R/V Endeavor 473 Expedition Cruise Report

Project REPONSE: Collaborative Research: Offshore coseismic effects of the Port au Prince earthquake, Haiti

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I. Introduction

The national catastrophe in Haiti called for an immediate response from the geoscience community to map the offshore seismogenic structures of the Enriquillo-Plantain Garden fault (EPGF) zone associated to the January 12, 2010 earthquake. The M7 January 12 mainshock ruptured a relatively small segment of the EPGF, the southern of two parallel E-W sinistral transforms that accommodate most of the motion between the North America and Caribbean plates and form the boundaries of the Gonave microplate. We proposed to the National Science Foundation RAPID response program an urgent field survey of offshore faults associated to the plate boundary and the earthquake. These structures have their expression along the coast of Haiti and include offshore segments of the January 12 rupture. As a result of the offshore deformation, several small tsunamis were generated. The marine survey was urgent, not only because civic authorities now require advice from earthquake experts, but also because: 1) many of the structures were unmapped preventing the construction of reliable models of strain accumulation and seismogenic release along the EPGF; 2) the survey needed to capture detailed sea-floor features related to rupture such as turbidites and mass wasting; 3) terrestrial sediments from the earthquake can be identified with ^{7}Be (half-life 53 days); 4) scarps, offset sedimentary or erosional features, such as channels, gas-escape and related bacterial mats related to the earthquake and rupture are short lived in the energetic shallow-water environment of the shelf and needed to be mapped as soon as possible.

The main goals of the survey were: 1) improving maps of the EPGF in the rupture area and near its termini; 2) determining whether the rupture reached the surface; 3) characterizing the rupture pathway offshore and tying it to the onshore pathway; 4) documenting the signature of the earthquake in the sediments and establishing the paleoseismic record of the EPGF; 5) determining what secondary faults may be involved in the transpression manifested by the aftershocks; 6) determining how such secondary faults interact with the transtensive jog further west; and 7) investigating the origin of the tsunamis and patterns of subsidence and uplift. The initial results indicate that the offshore survey successfully contributed to achieving the proposed goals and that the rapid-response marine geophysical data acquisition and sediment sampling in Haitian waters will contribute to the growing multinational scientific response to the disastrous earthquake.

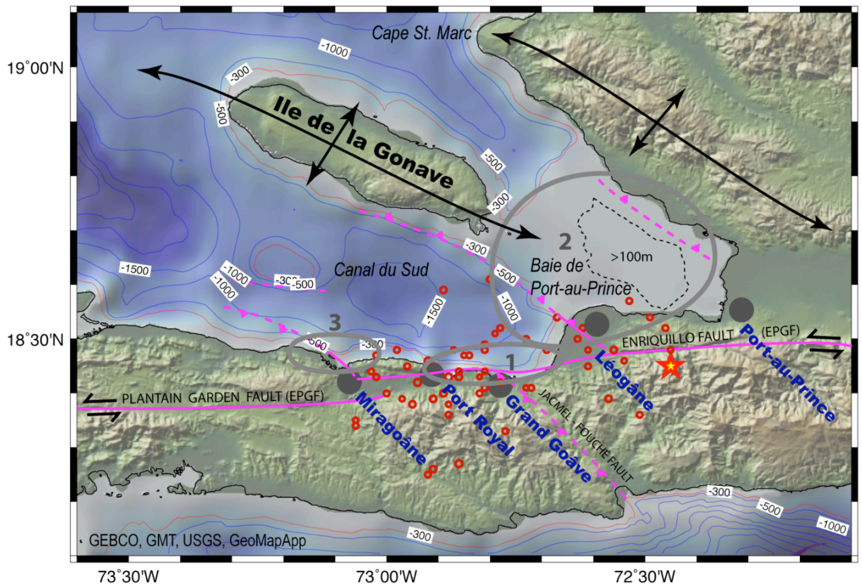

Figure 1. Proposed survey areas 1, 2, 3 in the gray ellipses. The red line marks the 300 m contour, the practical depth limit for the multibeam. 1. Includes the submarine portion of the EPGF. 2. Is the large shallow area of the Baie de Port au Prince that contains an isolated basin. 3. Is the intersection of a NW-striking fault and the EGPF. The star and small red circles are the mainshock and aftershock epicenters (USGS). We expanded the survey to additionally cover areas within the Canal du Sud, Ile de la Gonave and Cape St. Marc.

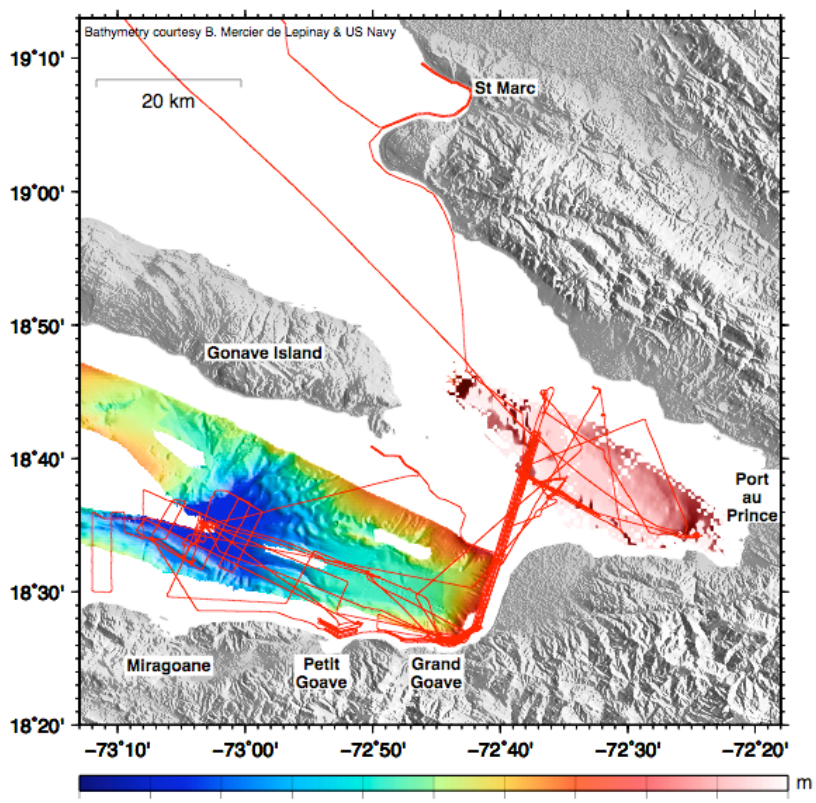

Figure 2. All navigation tracks (multibeam, sidescan sonar, chirp subbottom profiler for the R/V Endeavor Leg 473 survey.

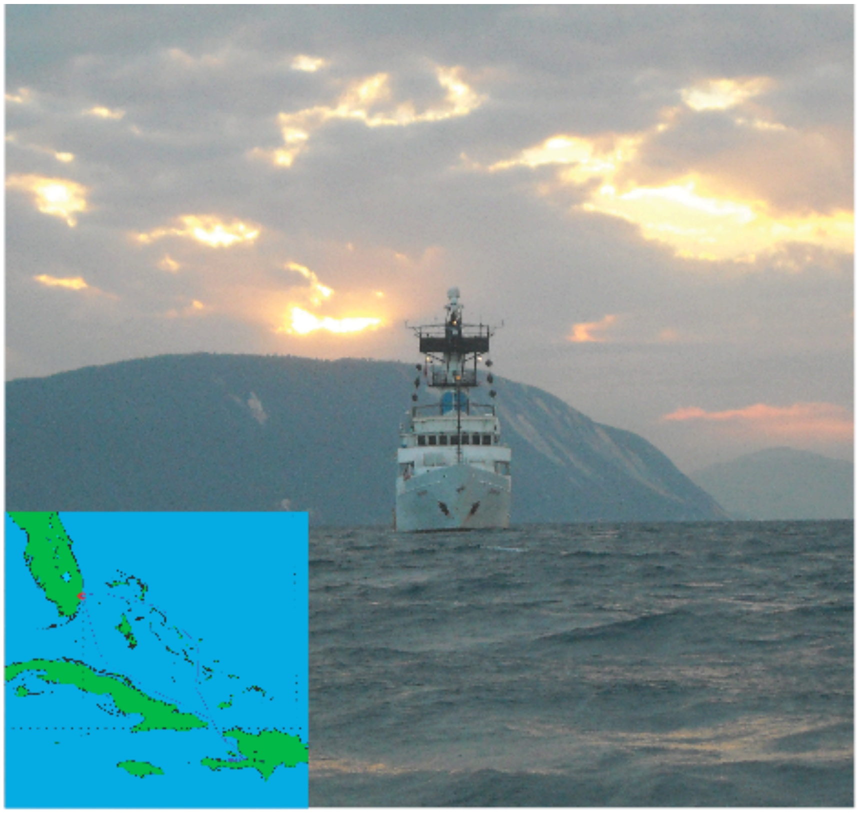

Figure 3. R/V Endeavor in Haiti. Tapion ridge on the background. Inset shows the R/V Endeavor navigation tracks from Port Everglades to Haiti and back to Port Everglades.

II. The REPONS (Rapid Enriquillo Plantain Offshore Neotectonic Study) Scientific Team

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Figure 4. REPONS team from left to right: Christopher Sorlien, Milene Cormier, John Diebold, Sean Gulick, Robert Wilson, Roby Douilly, Hal Johnson, Nicole Braudy, Jake Deming, Cecilia McHugh, John Templeton, Katie Mishkin, Nicole Dieudonne, Nano Seeber, Marcy Davis, Steeve Symithe, Matt Hornbach

III. Overview of Operations

The survey took place on the *R/V Endeavor* from February 24 to March 15, 2010 (14 days of survey and 5 days of transit). We departed Port Everglades, Florida and arrived to Haiti on February 27, 2010. The survey concentrated on the offshore portion of the main rupture and of some of the secondary structures associated with it along: 1) the southern peninsula extending from the Baie de Grand Goâve to the Baie de Petit Goâve; 2) the Canal du Sud region as well as the southern margin of the Ile de Gonave; 3) the Baie de Port au Prince; and 4) Pointe de Saint Marc, a region being considered for possible rebuilding of the City of Port au Prince. Multibeam bathymetry, sidescan sonar, chirp sonar profiles (deep towed and hull mounted), and sediment sampling (gravity cores, multicores, grabs) were conducted in water depths of 4 m to 1750 m from the R/V Endeavor and a small inflatable zodiac.

Transits and transfers

We departed Port Everglades, Florida on February 24, 2010 at 13:30. All gear were loaded and all operations completed to get underway. We sailed to a flat area of the seafloor to test the Reson Seabat 8101-ER multibeam bathymetric sonar where two CTD stations were conducted at 26°06.49N; 080° 04.36' W and 26° 06.23'N; 080 04.92'W prior to testing the multibeam for pitch and yaw and roll along four lines.
1) East to West 26°06'13.9017"; 080° 05' 17.175" and 26° 06'13.2893"; 080° 05' 6.9068"
2) North to South 26°06'33.3252"; 080°05' 20.1387" and 26°06'23.4333" and 080°05'22.249"
3) West to East 26°06'17.1262"; 080°05'20.1387" and 26°06'16.513"; 080°05'16.939"
4) North to South 26°06' 32.7205"; 080°05'16.622" and 26°06'22.8288"; 080°05'18.7089".
However, the cable connection failed after the first test line, and the pole assembly and sonar were brought back on deck. Inspection of the sonar head confirmed that a bad connector was the problem, something that can be remedied simply. It was decided to start the transit to Haiti and carry out the patch test along with calibration on site.

While on transit the main laboratories were set up with computer terminals and the sedimentology laboratory was set up for coring and the extrusion of sediments from the multicorer liners. The multicorer and gravity corer were checked. A weld to repair the multicorer was not strong. We fixed both valves on gravity corer. Science safety and orientation, and personnel training in equipment logging and operation were conducted all day on Thursday, February 25 and personnel began to adjust to their shift schedules as follows:

	8:00-12:00	12:00-16:00	16:00-20:00
CHIRP	Matt	John D.	**Sean**
	Nano	Chris	John T.
SIDE SCAN	Harold	**Milene**	Nicole B.
		Nicole D.	Roby
MB	Jacob	**Milene**	Marcy
	Cecilia	Steeven	Katie

We arrived at Port-au-Prince Bay on Saturday February 27 at 16:00 and the Master of the *R/V Endeavor* contacted the Captain of the Military Sealift Command Crane Vessel "Cornhusker State" to work out the logistics to deliver the container of humanitarian supplies. The *R/V Endeavor* tied up alongside the USNS Cornhusker State, which used their crane to lift the fully loaded 20’ container and 3’x6’x8’ pallets of tarp structures off the *R/V Endeavor* (Fig. 5). The cargo was deposited on the Conrhusker State and the operation was successfully completed by 18:40. The cargo was delivered to an Agent in Port au Prince (Fig. 6). Our three Haitian colleagues: S. Symithe, R. Douilly (Universite d'Etat de Haiti)and N. Dieudonne (Bureau of Mines, Haiti) boarded the *R/V Endeavor* via the Port Au Prince Pilot boat at 19:05.

Fig. 5. Along side the USNS Cornhusker State and offloading the cargo and container of humanitarian supplies.

Fig. 6. Humanitarian supplies sponsored by Plan USAS Shelters were safely delivered.

The multibeam pole and chirp were deployed into the water by 21:45 and the *R/V Endeavor* sailed 10 nm NW to a location in Port-au-Prince Bay where a patch test was conducted (Fig. 7). This test allowed for the calibration of the multibeam for pitch, yaw and roll. The chirp was also tested for altitude and wire-out on the transit to the patch test site. After testing the equipment, we surveyed with the chirp along and across of Canal du Sud in water depths of 50 m to 2000 m. On the morning of Sunday February 28, we met meet Paul Mann, Fred Taylor, and Rich Briggs at 18° 26.276’ N -72° 44.803’ W to the north of Fouche, Haiti to deliver the equipment for their land survey (zodiac, supplies and a saw for cutting corals; Fig. 8). After these transfers of equipment we continued surveying along the eastern and southern coasts of Canal du Sud where the Enriquillo-Plantain Garden Fault extends offshore and where there were reports of tsunami.

