p190all.csh
Runs p190strip.csh on all currently available p190 files. Run
rsync.csh first to make sure you've got all the available files.
Usage: p190stripall.csh

stations.csh
***Note, this script uses the P190 UTM x,y values, which have been
shown to be innacurate over long distances. Better to use lat/lon
values and some kind of WGS84 distance calculation (spreadsheet).***
Reads x, y positions from file created by p190strip.csh
and calculates distance along track for each shotpoint.
Writes out a file containing linename, shot, distance
along track, station number, and geometry pattern number
into /tg1/nav. Total distance along track has a constant
(6500 at this time) added to it to ensure the first shot
is in "positive" territory.
*** Important to change near offset and cdp bin size
within this script as it changes in the field ***
Usage: stations.csh linename
e.g. stations.csh MGL0905_01

lsdawk.csh
Runs "lsd" on a processed SEGY file, and then strips out only the cdps
that are "near channel" cdps, i.e. the cdp's closest to a shotpoint.
Used by navmerge.csh
Usage: lsdawk.csh linename
e.g. lsdawk.csh MGL0905_25

lsdall.csh
Runs lsdawk.csh on all processed lines.
Usage: lsdall.csh

navmerge.csh
Uses the "sources" file created by p190strip.csh and the "segystrip"

file created by lsdawk.csh to merge a processed CDP location nav file.
Usage: navmerge.csh linename
e.g. navmerge MGL0905_20

navmerge_dec.csh
Similar to navmerge.csh, only for lines shot with decreasing shotpoint.
Usage: navmerge_dec.csh linename
e.g. navmerge_dec MGL0905_20

navmergeall.csh
Runs navmerge.csh on all lines that have been processed AND have available p190 files. Decreasing lines will still have to be run manually.
Usage: navmergeall.csh

Seismic Processing Scripts:

segdget.csh
Copies raw SEGD files from the "working" directory on nas onto a taiger disk, typically an external USB disk. Files are concatenated into a single large file. Can append to an existing destination file or remove the existing file before continuing.
Usage: segdget.csh linename firstreel (lastreel)
lastreel defaults to firstreel
e.g. segdin.csh MGL0905_01 50002 50007

segdin.csh
Creates a Focus job to convert a SEGD file into FOCUS format, resampling to 4 ms and bandpass filtering along the way.
Usage: segdin.csh linename (reclen)
reclen defaults to 15000
e.g. segdin.csh MGL0905_01 16000

nearchan.csh
Runs a Focus job to create a near channel (chan 468) section. It's not really necessary to run this job, the brute stack is more useful.
Usage: nearchan.csh linename
e.g. nearchan.csh MGL0905_03

geometry.csh
Runs LINE/PATTERN/SOURCE to establish Focus geometry at 50.0 shot spacing. Near offset is assumed to be 164 meters, this must be changed in the script if the near offset changes.
Usage: geometry.csh linename firstshot

e.g. geometry.csh MGL0905_01 1209

sort.csh
Sorts Focus shotgathers into CDP gathers. A t1.5 gain is applied.
Usage: sort.csh linename (firstshot) (lastshot)
default is to use all shots
e.g. sort.csh MGL0905_01 1209 4367

brutestack.csh
Performs a water velocity brute stack from SEGD shotgathers.
Only near 108 channels are used.
Usage: brutestack.csh linename
e.g. brutestack.csh MGL0905_01

velstack.csh
Performs full-fold velocity stack from CDP sorts. A list of bad shots/channels named linename.badchan must be created in the JOBS directory before running this script. Outputs Focus format and SEGY in /tg2/SEGY.
Usage: velstack.csh linename
e.g. velstack.csh MGL0905_01

fkmig.csh
Runs 1500m/s F/K migration on velocity stack. Outputs Focus format and SEGY in /tg2/SEGY.
Usage: fkmig.csh linename
e.g. fkmig.csh MGL0905_01