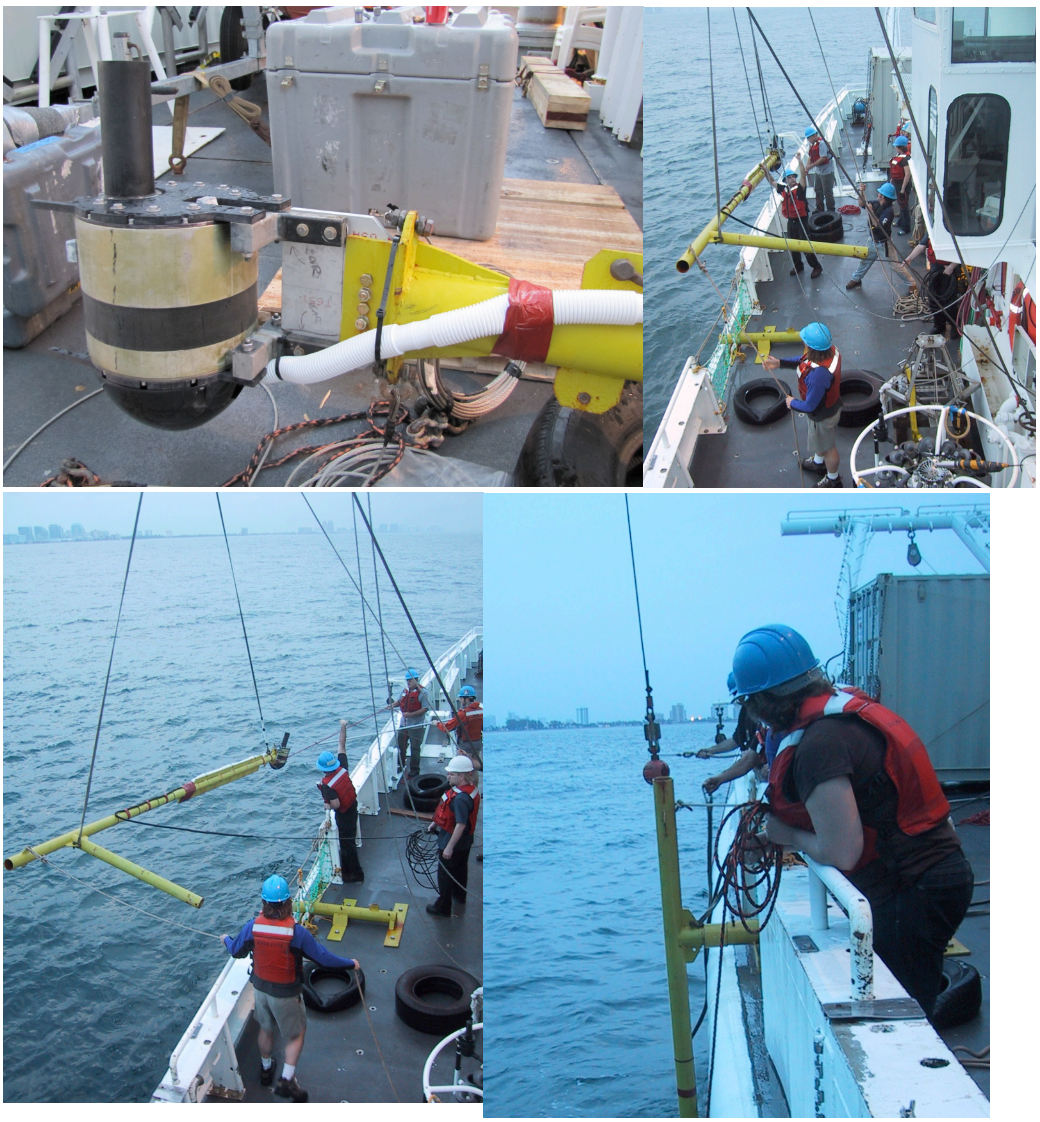


Fig. 7. Reson Seabat 8101ER head and pole mount along starboard of the R/V Endeavor

Fig. 8. Delivery of equipment (zodiac, saw, and supplies) to Paul Mann, Fred Taylor (UTIG) and Carol Prentice and Richard Briggs (USGS).

<u>*Data Acquisition Overview*</u>

Data acquisition extended over a range of water depths extending from 4 m to 2000 m taking advantage of both the R/V *Endeavor* and a small boat as acquisition platforms. Two instruments were towed in shallow waters from 4 m to 100 m using the Endeavor's rescue boat a reinforced inflatable Zodiac. These included: 1) a small chirp system consisting of a portable 320 B/R echosounder made by Knudsen Engineering with a transducer that sweeps through a range of frequencies spanning from 1-10 kHz, with a peak amplitude occurring at a frequency of 3.5 kHz was used; 2) a side-scan sonar, which has limited depth range up to 100 m. On the Endeavor, the multibeam bathymetric system (a Reson 8101 SeaBat) was operable between 50 m to 250 m of water depth. This system was also dependent on the angle of the slope that, when very steep, impaired data acquisition. The Edgetech 512 chirp was deep-towed from 10-200 m, operated with a range of pulses appropriate for the different water depths, and acquired data from water depths of 50 m to 2000 m. We recovered 27 gravity cores ranging in length from 25 cm to 186 cm for a total sediment recovery of 22.12 m, 4 multicores (4 liners in each, 10 to 40 cm in length), and 4 grab stations. The sediment sampling program was guided by the geophysical data sets including the side-scan sonar, chirp and multibeam bathymetry.

IV. Media Coverage

Media coverage was coordinated by Kevin Krajick at Lamont-Doherty Earth Observatory of Columbia University and by Mark Airhart at the University of Texas, Jackson School of Geosciences.

Haiti Project Home Page:
http://www.ldeo.columbia.edu/research/marine-geology-geophysics/haiti-offshore-a-rapid-response-expedition

There were press releases:

At the University of Rhode Island on February 17, 2010 where Todd Mcleish is the media contact: "URI research vessel Endeavor to travel to Haiti for scientific investigation, humanitarian mission".
http://www.uri.edu/news/releases/?id=5220

At Lamont-Doherty Earth Observatory entitled "Scientists Sail to Assess Haiti Quake Threat" by Kevin Krajaick on February 22, 2010.
http://www.ldeo.columbia.edu/news-events/scientists-set-sail-assess-haiti-quake-threat

At the University of Texas at Austin Jackson School of Geosciences on February 23, 2010 by Mark Airhart
http://www.jsg.utexas.edu/news/rels/022310.html

Interviews:

Cecilia McHugh by Amanda Buckiewicz of the Discovery Channel, Canada on February 22, 2010. Film can be seen at
http://watch.discoverychannel.ca/daily-planet/february-2010/daily-planet---february-23-2010/#clip269605

Sean Gulick and Paul Mann were interviewed by Richard Harris from NPR. The interview was aired March 6 to March 8, 2010 in the "All Things Considered Weekend Edition" about the Haiti rapid response projects.
http://www.npr.org/templates/story/story.php?storyId=124655789

Leonardo Seeber and Cecilia McHugh were in live communication from the *R/V Endeavor* with the Lamont Advisory Board Meeting on Wednesday March 10, 2010 where they reported about their findings of the offshore trace of the Enriquillo fault with the assistance of Michael Steckler.

Sean Gulick and Paul Mann were interviewed by Discovery in US

http://dsc.discovery.com/tv-schedules/special.html?paid=1.14951.26206.0.0

The program also appeared in Pioneer TV in UK

http://uk-tv-guide.com/pick-of-the-day/2-February-2010/documentary-haitis-killer-quake-why-it-happened/

Blogs:

Queens College, CUNY Ph.D. student Katie Mishkin maintained a daily blog of the expedition at:
http://www.amishkin.com

Katie should be especially commended for her efforts!

Excerpts of the expedition were posted daily by Kevin Krajick on the Columbia University State of the Planet blog:
http://blogs.ei.columbia.edu/blog/tag/haiti-earthquake/

White House Home Page Article by Dr. Kate Moran

http://www.whitehouse.gov/administration/eop/ostp

V. Multibeam Report

A Reson Seabat 8101ER was leased for this expedition from Seafloor System Inc (Fig. 7). This portable multibeam bathymetric sonar pings at 240 kHz, collecting 101 beams with a coverage of 150°. The system was mounted on a sturdy pole on the starboard side of the ship. Though rated for water depth of up to 400m, in practice, the system returned useful information to a maximum depth of 300m. From 30 m to 300 m, the useful swath width was at least 200 m, and up to 350 m at 130 m water depth. We therefore adopted a nominal track spacing of 200 m for most of the subareas we surveyed. It was discovered that the earlier calibration test carried on February 28 at the northern side of Port-au-Prince Bay could not be applied because of software issues. After the right software was located and downloaded, the system was precisely calibrated on March 3 at the SW corner of Port-au-Prince Bay. Parallel tracks oriented WSW ran from the flat 130m deep basin floor up to the 30m deep platform that rims it. Final calibration indicated a roll offset of 2.83°, a pitch offset of 3.8°, and a yaw offset of -5.7° (see calibration report at end of document). With the pole assembly rotated vertical in the water, the ship was limited to a survey speed of about 4 knots, also a good survey speed for the towed chirp sonar and the sidescan sonar. With the 300m depth limitation of the system, and considering the 5m draft of the R/V *Endeavor*, and the absence of a shelf along most of the Haitian coastline, we had to adopt a survey strategy with tracks that hug the coastline and presumably follow the 100m (safe) contour lines, a contour line often absent from the nautical charts. Based on the processing of the multibeam data, it was sometimes possible to run a few other tracks landward of the initial tracks.

We noticed a systematic shift between the multibeam bathymetric data and the chirp data, the chirp data being systematically deeper than the multibeam bathymetric data. The shift varies with location, and at the time of writing this report, had not been tracked to its origin. Over the shallow platform west of Port-au-Prince Bay, the shift appears to be about 5 to 6 m, the draft of the R/V *Endeavor*. Further inquiry into all the offset correction and sound velocity correction is in order.

Table 1. Multibeam data acquisition.

Area	**Start date & time (GMT)**	**End date & time (GMT)**	**west longitude**	**east longitude**	**north latitude**	**south latitude**
calibration test SW corner of Port-au-Prince Bay	March 3 14:00 jd062	March 3 16:08 jd062	72°37.5'	72°34.5'	18°38'	18°39'
Port-au-Prince Bay to Grand Goave Bay Line 107, N107°	March 3 17:19 jd062	March 3 22:57 jd062	72°42'	72°36'	18°26'	18°42'

Grand Goave Bay to Port-au-prince Bay Line 105, N017°	March 4 01:82 jd063	March 4 07:39 jd063	72°41'	72°37'	18°33'	18°42'
Port-au-Prince Bay to Grand Goave Bay Line 104 N107°	March 4 07:47 jd063	March 4 12:55 jd063	72°40'	72°37'	18°33'	18°40'
WSW-ENE lines Grand Goave Bay	March 4 12:55 jd063	March 4 21:58 jd063	72°46.5'	72°41'	18°26'	18°28'
Entrance to Petit Goave Bay V-shaped tracks	March 5 17:54 jd064	March 5 23:35 jd064	72°54.5	72°50.5'	18°26.5'	18°28.5'
Grand Goave Bay to Port-au-prince Bay Line 106 N017°	March 6 22:39 jd065	March 7 04:37 jd066	72°42.5	72°31'	18°27'	18°46'
Port-au-Prince Bay to Grand Goave Bay Line 103 N107°	March 7 04:57 jd066	March 7 10:53 jd066	72°42'	72°35.5'	18°27'	18°46'
Grand Goave Bay to Port-au-prince Bay Line 102 N017°	March 7 11:19 jd066	March 7 17:15 jd066	72°42'	72°35.5'	18°27'	18°46'

Area	Start date & time (GMT)	End date & time (GMT)	west longitude	east longitude	north latitude	south latitude
Port-au-Prince Bay to Grand Goave Bay Line 101 N107°	March 7 17:23 jd066	March 7 23:30 jd066	72°42'	72°35.5'	18°27'	18°46'
Grand Goave bay, and west of it ("knit")	March 8 09:35 jd067	March 8 22:49 jd067	72°50'	72°42'	18°26'	18°27.5'
Coast survey Grand Goave Bay toward Miragoane	March 9 00:03 jd068	March 9 07:33 jd068	72°43'	73°05'	18°26'	18°29'
Reef edge, SE Gonave Island	March 10 06:23 jd069	March 10 12:55 jd069	72°50.5'	72°40'	18°33'	18°41.5'
Zig-zags across Port-au-Prince Bay	March 10 12:55 jd069	March 11 16:36 jd070	72°40.5'	72°24'	18°32'	18°46'
South rim of Port-au-Prince Bay WNW-ESE tracks and across west platform	March 11 16:36 jd070	March 12 03:34 jd071	72°38.5'	72°32'	18°35.5'	18°39.5'
south of St Marc coast-following tracks	March 12 06:07 jd071	March 12 07:46 jd071	72°51'	72°37'	18°37'	19°10'N
St Marc coast-following tracks	March 12 08:21 jd071	March 12 15:26 jd071	72°51'	72°37'	18°37'	19°10'M

VI. Edgetech Deep Tow Chirp

During EN473 we towed an Edgetech 512i chirp sonar towfish and operated it simultaneously with the Reson Seabat 8101 multibeam and hull mounted Knudson 3.5 kHz chirp. Figure 9 shows the Edgetech 512i on deck offshore Haiti.

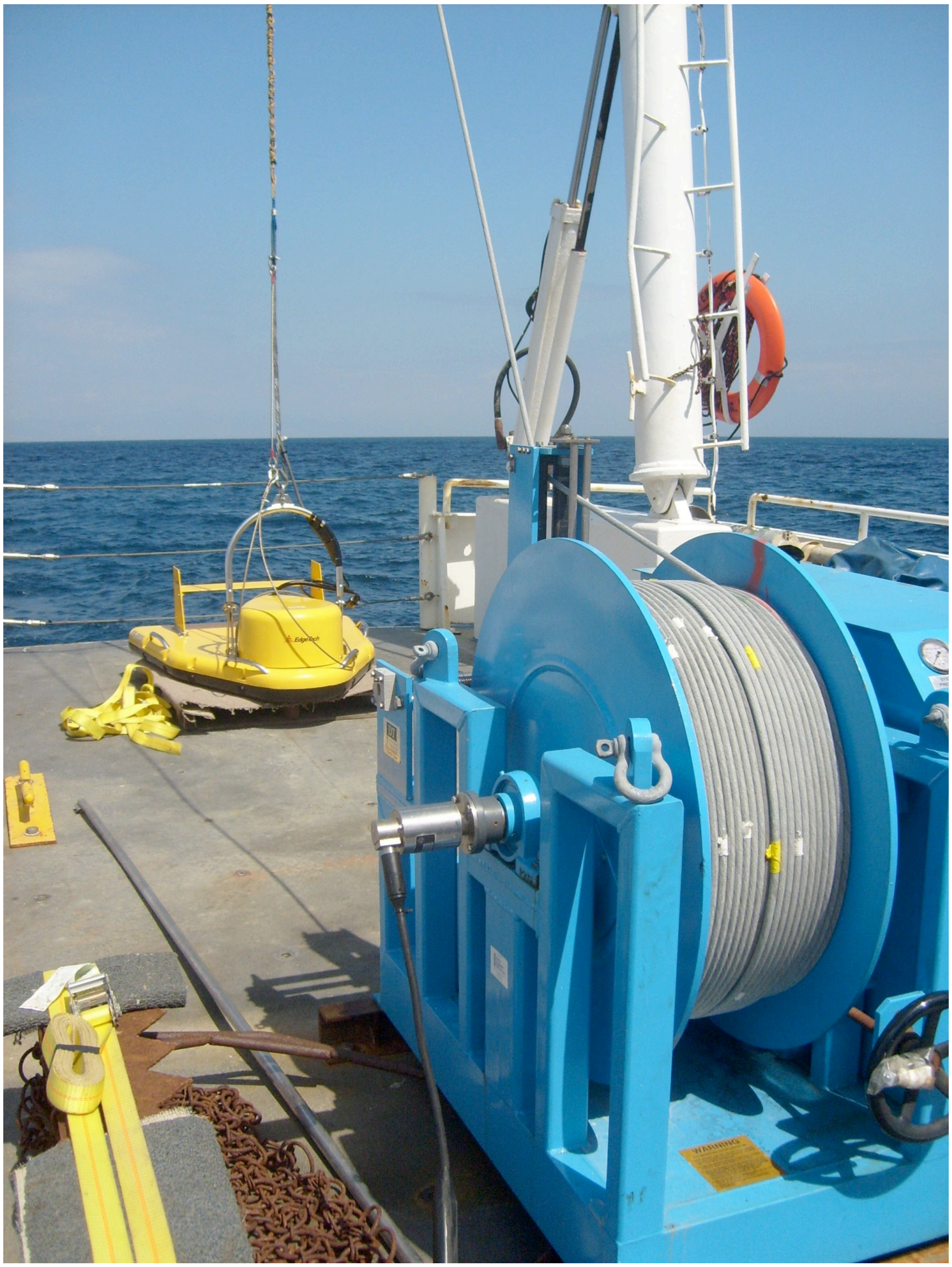


Fig. 9. Edgetech chirp connected by smartwire to marine winch. Wireout was determined by measuring along the wire for the first 50 m and then using wrap lengths for the larger amounts of wireout.

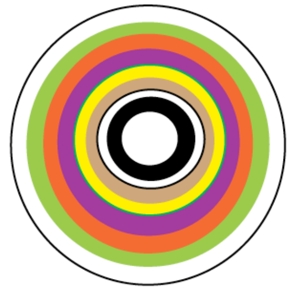
Logging and Operations

The Edgetech has a variety of pulses to choose from; during EN473 we used a 1-6 kHz 40 ms long pulse for water depths over 750 m, a 0.5-7.2 kHz 30 ms pulse, and a 0.7-12 kHz 20 ms pulse for depths less than 250 m. We also changed the ping rate with water depth to avoid more than one ping in the water at the same time. We used 0.5 Hz ping rate for depths over 750 m, 1 Hz ping rate for depths between 250 m and 750 m, and a 10 Hz ping rate for depths under 250 m. There was some experimenting with different pulses and ping rates as well as some operator errors at times and therefore all the details of how each Edgetech Chirp line was collected is shown in Appendix E1.

Vertical resolution for the deep tow Chirp system varies greatly by the pulse used. When using the 0.7-12 kHz pulse vertical resolution is less than 10 cm; the 0.5-7.2 kHz pulse provides a vertical resolution of ~10 cm, and the 1-6 kHz pulse provides a resolution of 10-15 cm.

Line naming convention was in numerical order from the start of the cruise with Additional information was recorded in the observer log sheets every 15 minutes and whenever operational parameters changed. The observer logs included day, time, postion, line #, shot (ping) #, altitude (how far above the seafloor the Chirp was flying), wireout (an estimate of wire currently spooled off the reel), speed through the water, depth based on the 3.5 kHz Knudson, and start and end of lines. In the log book the observers were encouraged to write notes about features they viewed on the data as it was collected and specific events or changes in operations. Appendix E2 is a scanned copy of the observer logs.

For this survey we towed the Edgetech Chirp using a DT Marine Products winch purchased from Survey Equipment Systems with a “smart wire” cable built by D&A Wire Company where the electronics cable is inside an armored sheathing and used to both tow the fish and transmit signals to the fish on the type of pulse to use and how frequently to fire it as well as receive the data back on shipboard. Positioning was determined using a portable GPS antenna run through a splitter module to be fed into the Chirp acquisition computer as well as a navigation laptop running Fugawi. In order to determine layback of the Chirp from the GPS antenna and depth of the Chirp below the sea surface, we needed to know wireout on the winch. Unfortunately, the winch does not come with a measurement device and thus we both measured down the cable for the first 50 m using tape to mark each meter and 5 meter positions as well as calculated the length each wrap of the wire is on the winch drum for each of the layers (see Table 2). Between these two methods we could determine wireout to within 1-2 meters with error being greater for larger amounts of wireout.



IMPORTANT VALUES:	
# loops/layer:	23
Radius when all loops on wire:	0.384
Thickness of wire (m):	0.0127
Amount Nessled:	0.0034

Reel layer # (top to bottom)	Payout/layer (m)	Running total (m)	Loop Circumference (m)
1	33.18	33.18	2.37
2	53.13	86.31	2.31
3	51.36	137.67	2.23
4	49.99	187.66	2.17
5	48.61	236.27	2.11
6	47.23	283.5	2.05
7	45.86	329.36	1.99
8	44.48	373.84	1.93
9	43.10	416.94	1.87
10	41.73	458.67	1.81

Table 2: Estimated circumference of each wire wrap on the winch and the total length of one full layer of wraps to aid in determining wireout. The colors were spraypainted on the winch as shown.

To determine the depth below the sea surface we empirically determined the difference between the altitude on the towfish and depth based on the 3.5 kHz and checked this values against the ghost where visible. These points at 4 knots speed through the water were fit to a quadratic to be used to determine depth below the sea surface (Figs. 10, 11). In addition we determined layback from the GPS antenna based on measurements back to the block on the A-frame through which the tow wire was strung and then using the same quadratic equation to determine distance of the fish behind the block. See Figure E2 for configuration and distance on the fantail. By comparing this distance with vessel speed over the ground we determined a layback in time and will substitute the GPS value in the SEGY files for the corrected GPS value.

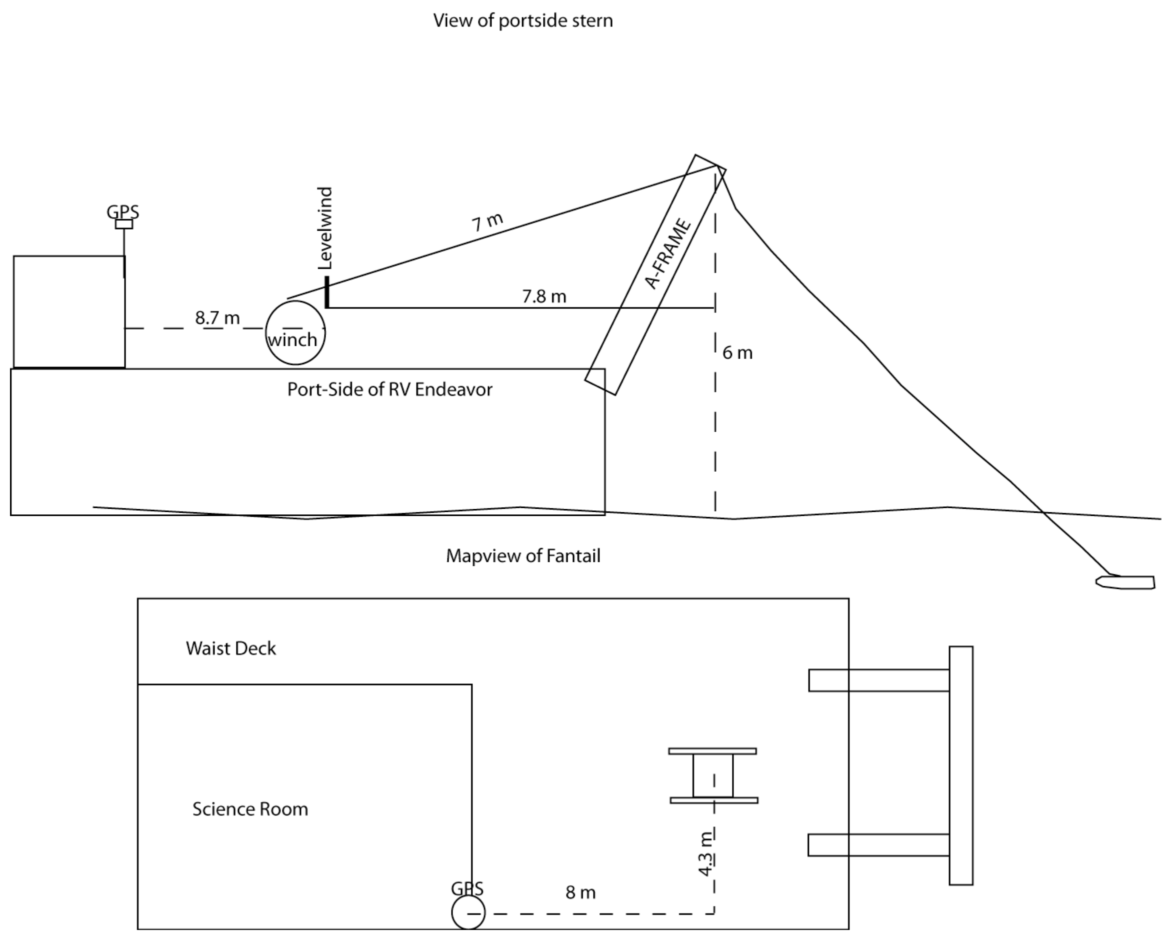


Fig. 10. Sketches of towing arrangement showing distances from GPS to winch and from winch to towing block. The relationship between wireout and the distance of the Chirp relative to the block behind the ship and depth below the sea surface were determined empirically and fit to a quadratic function.

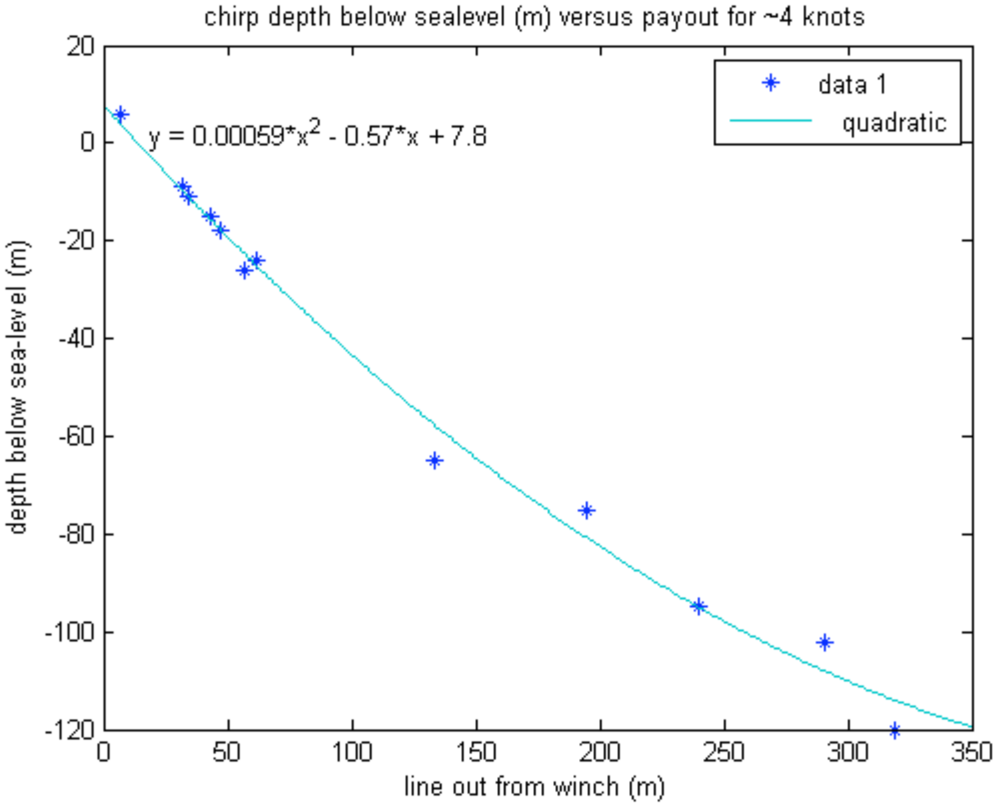


Fig. 11. Empirically determined quadratic function defining the wireout versus depth below sea-level relationship. This equation also allows for determination of distance behind the block at different wireouts.

<u>*Observations*</u>

In Appendix E1, the area where each line was acquired is shown by an abbreviation. These include: PaP-Port au Prince, GG- Baie de Grand Goave, PG- Baie de Petit Goave, CdS- Canal du Sud, GI- Gonave Island, EC- East Coast of Canal du Sud, SC- South Coast of Canal du Sud, and StM- Baie de St. Marc. Where a line is transiting between two survey areas we label with the #2 between the abbreviations (see Appendix E1). In general the deep tow Chirp out-performed the Knudson Chirp in waters shallower than ~750 m while the Knudson out performed the Edgetech in deeper waters. Neither chirp penetrated the sea surface along steep slopes with minimal recent sediment, whereas both chirps did better in the presence of soft sediment as expected.

Some highlights of our observations are shown in Figures 12-19.

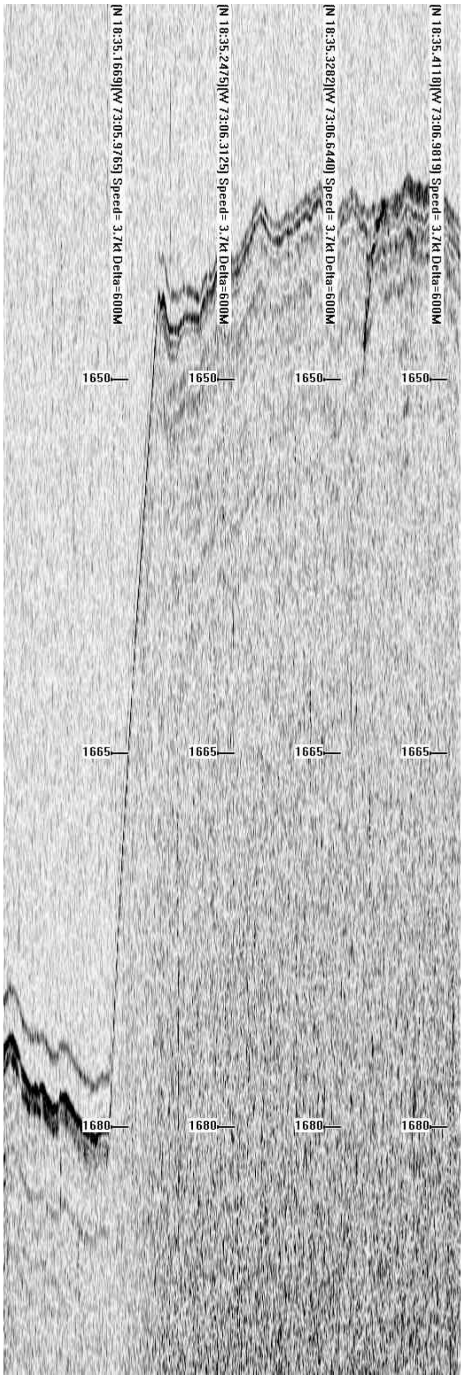


Fig. 12. Breaks in topography with extremely steep slopes suggestive of potential fault scarps (vertical exaggeration ~120X).