STANDARD RUNNING ORDER OF SCRIPTS

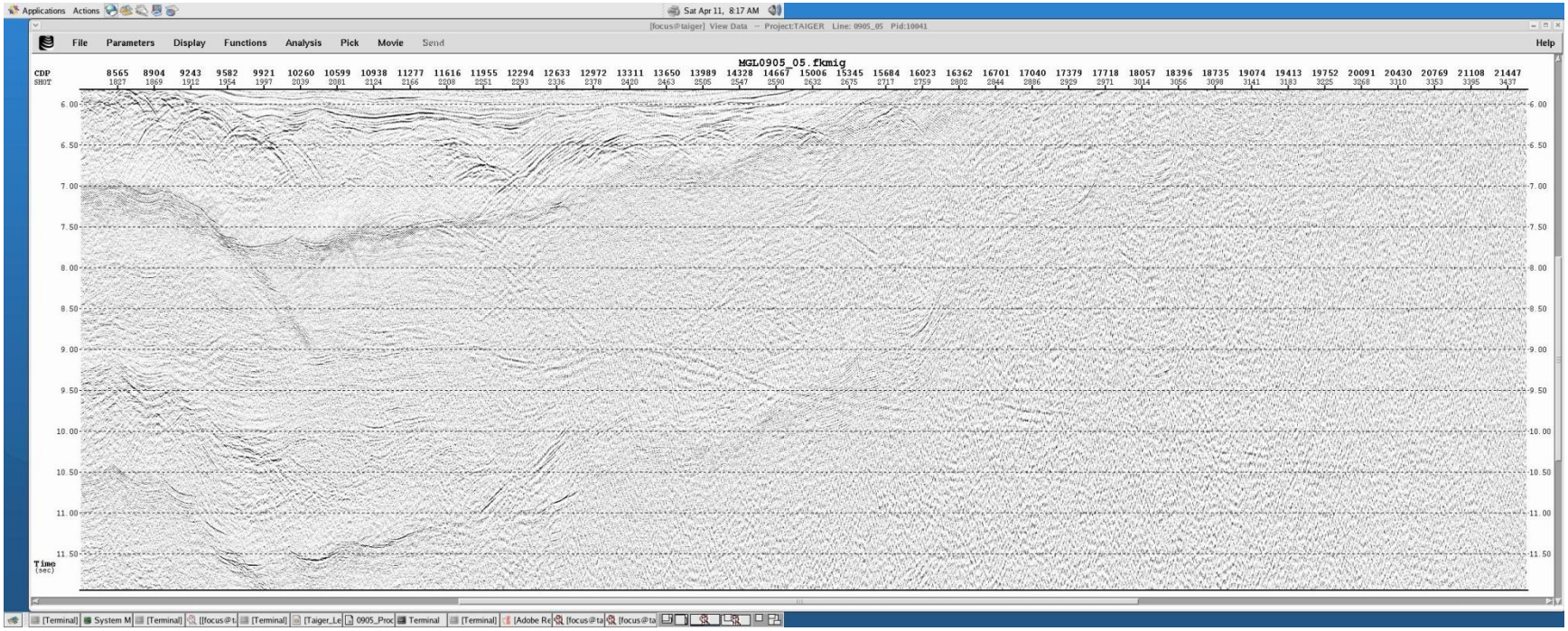
1) segdget.csh linename firstreel (lastreel)
2) segdin.csh linename (reclen)
3) (Look at shotgathers to determine first,last good shot and to inspect for bad channels. Use first good shotpoint as input to geometry.csh)
4) geometry.csh linename firstshot
5) sort.csh linename (firstshot) (lastshot)
6) brutestack.csh linename
7) (Pick seafloor time from brute stack, look for any errors in line. Seafloor should be picked right on arrival, not above it.)
   Event: SF
   Attribute: TIME
8) (Pick velocities, copy existing from veldef.dat job.)
9) (Create linename.badchan file in JOBS directory.)
10) velstack.csh linename
11) fkmig.csh linename