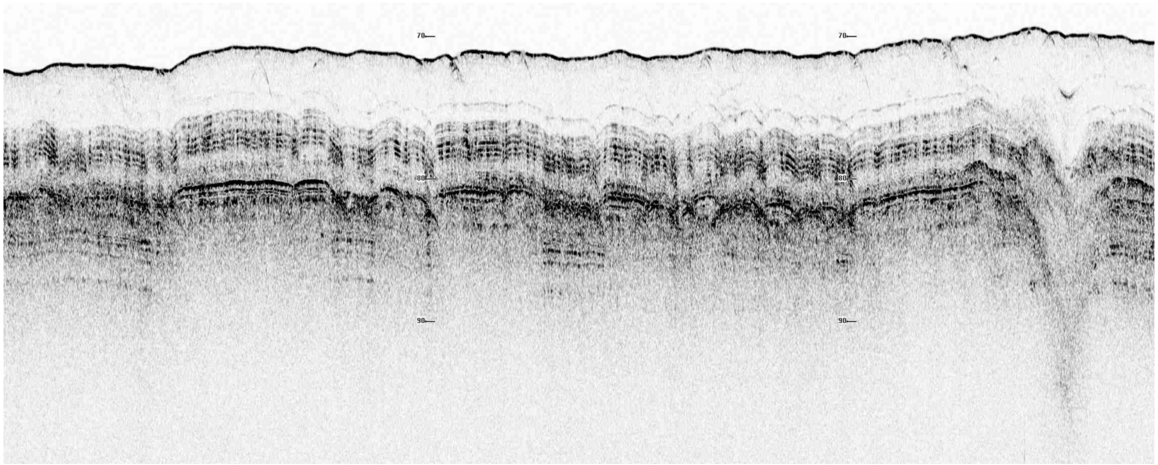


Fig. 13. Potential outflow channel within the suspected paleolake beneath Baie de Port-au-Prince. Depth of penetration is >20 m.

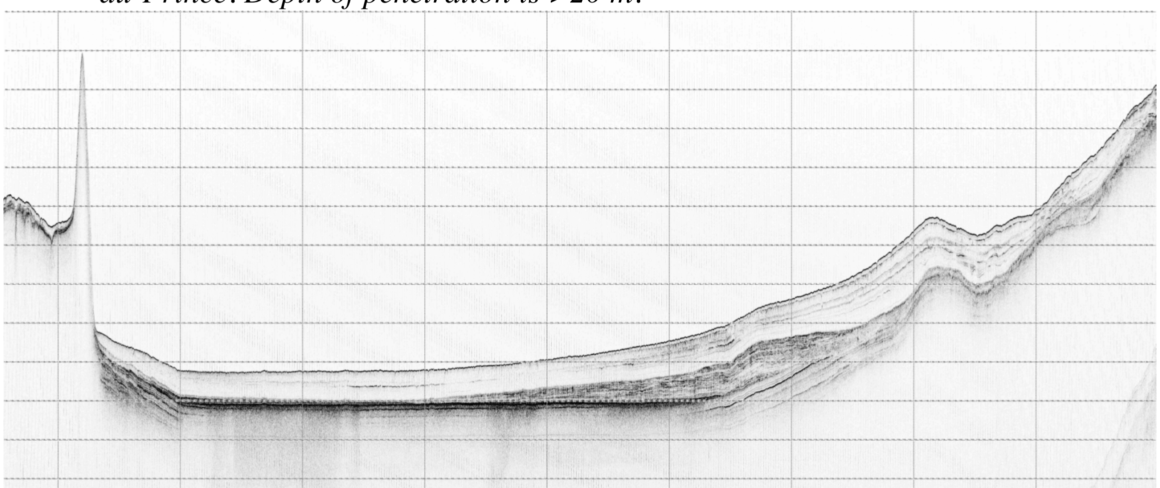


Fig. 14. Within the suspected paleolake evidence of active deformation and slumping. Horizontal lines are 10 m apart; vertical lines are ~500 m apart for Figs 14 and 15.

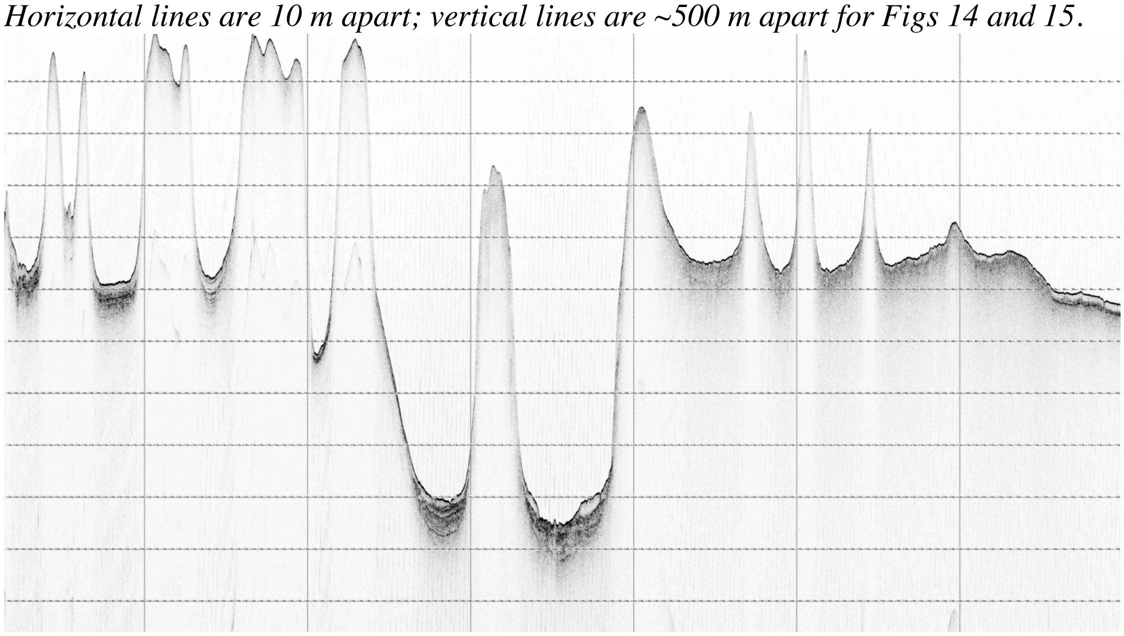


Fig. 15. Karst topography with sediments and slumps in between in Baie de Port-au-Prince.

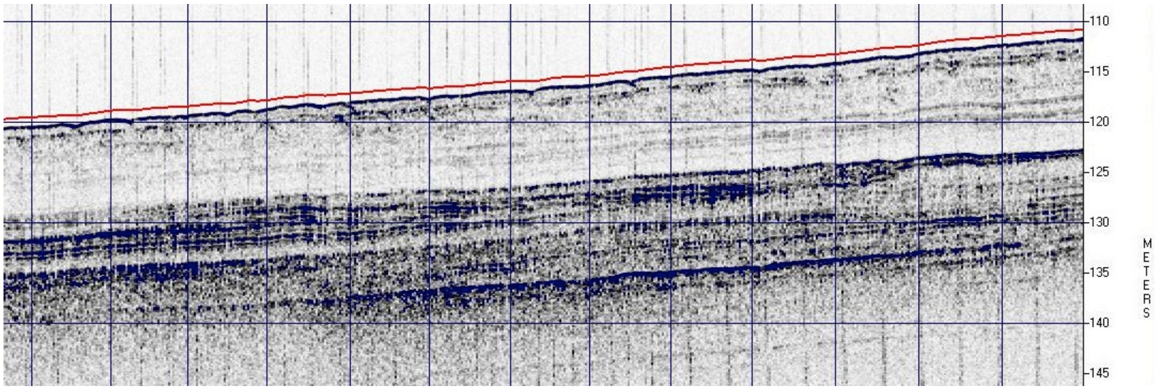


Fig. 16. Evidence of possible shorelines within the paleolake fill.

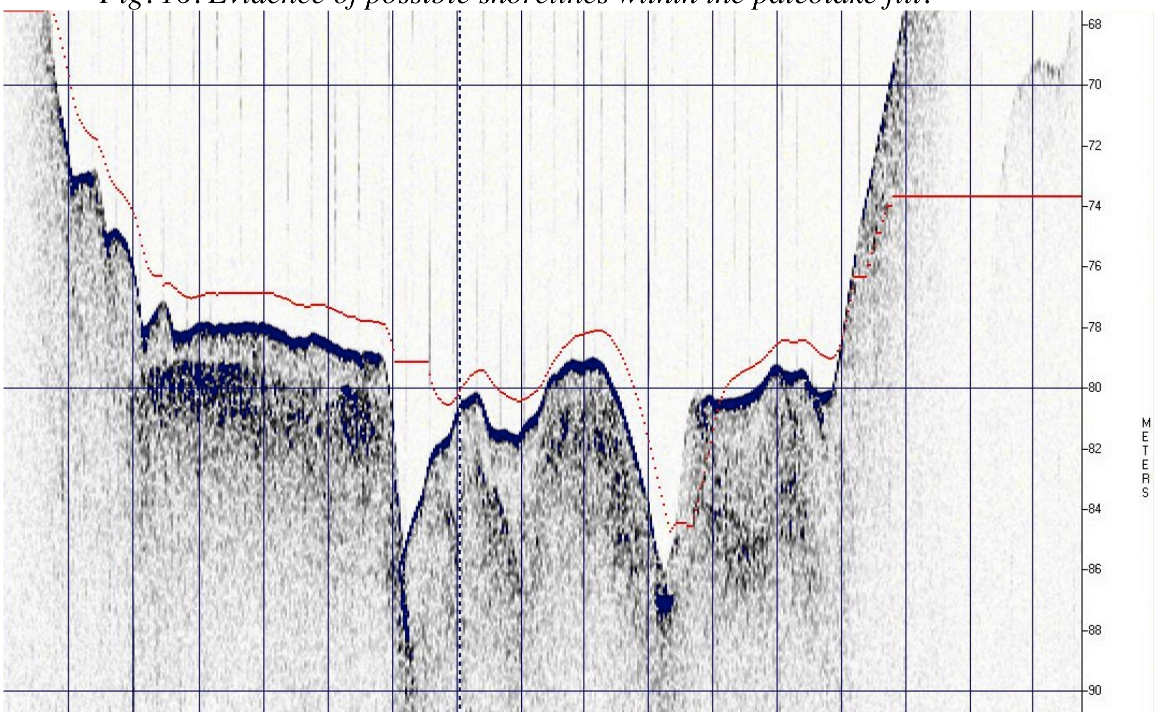


Fig. 17. Potential sinkholes suggestive of active hydrologic system beneath reefs that rim Port-au-Prince.

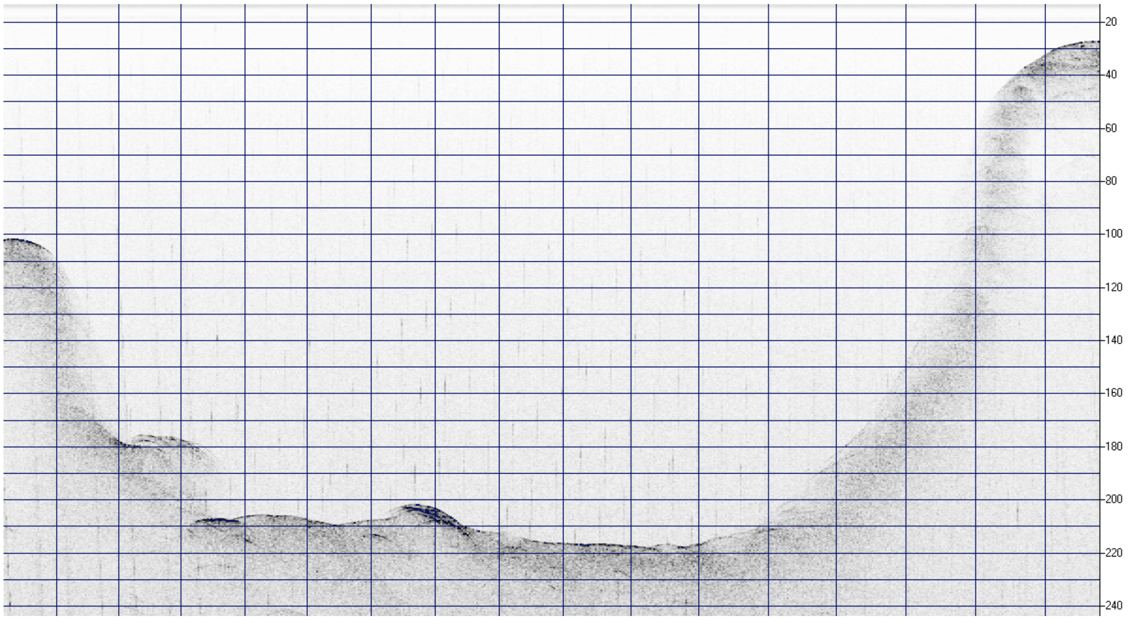


Fig. 18. Slide scar from slump in Baie de St. Marc that correlates with multibeam.

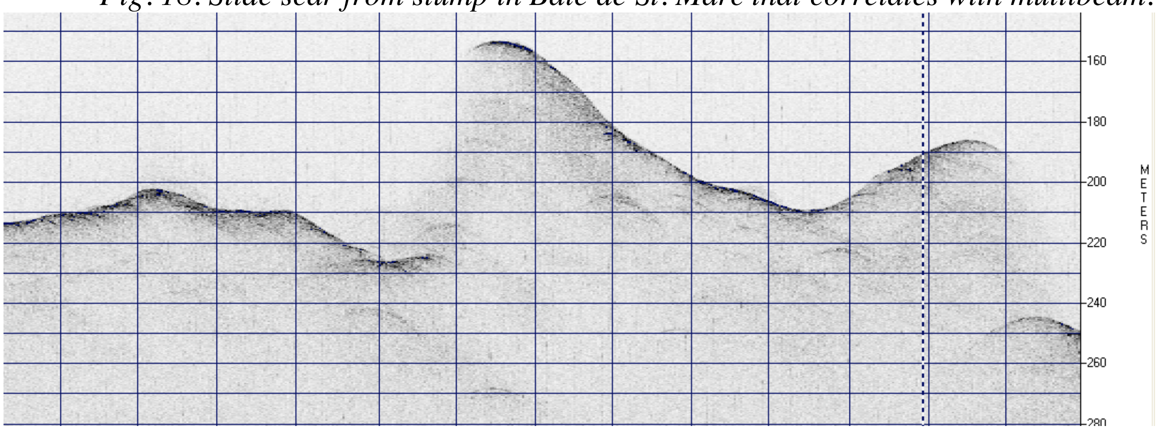


Fig. 19. Potential faults cutting offshore Ile de Gonave.

Fig 20: Photo of Chirp recovery.