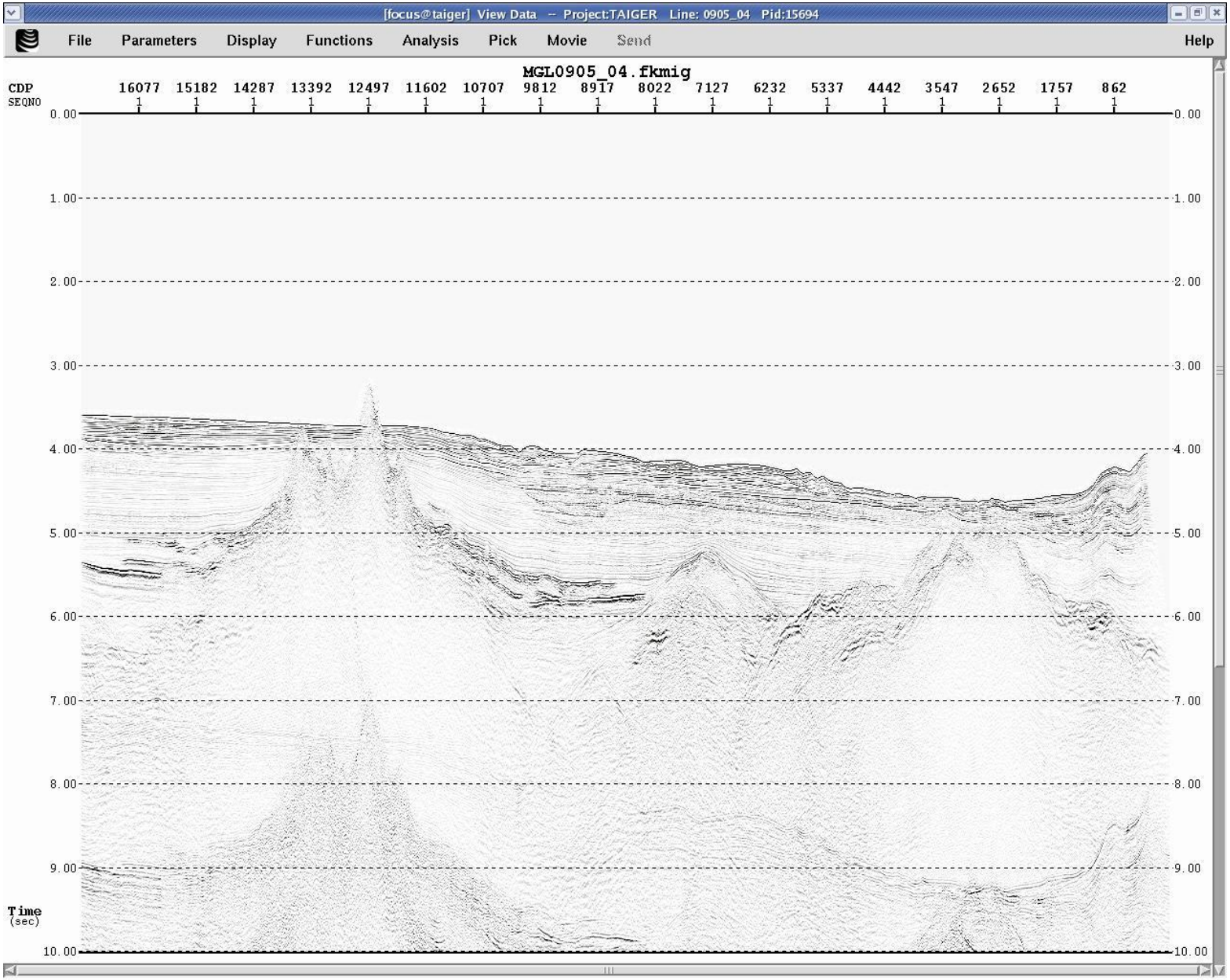
(Nav Processing)

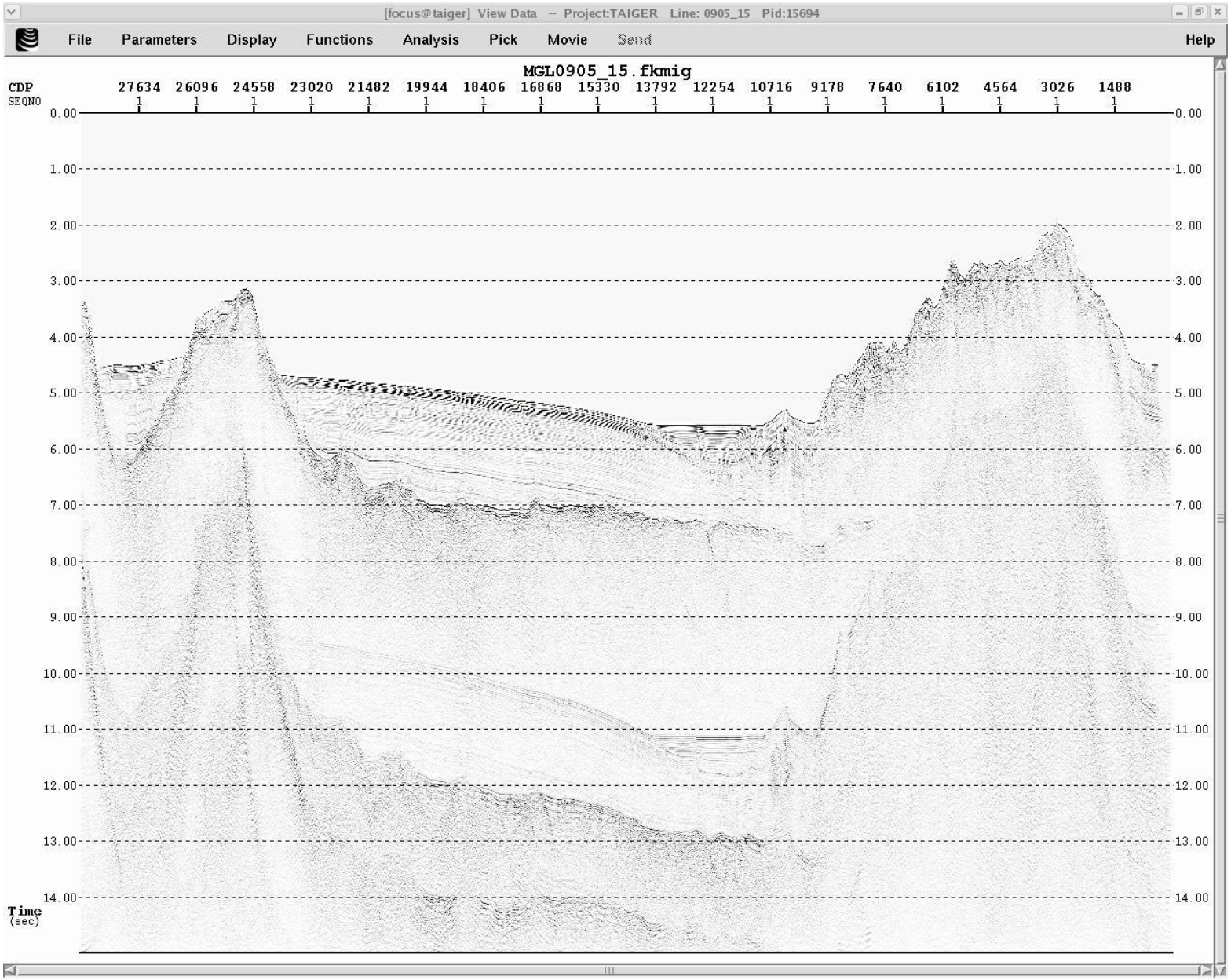
12) p190strip.csh linename
13) lsdawk.csh linename
14) navmerge.csh linename