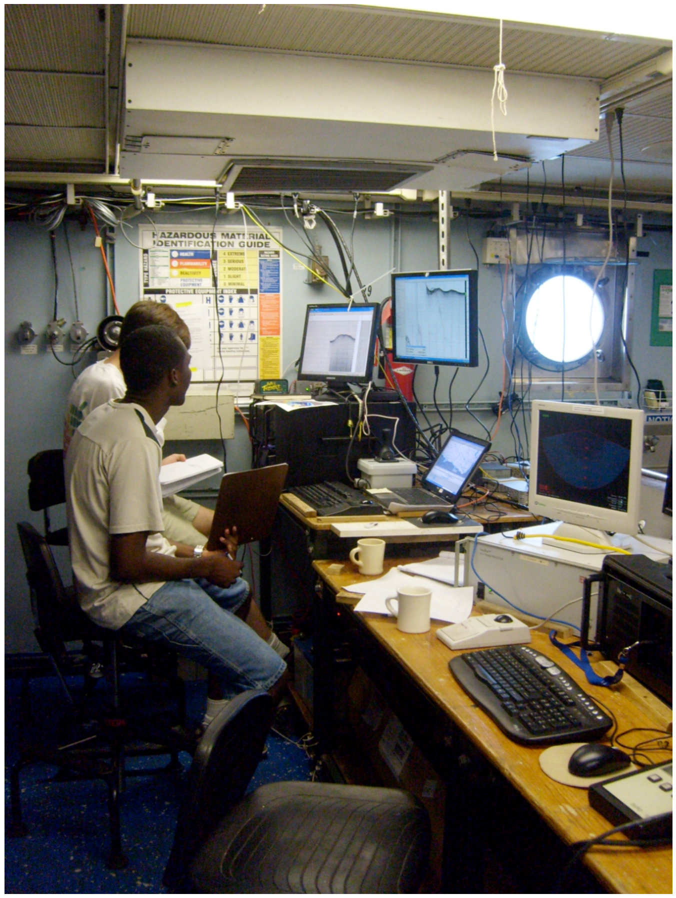


Fig 21: Photo of operation station

Table 3. Chirp Line Summary

Line Number	File Name	Time	Pulse	Record Start	Record Stop	Format	Notes
Line 1	line1	2/28 - 13:22	.7-12	0	150	.jsf, .sgy	
	line1.001	2/28 - 13:25	.7-12	0	200	.jsf, .sgy	
	line1.002	2/28 - 13:46	.7-12	0	200	.jsf, .sgy	
Line 2	line2	2/28 - 13:57	.7-12	0	200	.jsf, .sgy	
	line2.001	2/28 - 14:18	.7-12	0	200	.jsf, .sgy	
	line2.002	2/28 - 14:39	.7-12	0	200	.jsf, .sgy	
	line2.003	2/28 - 15:00	.7-12	0	200	.jsf, .sgy	
	line2.004	2/28 - 15:21	.7-12	0	200	.jsf, .sgy	
	line2.005	2/28 - 15:42	.7-12	0	200	.jsf, .sgy	
	line2.006	2/28 - 16:03	.7-12	0	200	.jsf, .sgy	
	line2.007	2/28 - 16:24	.7-12	0	200	.jsf, .sgy	
	line2.008	2/28 - 16:35	.7-12	0	500	.jsf, .sgy	
	line2.009	2/28 - 16:41:00 PM	.7-12	0	1000	.jsf, .sgy	
	line2.010	2/28 - 16:57	.7-12	0	1000	.jsf, .sgy	
	line2.011	2/28 - 17:17	.7-12	0	1000	.jsf, .sgy	
	line2.012	2/28 - 17:27	.7-12	0	1500	.jsf, .sgy	
	line2.013	2/28 - 17:46	.7-12	0	1500	.jsf, .sgy	
	line2.014	2/28 - 17:57	.7-12	0	1500	.jsf, .sgy	
Line 3	line3	2/28 - 18:11	.7-12	0	1500	.jsf, .sgy	
	line3.001	2/28 - 18:38	.7-12	0	1500	.jsf, .sgy	
Line 4	line4	2/28 - 20:40	.7-12	0	1500	.jsf, .sgy	

	line4.001	2/28 - 21:00	.7-12	0	1500	.jsf, .sgy	
Line 5	line5	2/28 - 21:12	.7-12	0	1500	.jsf, .sgy	
		2/28 - 21:18	.7-12	500	2000	.jsf, .sgy	
	line5.001	2/28 - 21:35	.7-12	500	2000	.jsf, .sgy	
	line5.002	2/28 - 22:01	.7-12	500	2000	.jsf, .sgy	
	line5.003	2/28 - 22:27	.7-12	500	2000	.jsf, .sgy	
	line5.004	2/28 - 22:53	.7-12	500	2000	.jsf, .sgy	
	line5.005	2/28 - 23:19	.7-12	500	2000	.jsf, .sgy	
Line 6	line6	2/28 - 23:24	.7-12	500	2000	.jsf, .sgy	
	line6.001	2/28 - 23:50	.7-12	500	2000	.jsf, .sgy	
	line6.002	3/1 - 0:15	.7-12	500	2000	.jsf, .sgy	
Line 7	line7	3/1 - 0:33	.7-12	500	2000	.jsf, .sgy	
	line7.001	3/1 - 0:58	.7-12	500	2000	.jsf, .sgy	
	line7.002	3/1 - 1:09	.7-12	250	1500	.jsf, .sgy	
	line7.003	3/1 - 1:33	.7-12	250	1500	.jsf, .sgy	
	line7.004	3/1 - 1:56	.7-12	250	1500	.jsf, .sgy	
	line7.005	3/1 - 2:20	.7-12	250	1500	.jsf, .sgy	
	line7.006	3/1 - 2:43	.7-12	250	1500	.jsf, .sgy	
Line 8	line8	3/1 - 3:03	.7-12	250	1500	.jsf, .sgy	
	line8.001	3/1 - 3:30	.7-12	250	1500	.jsf, .sgy	
		3/1 - 3:33	.7-12	100	2250		
	line8.002	system crash file only 225kb					
	line8a	3/1 - 3:37	.7-12	1000	3000	.jsf	

	line8a.001	3/1 - 4:05	.7-12	1000	3000	.jsf	
	line8a.002	3/1 - 4:34	.7-12	1000	3000	.jsf	
	line8a.003	system crash file only 225kb				.jsf	
Line 9	line9	3/1 - 5:02	.7-12	1000	3000	.jsf	
	line9.001	3/1 - 5:31	.7-12	1000	3000	.jsf	
		3/1 - 5:41	.5-7.2	1000	3000		
	line9.002	3/1 - 5:56	.5-2.7	1000	3000	.jsf	
		3/1 - 6:20	.5-2.7	0	1000		
		3/1 - 6:22	.5-2.7	500	2000		
	line9.003	3/1 - 6:28	.5-2.7	500	2000	.jsf	
		3/1 - 6:33	.4-4	500	2000		
		3/1 - 6:38	.5-4.5	500	2000		
		3/1 - 6:41	.5-2.7	500	2000		
	line9.004	3/1 - 6:55	.5-2.7	500	2000	.jsf	
	line9.005	3/1 - 7:21	.5-2.7	500	2000	.jsf	
		3/1 - 7:36	1.0-10.0	500	2000		
		3/1 - 7:37	1.0-6.0	500	2000		Interference from 3.5?
	line9.006	3/1 - 7:46	1.0-6.0	500	2000	.jsf	
Line 10	line10	3/1 - 7:47	1.0-6.0	500	2000	.jsf	
	line10.001	3/1 - 7:47	1.0-6.0	500	2000	.jsf	
Line 11	line11	3/1 - 8:11	1.0-6.0	500	2000	.jsf	Interference from 3.5?
	line11.001	3/1 - 8:37	1.0-6.0	500	2000	.jsf	Interference from 3.5?
	line11.002	3/1 - 9:03	1.0-6.0	500	2000	.jsf	Interference from 3.5?
		3/1 - 9:05	.5-7.2	500	2000		
		3/1 - 9:11	.7-12	500	2000		
		3/1 - 9:13	1.0-6.0	500	2000		
		3/1 - 9:19	.5-4.5	500	2000		
		3/1 - 9:21	.5-7.2	500	2000		
	line11.003	3/1 - 9:30	.5-7.2	500	2000	.jsf	Interference from 3.5?
	line11.004	3/1 - 9:55	.5-7.2	500	2000	.jsf	
		3/1 - 10:18	.5-7.2	250	1500		
	line11.005	3/1 - 10:21	.5-7.2	250	1500	.jsf	Interference from 3.5?
Line 12	line12	3/1 - 10:31	.5-7.2	250	1500	.jsf	Interference from 3.5?
		3/1 - 10:32	1.0-6.0	250	1500		
		3/1 - 10:38	1.0-6.0	0	1000		

	line12.001	3/1 - 10:52	1.0-6.0	0	1000	.jsf	interference from 3.5
		3/1 - 11:10	1.0-6.0	250	1500		interference from 3.5
	line12.002	3/1 - 11:13	1.0-6.0	250	1500	.jsf	interference from 3.5
	line12.003	3/1 - 11:36	1.0-6.0	250	1500	.jsf	interference from 3.5
	line12.004	3/1 - 12:00	1.0-6.0	250	1500	.jsf	interference from 3.5
		3/1 - 12:21	1.0 - 6.0	500	2000		interference from 3.5
	line12.005	3/1 - 12:26	1.0-6.0	500	2000	.jsf	interference from 3.5
	line12.006	3/1 - 12:50	1.0-6.0	500	2000	.jsf	interference from 3.5
		3/1 - 12:53	.5-7.2	500	2000		interference from 3.5
		3/1 - 12:54	.7-12	500	2000		interference from 3.5
		3/1 - 12:55	1.0-6.0	500	2000		interference from 3.5
	line12.007	3/1 - 13:16	1.0-6.0	500	2000	.jsf	interference from 3.6
	line12.008	3/1 - 13:42	1.0-6.0	500	2000	.jsf	
		3/1 - 13:43	.5-7.2	500	2000		
		3/1 - 13:44	.5-2.7	500	2000		
		3/1 - 13:46	.4-4	500	2000		
		3/1 - 13:47	.5-4.5	500	2000		
		3/1 - 13:38	.5-6	500	2000		
		3/1 - 13:49	.5 - 2.7	500	2000		
		3/1 - 13:51	.5-4.5	500	2000		
		3/1 - 13:54	1.0-6.0	500	2000		
		3/1 - 13:58	.5-2.7	500	2000		
		3/1 - 14:00	.5-4.5	500	2000		
		3/1 - 14:01	1.0-6.0	500	2000		
	line12.009	3/1 - 14:09	1.0-6.0	500	2000	.jsf	
	line12.010	3/1 - 14:35	1.0-6.0	500	2000	.jsf	
	line12.011	3/1 - 15:01	1.0-6.0	500	2000	.jsf	
	line12.012	3/1 - 15:30	1.0-6.0	500	2000	.jsf	
Line 13	line13	system crash					
	line13.001	system crash					
	line13.002	system crash					
	line13.003	system crash					
	line13a	system crash					

	line13b	system crash					
	line 13c	system crash					
	line13d	3/2 - 04:11	1.0-6.0	1000	2000	.jsf	
Line 14	line14	3/2 - 04:47	1.0-6.0	1000	2000	.jsf	
	line14.001	3/2 - 05:25	1.0-6.0	1000	2000	.jsf	
	line14.002	3/2 - 6:04	1.0-6.0	1000	2000	.jsf	
Line 15	line15	3/2 - 6:24	1.0-6.0	1000	2000	.jsf	
	line15.001	3/2 - 7:03	1.0-6.0	1000	2000	.jsf	
	line15.002	3/2 - 7:41	1.0-6.0	1000	2000	.jsf	
Line 16	line16	3/2 - 7:55	1.0-6.0	1000	2000	.jsf	
Line 17	line17	3/1 - 8:09	1.0-6.0	1000	2000	.jsf	
	line17.001	3/2 - 8:48	1.0-6.0	1000	2000	.jsf	
	line17.002	3/2 - 9:27	1.0-6.0	1000	2000	.jsf	
Line 18	line18	3/2 - 9:34	1.0-6.0	1000	2000	.jsf	
Line 19	line19	3/2 - 9:49	1.0-6.0	1000	2000	.jsf	
	line19.001	3/2 - 10:28	1.0-6.0	1000	2000	.jsf	
	line19.002	3/2 - 11:07	1.0-6.0	1000	2000	.jsf	
Line 20	line20	3/2 - 11:12	1.0-6.0	1000	2000	.jsf	
	line20.001	3/2 - 11:51	1.0-6.0	1000	2000	.jsf	
Line 21	line21	3/2 - 12:04	1.0-6.0	1000	2000	.jsf	
Line 22	line22	empty					
	line22.001	3/2 - 12:24	1.0-6.0	1000	2000	.jsf	
	line22.002	3/2 - 13:02	1.0-6.0	1000	2000	.jsf	
Line 23	line23	3/3 - 10:03	0.5-7.2	0	1000	.jsf	Ping 0.5 hz
	line23a	3/3 - 10:20	0.5-7.2	0	1000	.jsf	Ping 1 hz
Line 24	line24	3/3 - 10:23	0.5-7.2	0	1000	.jsf	
	line24.001	3/3 - 10:43	0.5-7.2	0	1000	.jsf	
	line24.002	3/3 - 11:01	0.5-7.2	0	1000	.jsf	
Line 24a	line24a	3/3 - 11:08	.7-12	0	250	.jsf	Ping 10 hz
	line24a.001	3/3 - 11:29	.7-12	0	250	.jsf	
	line24a.002	3/3 - 11:49	.7-12	0	250	.jsf	
	line24a.003	3/3 - 12:12	.7-12	0	250	.jsf	
	line24a.004	3/3 - 12:31	.7-12	0	250	.jsf	
	line24a.005	3/3 - 12:52	.7-12	0	250	.jsf	
Line 25	line25	3/3 - 13:57	.7-12	0	250	.jsf	
	line25.001	3/3 - 14:18	.7-12	0	250	.jsf	
	line25.002	3/3 - 14:39	.7-12	0	250	.jsf	
	line25.003	3/3 - 15:00	.7-12	0	250	.jsf	
	line25.004	3/3 - 15:20	.7-12	0	250	.jsf	
	line25.005	3/3 - 15:42	.7-12	0	250	.jsf	fish rasied in middle of line
	line25.006	3/3 - 16:01	.7-12	0	250	.jsf	
Line 26	line26	3/3 - 16:13	.7-12	0	250	.jsf	
	line26.001	3/3 - 16:33	.7-12	0	250	.jsf	