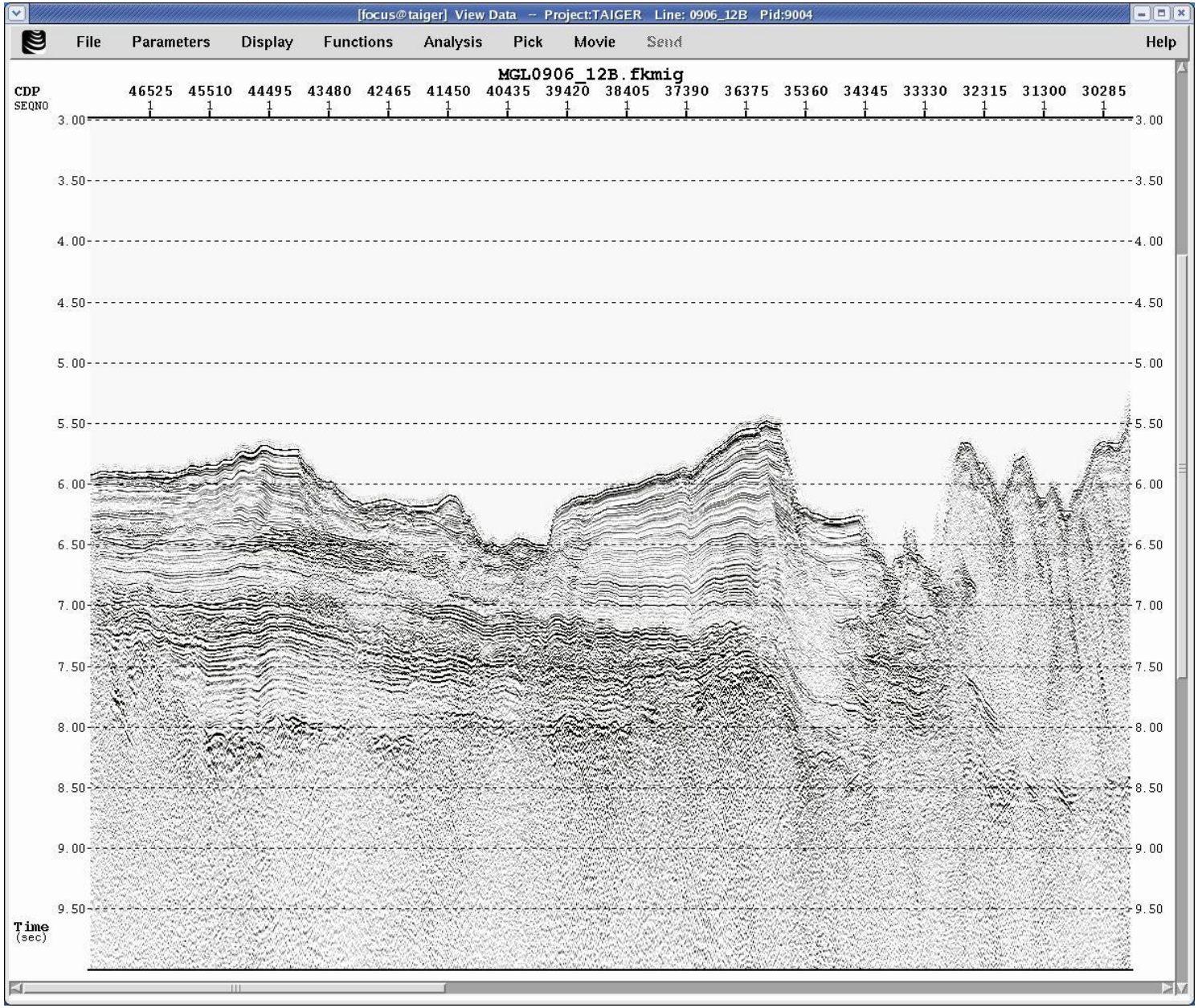
Data Examples From Onboard Processing

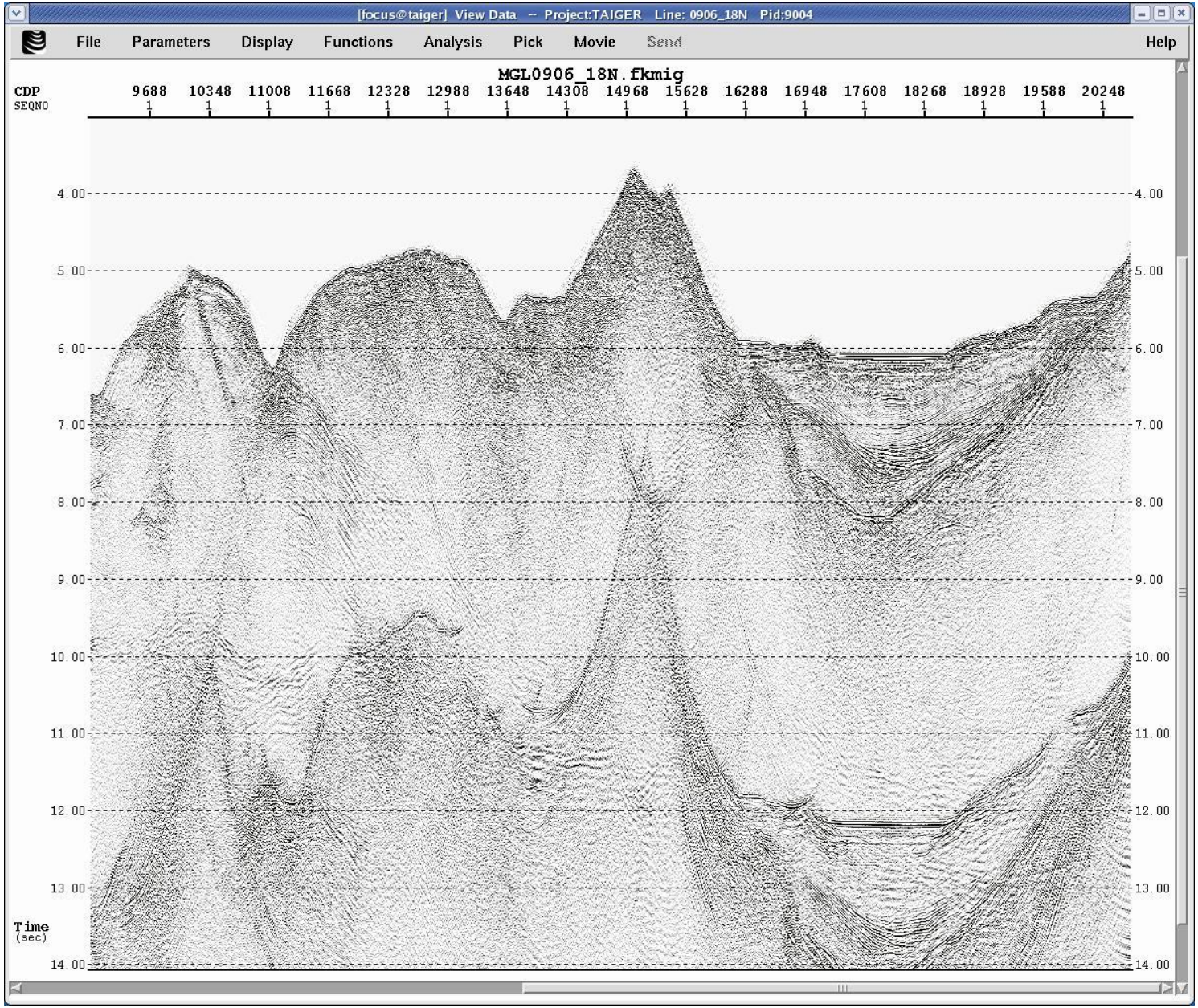
In each image below, the Cruise ID, e.g., MGL0905, and the line # are indicated.