	line26.002	3/3 - 16:53	.7-12	0	250	.jsf	
Line 27	line27	3/3 - 16:54	.7-12	0	250	.jsf	
		3/3 - 16:55	.7-12	0	1000	.jsf	
	line27.001	3/3 - 17:14	.7-12	0	1000	.jsf	fish rasied near beginning
Line 28	line28	3/3 - 17:19	.7-12	0	1000	.jsf	
	line28.001	3/3 - 17:40	.7-12	0	1000	.jsf	
	line28.002	3/3 - 17:59	.7-12	0	1000	.jsf	
	line28.003	3/3 - 18:17	.7-12	0	1000	.jsf	
	line28.004	3/3 - 18:37	.7-12	0	1000	.jsf	
	line28.005	3/3 - 18:57	.7-12	0	1000	.jsf	
	line28.006	3/3 - 19:17	.7-12	0	1000	.jsf	
	line28.007	3/3 - 19:36	.7-12	0	1000	.jsf	
Line 28a	line28a	3/3 - 19:44	0.5-7.2	0	1000	.jsf	deepened fish
	line28a.001	3/3 - 20:03	0.5-7.2	0	1000	.jsf	
	line28a.002	3/3 - 20:25	0.5-7.2	0	1000	.jsf	
	line28a.003	3/3 - 20:44	0.5-7.2	0	1000	.jsf	
	line28a.004	3/3 - 21:04	0.5-7.2	0	1000	.jsf	
Line 29	line29	3/3 - 21:15	0.5-7.2	0	1000	.jsf	flew fish at end to avoid bottom
	line29.001	3/3 - 21:35	0.5-7.2	0	1000	.jsf	flew fish at end a lot to avoid bottom
Line 30	line30	3/3 - 21:48	0.5-7.2	0	1000	.jsf	
	line30.001	3/3 - 22:08	0.5-7.2	0	1000	.jsf	
	line30.002	3/3 - 22:27	0.5-7.2	0	1000	.jsf	
	line30.003	3/3 - 22:48	0.5-7.2	0	1000	.jsf	
	line30.004	3/3 - 23:06	0.5-7.2	0	1000	.jsf	
	line30.005	3/3 - 23:28	0.5-7.2	0	1000	.jsf	
Line 31	line31	3/3 - 23:40	0.5-7.2	0	1000	.jsf	
Line 32	line32	3/4 - 00:00	0.5-7.2	0	1000	.jsf	
	line32.001	3/4 - 00:19	0.5-7.2	0	1000	.jsf	
	line32.002	3/4 - 00:39	0.5-7.2	0	1000	.jsf	
	line32.003	3/4 - 01:00	0.5-7.2	0	1000	.jsf	
Line 33	line33	3/4 - 01:15	0.5-7.2	0	1000	.jsf	
	line33.001	3/4 - 01:36	0.5-7.2	0	1000	.jsf	
	line33.002	3/4 - 01:55	0.5-7.2	0	1000	.jsf	
Line 34	line34	3/4 - 02:08	0.5-7.2	0	1000	.jsf	
	line34.001	3/4 - 02:29	0.5-7.2	0	1000	.jsf	
	line34.002	3/4 - 02:49	0.5-7.2	0	1000	.jsf	
	line34.003	3/4 - 03:08	0.5-7.2	0	1000	.jsf	
	line34.004	3/4 - 03:30	0.5-7.2	0	1000	.jsf	
	line34.005	3/4 - 03:47	0.5-7.2	0	1000	.jsf	
	line34.006	3/4 - 04:07	0.5-7.2	0	1000	.jsf	

	line34.007	3/4 - 04:27	0.5-7.2	0	1000	.jsf	
	line34.008	3/4 - 04:44	0.5-7.2	0	1000	.jsf	
Line 35	line35	3/4 - 04:45	0.5-7.2	0	1000	.jsf	
		3/4 - 04:46	.7-12	0	1000	.jsf	
Line 35a	line35a	3/4 - 04:50	.7-12	0	1000	.jsf	
	line35a.001	3/4 - 05:07	.7-12	0	1000	.jsf	
	line35a.002	3/4 - 05:27	.7-12	0	1000	.jsf	
	line35a.003	3/4 - 05:48	.7-12	0	1000	.jsf	
	line35a.004	3/4 - 06:07	.7-12	0	1000	.jsf	
	line35a.005	3/4 - 06:27	.7-12	0	1000	.jsf	
	line35a.006	3/4 - 06:46	.7-12	0	1000	.jsf	
	line35a.007	3/4 - 07:06	.7-12	0	1000	.jsf	
	line35a.008	3/4 - 07:26	.7-12	0	1000	.jsf	
	line35a.009	3/4 - 07:43	.7-12	0	1000	.jsf	
Line 36	line36	3/4 - 07:45	.7-12	0	1000	.jsf	
	line36.001	3/4 - 08:03	.7-12	0	1000	.jsf	
	line36.002	3/4 - 08:23	.7-12	0	1000	.jsf	
	line36.003	3/4 - 08:44	.7-12	0	1000	.jsf	
	line36.004	3/4 - 09:02	.7-12	0	1000	.jsf	
	line36.005	3/4 - 09:23	.7-12	0	1000	.jsf	
	line36.006	3/4 - 09:43	.7-12	0	1000	.jsf	
	line36.007	3/4 - 10:02	.7-12	0	1000	.jsf	
	line36.008	3/4 - 10:21	.7-12	0	1000	.jsf	10:29 changed wireout
Line 36a	line36a	3/4 - 10:35	.7-12	0	1000	.jsf	
		3/4 - 10;40	0.5-7.2	0	1000	.jsf	
Line 36b	line36b	3/4 - 10:41	0.5-7.2	0	1000	.jsf	
	line36b.001	3/4 - 11;02	0.5-7.2	0	1000	.jsf	
	line36b.002	3/4 - 11:21	0.5-7.2	0	1000	.jsf	
	line36b.003	3/4 - 11:39	0.5-7.2	0	1000	.jsf	
	line36b.004	3/4 - 12:01	0.5-7.2	0	1000	.jsf	
Line 36c	line36c	3/4 - 12:10	.7-12	0	1000	.jsf	
	line36c.001	3/4 - 12:30	.7-12	0	1000	.jsf	
	line36c.002	3/4 - 12:52	.7-12	0	1000	.jsf	
Line 37	line37	3/4 - 12:59	.7-12	0	1000	.jsf	
	line37.001	3/4 - 13:17	.7-12	0	1000	.jsf	
Line 38	line38	3/4 - 14:26	.7-12	0	1000	.jsf	
Line 37a	line37a	3/4 - 14:39	.7-12	0	1000	.jsf	Note # mixup
Line 39	line39	3/4 - 14:52	.7-12	0	1000	.jsf	
Line 40	line40	3/4 - 15:05	.7-12	0	1000	.jsf	
	line40.001	3/4 - 15:24	.7-12	0	1000	.jsf	
	line40.002	3/4 - 15:41	.7-12	0	1000	.jsf	
	line40.003	3/4 - 16:03	.7-12	0	1000	.jsf	
Line 41	line41	3/4 - 16:09	.7-12	0	1000	.jsf	

Line 42	line42	3/4 - 16:19	.7-12	0	1000	.jsf	
	line42.001	3/4 - 16:38	.7-12	0	1000	.jsf	
Line 43	line43	3/4 - 17:36	.7-12	0	1000	.jsf	
Line 44	line44	3/4 - 17:50	.7-12	0	1000	.jsf	
	line44.001	3/4 - 18:18	.7-12	0	1000	.jsf	
	line44.002	3/4 - 18:28	.7-12	0	1000	.jsf	
	line44.003	3/4 - 18:47	.7-12	0	1000	.jsf	
	line44.004	3/4 - 19:07	.7-12	0	1000	.jsf	
Line 45	line45	3/4 - 19:16	.7-12	0	1000	.jsf	
	line45a	3/4 - 19:22	.5-7.2	0	1000	.jsf	
	line45a.001	3/4 - 19:42	.5-7.2	0	1000	.jsf	
	line45b.001	3/4 - 19:56	.5-7.2	0	1000	.jsf	
	line45b.002	3/4 - 20:21	.5-7.2	0	1000	.jsf	
	line45b.003	3/4 - 20:41	.5-7.2	0	1000	.jsf	
	line45b.004	3/4 - 21;01	.5-7.2	0	1000	.jsf	
Line 46	line46	3/4 - 21:10	.7-12	0	1000	.jsf	
	line46.001	3/4 - 21:35	.7-12	0	1000	.jsf	
	line46.002	3/4 - 21:57	.7-12	0	1000	.jsf	
Line 47	line47.000	3/5 - 15:33	.5-7.2	0	1000	.jsf	
	line47.001	3/5 - 15:59	.5-7.2	0	1000	.jsf	
	line47.002	3/5 - 16:17	.5-7.2	0	1000	.jsf	
Line 48	line48	3/5 - 16:21	.5-7.2	0	1000	.jsf	
	line48a	3/5 - 17:30	.5-7.2	0	1000	.jsf	
	line48a.001	3/5 - 17:51	.5-7.2	0	1000	.jsf	
	line48a.002	3/5 - 18:09	.5-7.2	0	1000	.jsf	
	line48a.003	3/5 - 18:26	.5-7.2	0	1000	.jsf	
	line48a.004	3/5 - 18:49	.5-7.2	0	1000	.jsf	
Line 49	line49	3/5 - 18:59	.5-7.2	0	1000	.jsf	
	line49.001	3/5 - 19:14	.5-7.2	0	1000	.jsf	
	line49.002	3/5 - 19:35	.5-7.2	0	1000	.jsf	
	line49.003	3/5 - 19:55	.5-7.2	0	1000	.jsf	
Line 50	line50	3/5 - 20:07	.5-7.2	0	1000	.jsf	
	line50.001	3/5 - 20:28	.5-7.2	0	1000	.jsf	
	line50.002	3/5 - 20:46	.5-7.2	0	1000	.jsf	
	line50.003	3/5 - 21:10	.5-7.2	0	1000	.jsf	
	line50.004	3/5 - 21:31	.5-7.2	0	1000	.jsf	
Line 51	line51	3/5 - 21:53	.5-7.2	0	1000	.jsf	
	line51.001	3/5 - 22:14	.5-7.2	0	1000	.jsf	
	line51a	3/5 - 22:58	.7-12	0	1000	.jsf	
	line51a.001	3/5 - 23:18	.7-12	0	1000	.jsf	
	line51a.002	3/5 - 23:37	.7-12	0	1000	.jsf	
Line 52	line52	3/5 - 23:51	.7-12	0	1000	.jsf	
	line52a	3/5 - 23:58	.5-7.2	0	1000	.jsf	
	line52a.001	3/6 - 00:16	.5-7.2	0	1000	.jsf	

	line52b	3/6 - 00:32	1.0-6.0	0	1000	.jsf	
	line52c	3/6 - 00:54	1.0-6.0	0	1000	.jsf	
	line52c.001	3/6 - 01:30	1.0-6.0	0	1000	.jsf	
	line52c.002	3/6 - 02:07	1.0-6.0	0	1000	.jsf	
	line52c.003	3/6 - 02:49	1.0-6.0	0	1000	.jsf	
	line52c.004	3/6 - 03:30	1.0-6.0	0	1000	.jsf	
	line52c.005	3/6 - 04:03	1.0-6.0	0	1000	.jsf	
Line 53	line53	3/6 - 04:20	1.0-6.0	0	1000	.jsf	
	line53.001	3/6 - 04:57	1.0-6.0	0	1000	.jsf	
Line 54	line54	3/6 - 05:04	1.0-6.0	0	1000	.jsf	
	line54.001	3/6 - 05:42	1.0-6.0	0	1000	.jsf	
	line54.002	3/6 - 06:12	1.0-6.0	0	1000	.jsf	change to fish depth
	line54.003	3/6 - 06:46	1.0-6.0	0	1000	.jsf	change to fish depth
Line 55	line55	3/6 - 06:49	1.0-6.0	0	1000	.jsf	
	line55.001	3/6 - 07:16	1.0-6.0	0	1000	.jsf	
	line55.002	3/6 - 07:48	1.0-6.0	0	1000	.jsf	
	line55.003	3/6 - 08:24	1.0-6.0	0	1000	.jsf	
Line 57	line57	3/6 - 08:43	1.0-6.0	0	1000	.jsf	
Line 58	line58	3/6 - 09:02	1.0-6.0	0	1000	.jsf	
Line 59	line59	3/6 - 09:23	1.0-6.0	0	1000	.jsf	
Line 60	line60	3/6 - 09:44	1.0-6.0	0	1000	.jsf	
	line60.001	3/6 - 10:17	1.0-6.0	0	1000	.jsf	
Line 61	line61	3/6 - 10:45	1.0-6.0	0	1000	.jsf	
	line61.001	3/6 - 11:14	1.0-6.0	0	1000	.jsf	
	line61.002	3/6 - 11:42	1.0-6.0	0	1000	.jsf	
	line61.003	3/6 - 12:20	1.0-6.0	0	1000	.jsf	
	line61.004	3/6 - 12:51	1.0-6.0	0	1000	.jsf	
	line61.005	3/6 - 13:24	1.0-6.0	0	1000	.jsf	
	line61.006	3/6 - 14:02	1.0-6.0	0	1000	.jsf	
	line61.007	3/6 - 14:33	1.0-6.0	0	1000	.jsf	
	line61.008	3/6 - 15:07	1.0-6.0	0	1000	.jsf	
Line 62	line62	3/6 - 20:19	1.0-6.0	0	1000	.jsf	
	line62.001	3/6 - 20:54	1.0-6.0	0	1000	.jsf	
	line62.002	3/6 - 21:26	1.0-6.0	0	1000	.jsf	
	line62a	3/6 - 21:41	.5-7.2	0	1000	.jsf	
	line62a.001	3/6 - 22:07	.5-7.2	0	1000	.jsf	
	line62a.002	3/6 - 22:28	.5-7.2	0	1000	.jsf	
	line62b	3/6 - 22:34	.5-7.2	0	1000	.jsf	change to fish depth
Line 63	line63	3/6 - 22:46	.5-7.2	0	1000	.jsf	
	line63.001	3/6 - 23:06	.5-7.2	0	1000	.jsf	
	line63.002	3/6 - 23:26	.5-7.2	0	1000	.jsf	

	line63.003	3/6 - 23:44	.5-7.2	0	1000	.jsf
	line63.004	3/7 - 00:03	.5-7.2	0	1000	.jsf
	line63.005	3/7 - 00:23	.5-7.2	0	1000	.jsf
	line63.006	3/7 - 00:43	.5-7.2	0	1000	.jsf
	line63.007	3/7 - 01:02	.5-7.2	0	1000	.jsf
	line63a	3/7 - 01:18	.7-12	0	300	.jsf
	line63b	3/7 - 01:21	.7-12	0	300	.jsf
	line63b.001	3/7 - 01:39	.7-12	0	300	.jsf
	line63b.002	3/7 - 02:01	.7-12	0	300	.jsf
	line63b.003	3/7 - 02:22	.7-12	0	300	.jsf
	line63b.004	3/7 - 02:41	.7-12	0	300	.jsf
	line63b.005	3/7 - 03:01	.7-12	0	300	.jsf
	line63b.006	3/7 - 03;22	.7-12	0	300	.jsf
	line63b.007	3/7 - 03:41	.7-12	0	300	.jsf
	line63b.008	3/7 - 04:01	.7-12	0	300	.jsf
	line63b.009	3/7 - 04:23	.7-12	0	300	.jsf
	line63b.010	3/7 - 04:42	.7-12	0	300	.jsf
	line63b.011	3/7 - 05:02	.7-12	0	300	.jsf
	line63b.012	3/7 - 05:23	.7-12	0	300	.jsf
	line63b.013	3/7 - 05:43	.7-12	0	300	.jsf
	line63b.014	3/7 - 06:03	.7-12	0	300	.jsf
	line63b.015	3/7 - 06:25	.7-12	0	300	.jsf
	line63b.016	3/7 - 06:44	.7-12	0	300	.jsf
	line63b.017	3/7 - 07:04	.7-12	0	300	.jsf
	line63b.018	3/7 - 07:25	.7-12	0	300	.jsf
	line63b.019	3/7 - 07:45	.7-12	0	300	.jsf
	line63b.020	3/7 - 08:05	.7-12	0	300	.jsf
	line63b.021	3/7 - 08:26	.7-12	0	300	.jsf
	line63b.022	3/7 - 08:47	.7-12	0	400	.jsf
	line63c	3/7 - 09:06	.5-7.2	0	400	.jsf
	line63d	3/7 - 09:08	.5-7.2	0	400	.jsf
	line63d.001	3/7 - 09:37	.5-7.2	0	400	.jsf
	line63d.002	3/7 - 10:03	.5-7.2	0	400	.jsf
	line63e	3/7 - 10:08	.5-7.2	0	500	.jsf
	line63e.001	3/7 - 10:28	.5-7.2	0	500	.jsf
	line63e.002	3/7 - 10:48	.5-7.2	0	500	.jsf
Line 64	line64	3/7 - 10:52	.5-7.2	0	500	.jsf
	line64.001	3/7 - 11:12	.5-7.2	0	500	.jsf
Line 65	line65	3/7 - 11:19	.5-7.2	0	500	.jsf
	line65.001	3/7 - 11:39	.5-7.2	0	500	.jsf
	line65a	3/7 - 12:02	.7-12	0	500	.jsf
	line65a.001	3/7 - 12:22	.7-12	0	500	.jsf
	line65b	3/7 - 12:35	.7-12	0	500	.jsf
	line65c	3/7 - 12:41	.7-12	0	500	.jsf