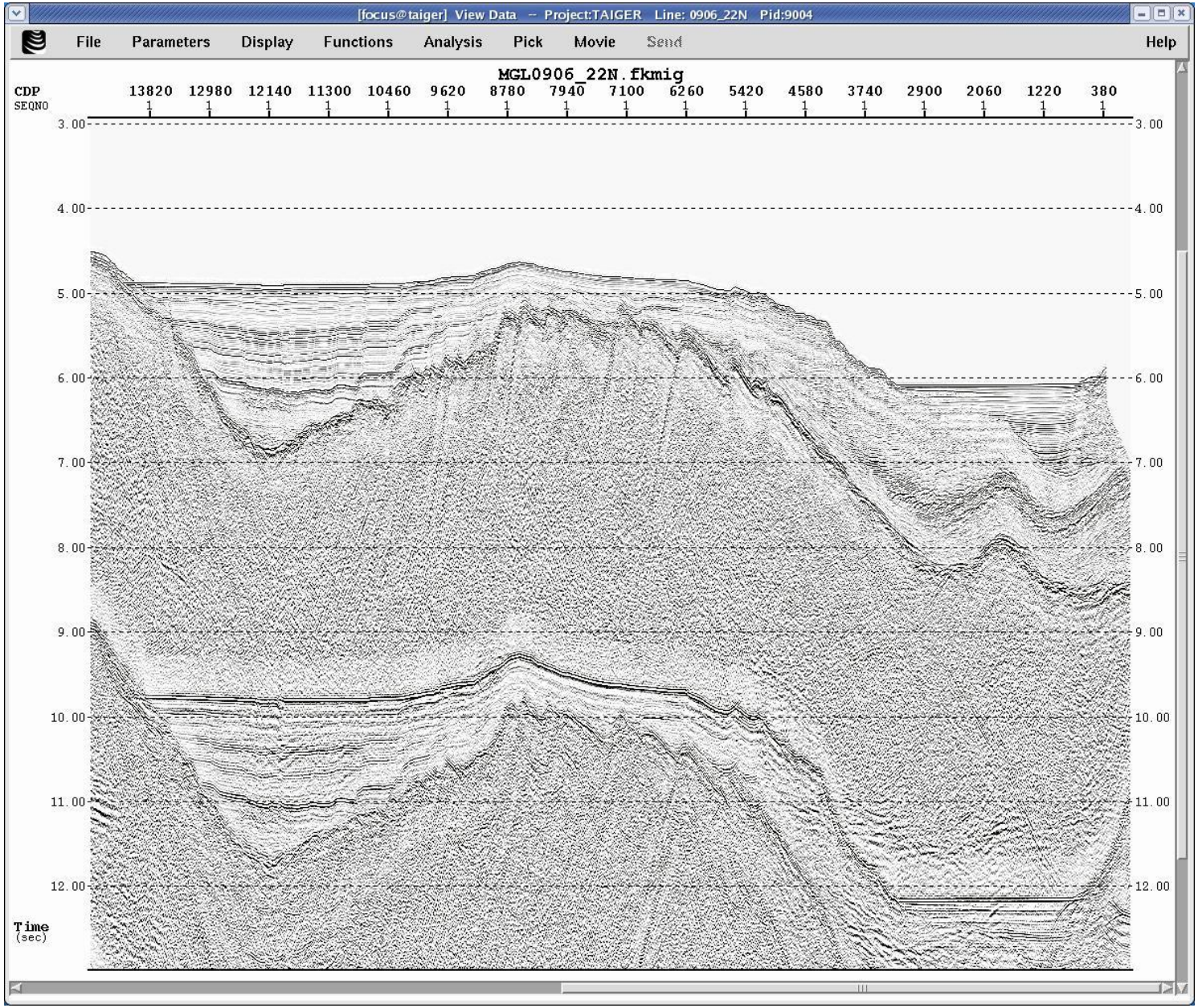

Applications Actions
Sat Apr 11, 8:17 AM
File Parameters Display Functions Analysis Pick Movie Send Help
MGL0905_05.fkmig
CDP
SHOT
Time (sec)

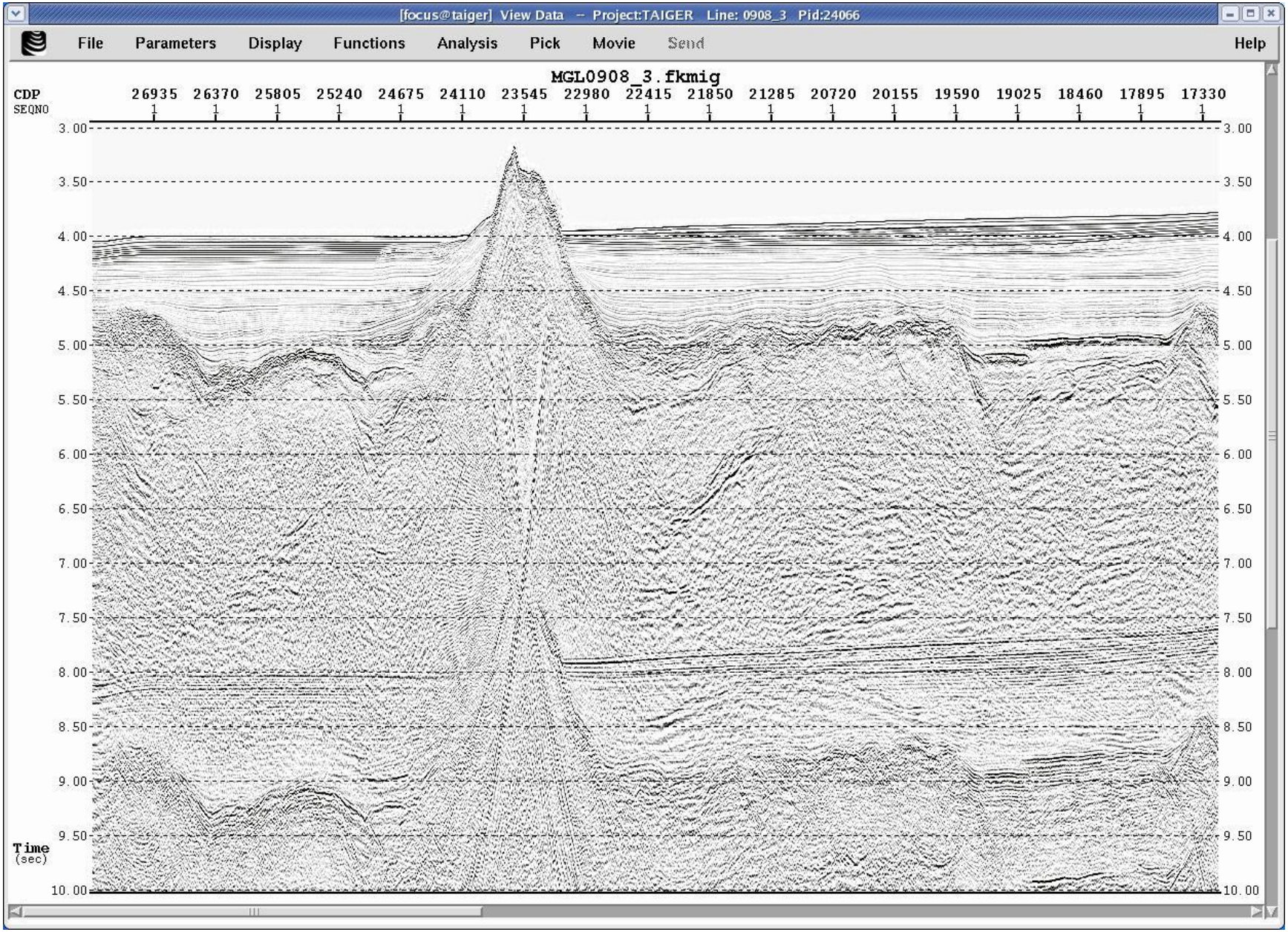

[focus@taiger] View Data -- Project:TAIGER Line: 0905_04 Pid:15694
File
Parameters
Display
Functions
Analysis
Pick
Movie
Send
Help
MGL0905_04.fkmig
CDP
SEQNO
16077 15182 14287 13392 12497 11602 10707 9812 8917 8022 7127 6232 5337 4442 3547 2652 1757 862
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
Time
(sec)