	line65c.001	3/7 - 13:01	.7-12	0	500	.jsf	
	line65c.002	3/7 - 13:21	.7-12	0	500	.jsf	
	line65c.003	3/7 - 13:41	.7-12	0	500	.jsf	
	line65c.004	3/7 - 14:01	.7-12	0	500	.jsf	
	line65c.005	3/7 - 14:21	.7-12	0	500	.jsf	
	line65c.006	3/7 - 14:44	.7-12	0	500	.jsf	
	line65c.007	3/7 - 15:03	.7-12	0	500	.jsf	
	line65c.008	3/7 - 15:20	.7-12	0	500	.jsf	
	line65c.009	3/7 - 15:40	.7-12	0	500	.jsf	
	line65c.010	3/7 -16:00	.7-12	0	500	.jsf	
	line65c.011	3/7 - 16:20	.7-12	0	500	.jsf	
	line65c.012	3/7 - 16:39	.7-12	0	500	.jsf	
	line65c.013	3/7 - 16:59	.7-12	0	500	.jsf	
Line 66	line66	3/7 - 17:20	.7-12	0	500	.jsf	
	line66.001	3/7 - 17:38	.7-12	0	500	.jsf	
	line66.002	3/7 - 17:58	.7-12	0	500	.jsf	
	line66.003	3/7 - 18:17	.7-12	0	500	.jsf	
	line66a	3/7 - 18:52	.7-12	0	500	.jsf	
	line66a.001	3/7 - 19:10	.7-12	0	500	.jsf	
	line66b	3/7 - 19:20	.7-12	0	500	.jsf	
	line66b.001	3/7 - 19:43	.7-12	0	500	.jsf	
	line66b.002	3/7 - 20:00	.7-12	0	500	.jsf	
	line66b.003	3/7 - 20:17	.7-12	0	500	.jsf	
	line66b.004	3/7 - 20:37	.7-12	0	500	.jsf	
	line66b.005	3/7 - 20:57	.7-12	0	500	.jsf	
	line66b.006	3/7 - 21:16	.7-12	0	500	.jsf	
	line66b.007	3/7 - 21:36	.7-12	0	500	.jsf	
	line66b.008	3/7 - 21:59	.7-12	0	500	.jsf	
	line66b.009	3/7 - 22:16	.7-12	0	500	.jsf	
	line66b.010	3/7 - 22:36	.7-12	0	500	.jsf	
	line66b.011	3/7 - 22:56	.7-12	0	500	.jsf	
Line 67	line67	3/7 - 23:10	.7-12	0	500	.jsf	
	line67.001	3/7 - 23:30	.7-12	0	500	.jsf	
Line 68	line68	3/8 - 09:35	.7-12	0	750	.jsf	
	line68.001	3/8 - 09:54	.7-12	0	750	.jsf	
	line68.003	3/8 - 10:33	.7-12	0	750	.jsf	
	line68.004	3/8 - 10:53	.7-12	0	750	.jsf	
	line68.005	3/8 - 11:12	.7-12	0	750	.jsf	
	line68.002	3/8 - 11:54	.7-12	0	750	.jsf	
Line 69	line69	3/8 - 11:16	.7-12	0	750	.jsf	**Time Discrepancy between the lines 68 and 69**
	line69.001	3/8 - 11:37	.7-12	0	750	.jsf	

	line69.002	3/8 - 11:54	.7-12	0	750	.jsf
	line69.003	3/8 - 12:13	.7-12	0	750	.jsf
	line69.004	3/8 - 12:33	.7-12	0	750	.jsf
	line69.005	3/8 - 12:53	.7-12	0	750	.jsf
Line 70	line70	3/8 - 13:47	.7-12	0	500	.jsf
	line70.001	3/8 - 14:08	.7-12	0	500	.jsf
	line70.002	3/8 - 14:24	.7-12	0	500	.jsf
	line70.003	3/8 - 14:44	.7-12	0	500	.jsf
Line 72	line72	3/8 - 15:00	.7-12	0	500	.jsf
Line 73	line73	3/8 - 15:07	.7-12	0	500	.jsf
Line 74	line74	3/8 - 15:20	.7-12	0	500	.jsf
Line 75	line75	3/8 - 15:26	.7-12	0	500	.jsf
Line 76	line76	3/8 - 15:34	.7-12	0	500	.jsf
Line 77	line77	3/8 - 15:45	.7-12	0	500	.jsf
Line 78	line78	3/8 - 15:58	.7-12	0	500	.jsf
Line 79	line79	3/8 - 16:00	.7-12	0	500	.jsf
Line 80	line80	3/8 - 16:04	.7-12	0	500	.jsf
Line 81	line81	3/8 - 16:14	.7-12	0	500	.jsf
Line 82	line82	3/8 - 16:20	.7-12	0	500	.jsf
Line 83	line83	3/8 - 16:27	.7-12	0	500	.jsf
Line 834	line834	3/8 - 16:34	.7-12	0	500	.jsf
Line 85	line85	3/8 - 16:40	.7-12	0	500	.jsf
Line 86	line86	3/8 - 17:32	.7-12	0	500	.jsf
	line86.001	3/8 - 17:52	.7-12	0	500	.jsf
Line 87	line87	3/8 - 17:54	.7-12	0	500	.jsf
Line 88	line88	3/8 - 18:11	.7-12	0	500	.jsf
Line 89	line89	3/8 - 18:28	.7-12	0	500	.jsf
	line89.001	3/8 - 18:49	.7-12	0	500	.jsf
	line89.002	3/8 - 19:07	.7-12	0	500	.jsf
Line 90	line90	3/8 - 19:19	.7-12	0	500	.jsf
Line 91	line91	3/8 - 19:34	.7-12	0	500	.jsf
	line91.001	3/8 - 19:54	.7-12	0	500	.jsf
	line91.002	3/8 - 20:14	.7-12	0	500	.jsf
	line91.003	3/8 - 20:34	.7-12	0	500	.jsf
	line91.004	3/8 - 20:54	.7-12	0	500	.jsf
Line 92	line92	3/8 - 21:03	.7-12	0	500	.jsf
	line92.001	3/8 - 21:19	.7-12	0	500	.jsf
	line92.002	3/8 - 21:38	.7-12	0	500	.jsf
	line92.003	3/8 - 21:58	.7-12	0	500	.jsf
	line92.004	3/8 - 22:18	.7-12	0	500	.jsf
Line 94	line94	3/9 - 00:09	.7-12	0	500	.jsf
	line94.001	3/9 - 00:29	.7-12	0	500	.jsf
	line94.002	3/9 - 00:48	.7-12	0	500	.jsf
	line94.003	3/9 - 01:08	.7-12	0	500	.jsf

	line94.004	3/9 - 01:28	.7-12	0	500	.jsf
Line 95	line95	3/9 - 01:43	.7-12	0	500	.jsf
	line95.001	3/9 - 02:03	.7-12	0	500	.jsf
Line 96	line96	3/9 - 02:20	.7-12	0	500	.jsf
	line96.001	3/9 - 02:39	.5-7.2	0	1000	.jsf
	line96.002	3/9 - 02:58	.5-7.2	0	1000	.jsf
Line 97	line97	3/9 - 03:07	.5-7.2	0	1000	.jsf
	line97.001	3/9 - 03:27	.5-7.2	0	1000	.jsf
Line 98	line98	3/9 - 03:43	.5-7.2	0	1000	.jsf
	line98.001	3/9 - 04:03	.5-7.2	0	1000	.jsf
	line98.002	3/9 - 04:21	.5-7.2	0	1000	.jsf
	line98.003	3/9 - 04:41	.5-7.2	0	1000	.jsf
	line98.004	3/9 - 05:02	.5-7.2	0	1000	.jsf
	line98.005	3/9 - 05:20	.5-7.2	0	1000	.jsf
Line 99	line99	3/9 - 05:31	.5-7.2	0	1000	.jsf
	line99.001	3/9 - 05:55	.5-7.2	0	1000	.jsf
	line99.002	3/9 - 06:10	.5-7.2	0	1000	.jsf
	line99.003	3/9 - 06:30	.5-7.2	0	1000	.jsf
	line99.004	3/9 - 06:50	.5-7.2	0	1000	.jsf
	like99.005	3/9 - 07:09	.5-7.2	0	1000	.jsf
Line 100	line100	3/9 - 07:27	.5-7.2	0	1000	.jsf
	line100.001	3/9 - 07:47	.5-7.2	0	1000	.jsf
	line100.002	3/9 - 08:07	.5-7.2	0	1200	.jsf
	line100.003	3/9 - 08:30	.5-7.2	0	1200	.jsf
	line100.004	3/9 - 08:55	.5-7.2	0	1500	.jsf
	line100.006	3/9 - 09:12	1.0-6.0	0	1500	.jsf
	line100.007	3/9 - 09:38	1.0-6.0	0	1500	.jsf
	line100.008	3/9 - 10:04	1.0-6.0	0	1500	.jsf
Line 101	line101	3/9 - 10:11	1.0-6.0	0	1500	.jsf
Line 102	line102	3/9 - 10:20	1.0-6.0	0	1500	.jsf
	line102.001	3/9 - 10:46	1.0-6.0	0	1500	.jsf
Line 103	line103	3/10 - 03:00	1.0-6.0	0	2000	.jsf
	line103.001	3/10 - 03:39	1.0-6.0	0	2000	.jsf
Line 104	line104	3/10 - 04:13	1.0-6.0	0	2000	.jsf
Line 105	line105	3/10 - 04:37	1.0-6.0	0	1000	.jsf
	line105.001	3/10 - 05:11	1.0-6.0	0	1000	.jsf
	line105.002	3/10 - 05:36	.5-7.2	0	1000	.jsf
	line105a	3/10 - 05:44	.5-7.2	0	1000	.jsf
	line105a.001	3/10 - 06:03	.5-7.2	0	1000	.jsf
Line 106	line106	3/10 - 06:23	.5-7.2	0	1000	.jsf
	line106a	3/10 - 06:42	.7-12	0	1000	.jsf
	line106a.001	3/10 - 07:01	.7-12	0	1000	.jsf
	line106a.002	3/10 - 07:21	.7-12	0	1000	.jsf
	line106a.003	3/10 - 07:40	.7-12	0	1000	.jsf

	line106a.004	3/10 - 08:00	.7-12	0	1000	.jsf
	line106a.005	3/10 - 08:19	.7-12	0	1000	.jsf
Line 107	line107	3/10 - 08:22	.7-12	0	1000	.jsf
	line107.001	3/10 - 08:40	.7-12	0	1000	.jsf
Line 108	line108	3/10 - 08:47	.7-12	0	1000	.jsf
	line108.001	3/10 - 09:07	.7-12	0	1000	.jsf
Line 109	line109	3/10 - 09:17	.7-12	0	1000	.jsf
	line109.001	3/10 - 09:36	.7-12	0	1000	.jsf
	line109.002	3/10 - 09:56	.7-12	0	1000	.jsf
	line109.003	3/10 - 10:15	.7-12	0	1000	.jsf
	line109.004	3/10 - 10:35	.7-12	0	1000	.jsf
	line109.005	3/10 - 10:54	.7-12	0	1000	.jsf
	line109.006	3/10 - 11:14	.7-12	0	1000	.jsf
	line109.007	3/10 - 11:33	.7-12	0	1000	.jsf
	line109.008	3/10 - 11:53	.7-12	0	1000	.jsf
	line109.009	3/10 - 12:14	.7-12	0	1000	.jsf
Line 110	line110	3/10 - 12:25	.7-12	0	1000	.jsf
Line 111	line111	3/10 - 12:33	.7-12	0	1000	.jsf
	line111.001	3/10 - 12:52	.7-12	0	1000	.jsf
Line 112	line112	3/10 - 12:56	.7-12	0	1000	.jsf
	line112.001	3/10 - 13:15	.7-12	0	1000	.jsf
	line112.002	3/10 - 13:35	.7-12	0	1000	.jsf
	line112.003	3/10 - 13:54	.7-12	0	1000	.jsf
	line112.004	3/10 - 14:14	.7-12	0	1000	.jsf
	line112.005	3/10 - 14:33	.7-12	0	1000	.jsf
	line112.006	3/10 - 14:53	.7-12	0	1000	.jsf
	line112.007	3/10 - 15:12	.7-12	0	1000	.jsf
	line112.008	3/10 - 15:32	.7-12	0	1000	.jsf
	line112.009	3/10 - 15:51	.7-12	0	1000	.jsf
	line112.010	3/10 - 16:12	.7-12	0	1000	.jsf
	line112.011	3/10 - 16:30	.7-12	0	1000	.jsf
	line112.012	3/10 - 16:50	.7-12	0	1000	.jsf
	line112.013	3/10 - 17:09	.7-12	0	1000	.jsf
Line 113	line113	3/10 - 17:38	.7-12	0	1000	.jsf
	line113.001	3/10 - 17:57	.7-12	0	1000	.jsf
	line113.002	3/10 - 18:17	.7-12	0	1000	.jsf
	line113.003	3/10 - 18:36	.7-12	0	1000	.jsf
	line113.004	3/10 - 18:56	.7-12	0	1000	.jsf
	line113.005	3/10 - 19:15	.7-12	0	1000	.jsf
	line113.006	3/10 - 19:35	.7-12	0	1000	.jsf
	line113.007	3/10 - 19:54	.7-12	0	1000	.jsf
	line113.008	3/10 - 20:16	.7-12	0	1000	.jsf
	line113.009	3/10 - 20:33	.7-12	0	1000	.jsf
	line113.010	3/10 - 20:53	.7-12	0	1000	.jsf