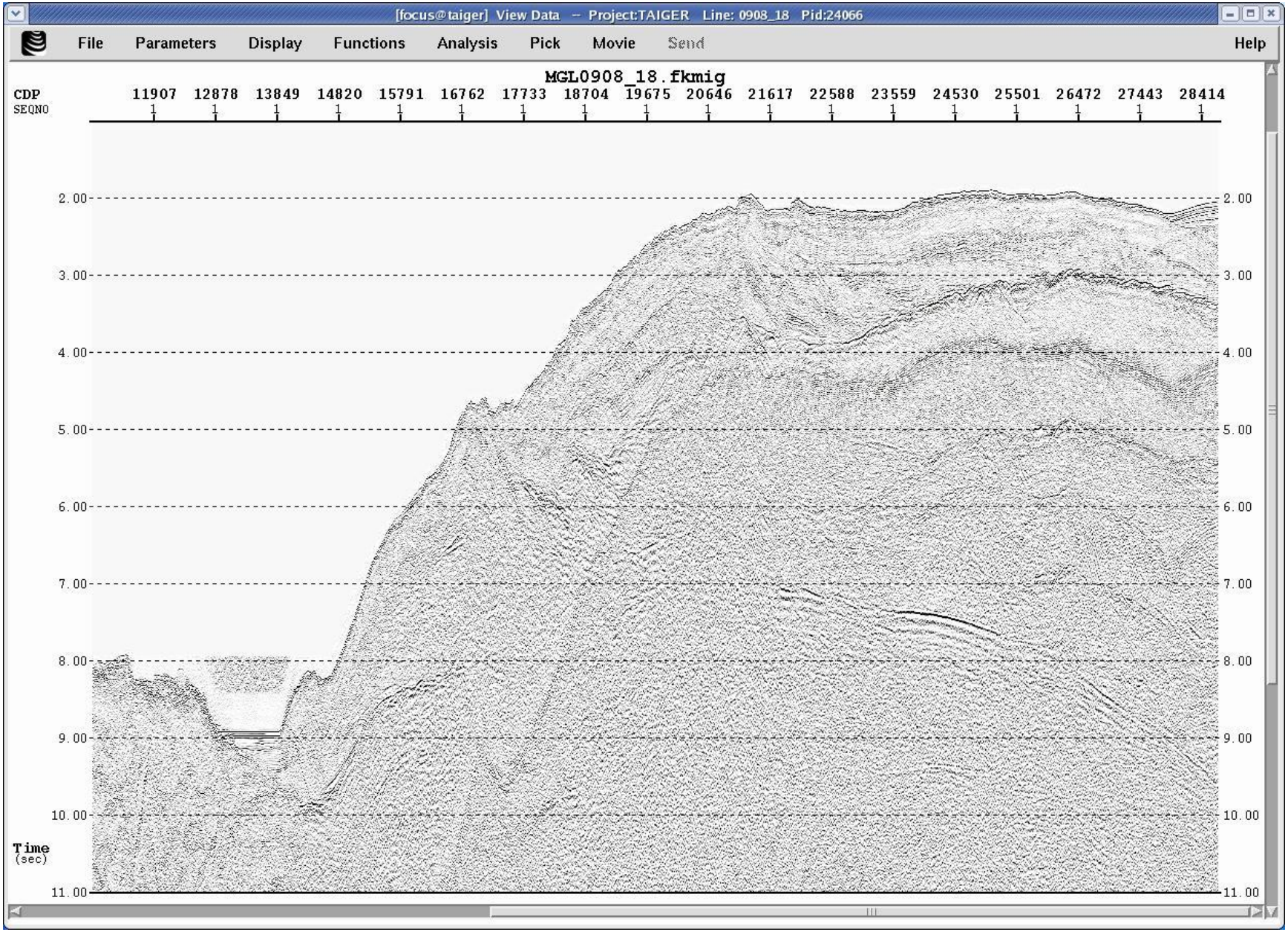

[focus@taiger] View Data – Project:TAIGER Line: 0905_15 Pid:15694
File
Parameters
Display
Functions
Analysis
Pick
Movie
Send
Help
MGL0905_15.fkmig
CDP
SEQNO
27634 26096 24558 23020 21482 19944 18406 16868 15330 13792 12254 10716 9178 7640 6102 4564 3026 1488
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
12.00
13.00
14.00
Time
(sec)


[focus@taiger] View Data -- Project:TAIGER Line: 0906_12B Pid:9004
File
Parameters
Display
Functions
Analysis
Pick
Movie
Send
Help
MGL0906_12B.fkmig
CDP
SEQNO
46525 45510 44495 43480 42465 41450 40435 39420 38405 37390 36375 35360 34345 33330 32315 31300 30285
3.00
3.50
4.00
4.50
5.00
5.50
6.00
6.50
7.00
7.50
8.00
8.50
9.00
9.50
Time
(sec)


[focus@taiger] View Data -- Project:TAIGER Line: 0906_18N Pid:9004
File
Parameters
Display
Functions
Analysis
Pick
Movie
Send
Help
MGL0906_18N.fkmig
CDP
SEQNO
9688
10348
11008
11668
12328
12988
13648
14308
14968
15628
16288
16948
17608
18268
18928
19588
20248
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
12.00
13.00
14.00
Time
(sec)


[focus@taiger] View Data -- Project:TAIGER Line: 0906_22N Pid:9004
File
Parameters
Display
Functions
Analysis
Pick
Movie
Send
Help
MGL0906_22N.fkmig
CDP
SEQNO
13820 12980 12140 11300 10460 9620 8780 7940 7100 6260 5420 4580 3740 2900 2060 1220 380
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
12.00
Time
(sec)


[focus@taiger] View Data -- Project:TAIGER Line: 0908_3 Pid:24066
File
Parameters
Display
Functions
Analysis
Pick
Movie
Send
Help
MGL0908_3.fkmig
CDP
SEQNO
26935 26370 25805 25240 24675 24110 23545 22980 22415 21850 21285 20720 20155 19590 19025 18460 17895 17330
3.00
3.50
4.00
4.50
5.00
5.50
6.00
6.50
7.00
7.50
8.00
8.50
9.00
9.50
10.00
Time
(sec)


[focus@taiger] View Data – Project:TAIGER Line: 0908_18 Pid:24066
File
Parameters
Display
Functions
Analysis
Pick
Movie
Send
Help
MGL0908_18.fkmig
CDP
SEQNO
11907 12878 13849 14820 15791 16762 17733 18704 19675 20646 21617 22588 23559 24530 25501 26472 27443 28414
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
Time
(sec)