Line 114	line114	3/10 - 21:02	.7-12	0	1000	.jsf
	line114.001	3/10 - 21:22	.7-12	0	1000	.jsf
	line114.002	3/10 - 21:42	.7-12	0	1000	.jsf
	line114.003	3/10 - 22:01	.7-12	0	1000	.jsf
	line114.004	3/10 - 22:20	.7-12	0	1000	.jsf
	line114.005	3/10 - 22:40	.7-12	0	1000	.jsf
	line114.006	3/10 - 23:00	.7-12	0	1000	.jsf
	line114.007	3/10 - 23:19	.7-12	0	1000	.jsf
Line 115	line115	3/10 - 23:36	.7-12	0	1000	.jsf
	line115.001	3/10 - 23:55	.7-12	0	1000	.jsf
	line115.002	3/11 - 00:15	.7-12	0	1000	.jsf
Line 116	line116	3/11 - 10:50	.7-12	0	1000	.jsf, .sgy
	line116.001	3/11 - 10:58	.7-12	0	1000	.jsf, .sgy
	line 116.002	3/11-11:28	.7-12	0	1000	.jsf, .sgy
	line116.003	3/11 - 11:49	.7-12	0	1000	.jsf, .sgy
	line116.004	3/11 - 12:08	.7-12	0	1000	.jsf, .sgy
	line116.005	3/11 - 12:12	.7-12	0	1000	.jsf, .sgy
Line 117	line117	3/11 - 12:33	.7-12	0	1000	.jsf, .sgy
	line117.001	3/11 - 12:52	.7-12	0	1000	.jsf, .sgy
	line117.002	3/11 - 13:11	.7-12	0	1000	.jsf, .sgy
	line117.003	3/11-13:31	.7-12	0	1000	.jsf, .sgy
	line117.004	3/11- 13:50	.7-12	0	1000	.jsf, .sgy
	line117.005	3/11-14:06	.7-12	0	1000	.jsf, .sgy
Line 118	line118	3/11-14:27	.7-12	0	1000	.jsf, .sgy
	line118.001	3/11-14:45	.7-12	0	1000	.jsf, .sgy
	line118.002	3/11-15:03	.7-12	0	1000	.jsf, .sgy
	line118.003	3/11-15:25	.7-12	0	1000	.jsf, .sgy
	line118.004	3/11-15:44	.7-12	0	1000	.jsf, .sgy

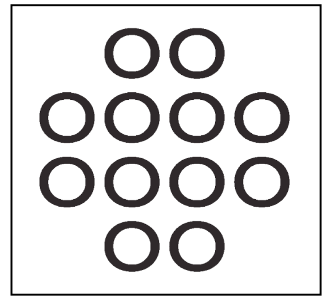
	line118.005	3/11-16:04	.7-12	0	1000	.jsf, .sgy
	line118.006	3/11-16:24	.7-12	0	1000	.jsf, .sgy
	line118.007	3/11-16:37	.7-12	0	1000	.jsf, .sgy
Line 119	line119	3/11-16:56	.7-12	0	1000	.jsf, .sgy
	line119.001	3/11-17:16	.7-12	0	1000	.jsf, .sgy
	line119.002	3/11-17:35	.7-12	0	1000	.jsf, .sgy
	line119.003	3/11-17:55	.7-12	0	1000	.jsf, .sgy
	line119.004	3/11-19:13	.7-12	0	1000	.jsf, .sgy
	line119.005	3/11-18:30	.7-12	0	1000	.jsf, .sgy
Line 120	line120	3/11-21:26	.7-12	0	1000	.jsf, .sgy
	line120.001	3/11-21:47	.7-12	0	1000	.jsf, .sgy
	line120.002	3/11-22:07	.7-12	0	1000	.jsf, .sgy
	line120.003	3/11-22:26	.7-12	0	1000	.jsf, .sgy
	line120.004	3/11-22:45	.7-12	0	1000	.jsf, .sgy
	line120.005	3/11-23:06	.7-12	0	1000	.jsf, .sgy
	line120.006	3/11-23:22	.7-12	0	1000	.jsf, .sgy
Line 121	line121	3/11-23:41	.7-12	0	1000	.jsf, .sgy
	line121.001	3/12-01:02	.7-12	0	1000	.jsf, .sgy
	line121.002	3/12-01:23	.7-12	0	1000	.jsf, .sgy
	line121.003	3/12-01:41	.7-12	0	1000	.jsf, .sgy
	line121.004	3/12-02:03	.7-12	0	1000	.jsf, .sgy
	line121.005	3/12-02:21	.7-12	0	1000	.jsf, .sgy
	line121.006	3/12-02:32	.7-12	0	1000	.jsf, .sgy

Line 122	line122	3/12-02:53	.7-12	0	1000	.jsf, .sgy	
	line122.001	3/12-03:12	.7-12	0	1000	.jsf, .sgy	
	line122.002	3/12-03:31	.7-12	0	1000	.jsf, .sgy	
	line122.003	3/12-03:52	.7-12	0	1000	.jsf, .sgy	
	line122.004	3/12-03:55	.7-12	0	1000	.jsf, .sgy	
Line123	line123	3/12-04:14	.5-7.2	0	1000	.jsf, .sgy	
	line123.001	3/12-04:34	.5-7.2	0	1000	.jsf, .sgy	
	line123.002	3/12-04:55	.5-7.2	0	1000	.jsf, .sgy	
	line123.003	3/12-05:14	.5-7.2	0	1000	.jsf, .sgy	
	line123.004	3/12-05:34	.5-7.2	0	1000	.jsf, .sgy	
	line123.005	3/12-05:54	.5-7.2	0	1000	.jsf, .sgy	
	line123.006	3/12-06:00	.5-7.2	0	1000	.jsf, .sgy	
Line 124	line124	3/12-06:21	.5-7.2	0	1000	.jsf, .sgy	
	line124.001	3/12-06:42	.5-7.2	0	1000	.jsf, .sgy	
	line124.002	3/12-07:01	.5-7.2	0	1000	.jsf, .sgy	
	line124.003	3/12-07:21	.7-12	0	1000	.jsf, .sgy	change in frequency range
	line124.004	3/12-07:38	.7-12	0	1000	.jsf, .sgy	
	line124.005	3/12-07:58	.7-12	0	1000	.jsf, .sgy	
	line124.006	3/12-08:19	.7-12	0	1000	.jsf, .sgy	
	line124.007	3/12-08:39	.7-12	0	1000	.jsf, .sgy	
	line124.008	3/12-8:58	.7-12	0	1000	.jsf, .sgy	
	line124.009	3/12-09:16	.7-12	0	1000	.jsf, .sgy	
Line 124a	line124a	3/12-09:37	.7-12	0	1000	.jsf, .sgy	

	line124a.001	3/12-09:56	.7-12	0	1000	.jsf, .sgy	
	line124a.002	3/12-10:16	.7-12	0	1000	.jsf, .sgy	
	line124a.003	3/12-10:33	.7-12	0	1000	.jsf, .sgy	
	line124a.004	3/12-10:55	.7-12	0	1000	.jsf, .sgy	
	line124a.005	3/12-11:15	.7-12	0	1000	.jsf, .sgy	
	line124a.006	3/12-11:34	.7-12	0	1000	.jsf, .sgy	
	line124a.007	3/12-11:51	.7-12	0	1000	.jsf, .sgy	
	line124a.008	3/12-12:13	.7-12	0	1000	.jsf, .sgy	
	line124a.009	3/12-12:16	.7-12	0	1000	.jsf, .sgy	
Line 125	line125	3/12-12:18	.7-12	0	1000	.jsf, .sgy	
	line125.001	3/12-12:38	.7-12	0	1000	.jsf, .sgy	
	line125.002	3/12-12:57	.7-12	0	1000	.jsf, .sgy	
	line125.003	3/12-13:11	.7-12	0	1000	.jsf, .sgy	
	line125.004	3/12-13:36	.7-12	0	1000	.jsf, .sgy	
	line125.005	3/12-13:56	.7-12	0	1000	.jsf, .sgy	
	line125.006	3/12-14:14	.7-12	0	1000	.jsf, .sgy	
	line125.007	3/12-14:35	.7-12	0	1000	.jsf, .sgy	
	line125.008	3/12-14:54	.7-12	0	1000	.jsf, .sgy	
	line125.009	3/12-15:14	.7-12	0	1000	.jsf, .sgy	
	line125.010	3/12-15:26	.7-12	0	1000	.jsf, .sgy	
Line 126	line126	3/12-15:46	.7-12	0	1000	.jsf, .sgy	
	line126.001	3/12-16:03	.7-12	0	1000	.jsf, .sgy	
	line126.002	3/12-16:34	.7-12	500	1500	.jsf, .sgy	change in depth scale

line126.003	3/12-16:40	.7-12	500	1500	.jsf, .sgy

VII. Shipbased Chirp



The *R/V Endeavor* is equipped with a dual-frequency, hull-mounted chirp sonar system. The twelve transducers form a cross-shaped array, shaped like a 4 x 4 element square with the corners missing (right). Single-frequency 12.5 kHz and 2 – 10 kHz chirp signals can be transmitted, received and recorded simultaneously with the Knudsen 3260 acquisition system. Both data types can be recorded in SEG-Y format in a choice of three forms: correlated, filtered correlated, and "detected" which is the envelope of the filtered, correlated data, as displayed on the real-time monitors. The "detected" version was chosen for our SEG-Y recordings. SEG-Y files were automatically named and limited to a maximum size of 25MB. SEG-Y headers included position from the navigation system and depth as detected by the Knudsen system. This depth, however, was often wrong, when transmitted or received pings from the towed Edgetech chirp system outweighed actual bottom returns.

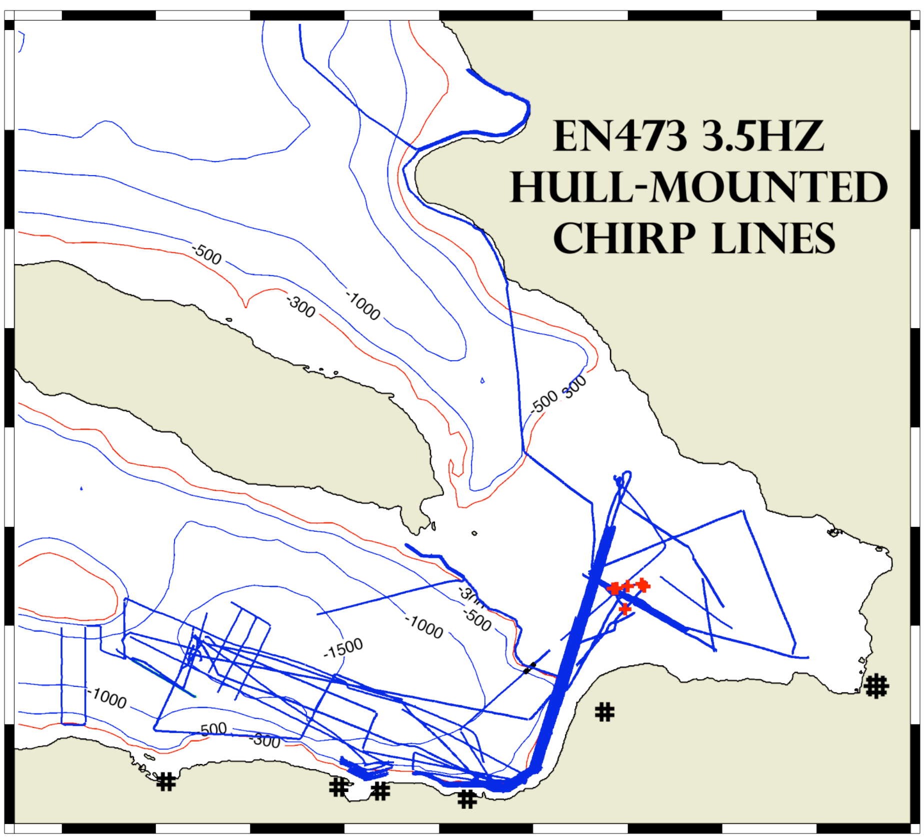


Fig. 22. Navigation of hull mounted chirp

The SEG-Y header positions were plotted, with GMT software, and the individual files were reassembled into about 130 longer, continuous lines. These were then imported into Kingdom Suite and sometimes plotted separately:

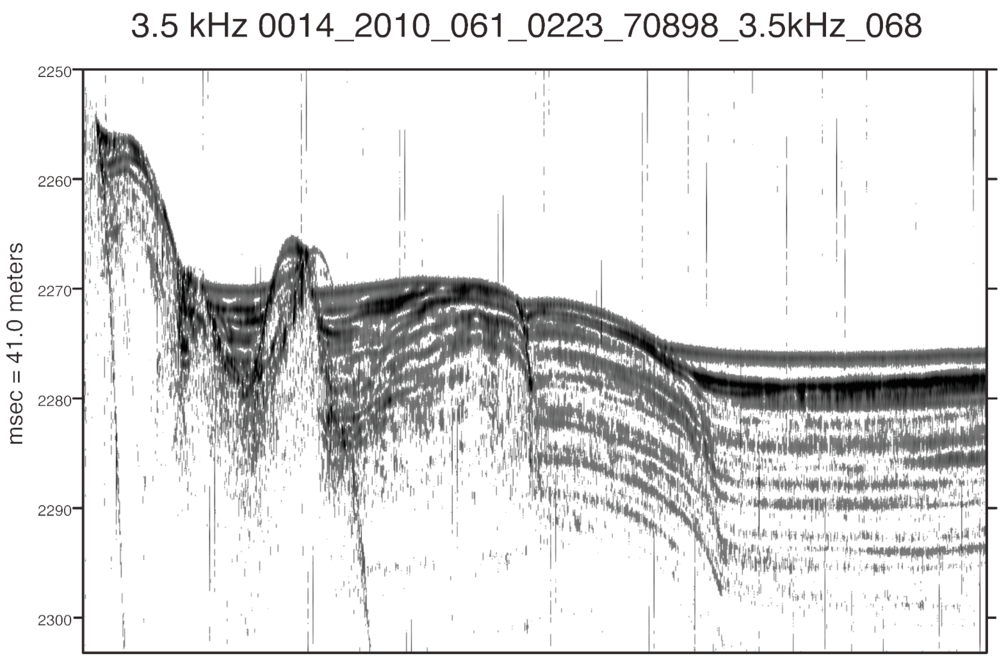


Fig. 23. 3.5 kHz crossing of an active fold and fault

In some cases, the 12kHz data show unusually good penetration:

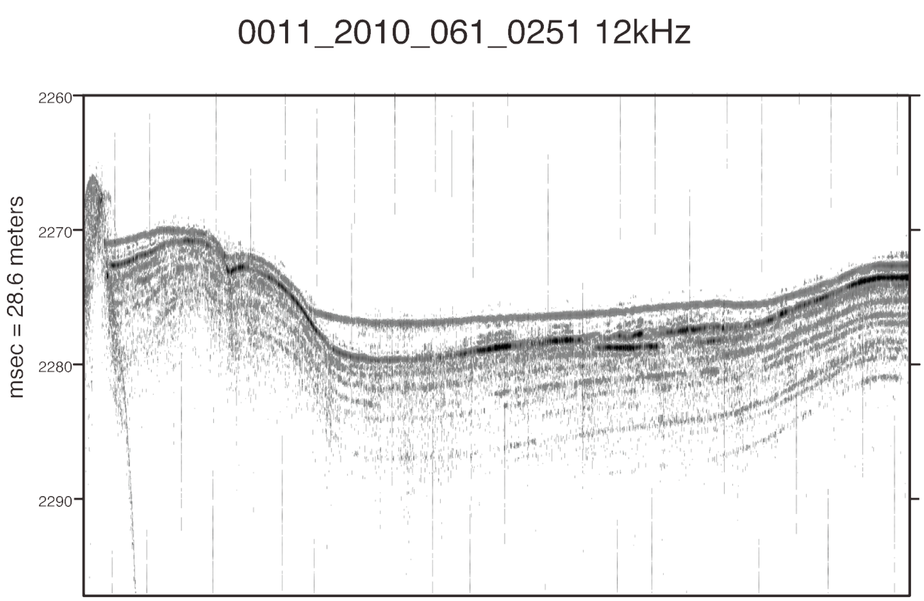


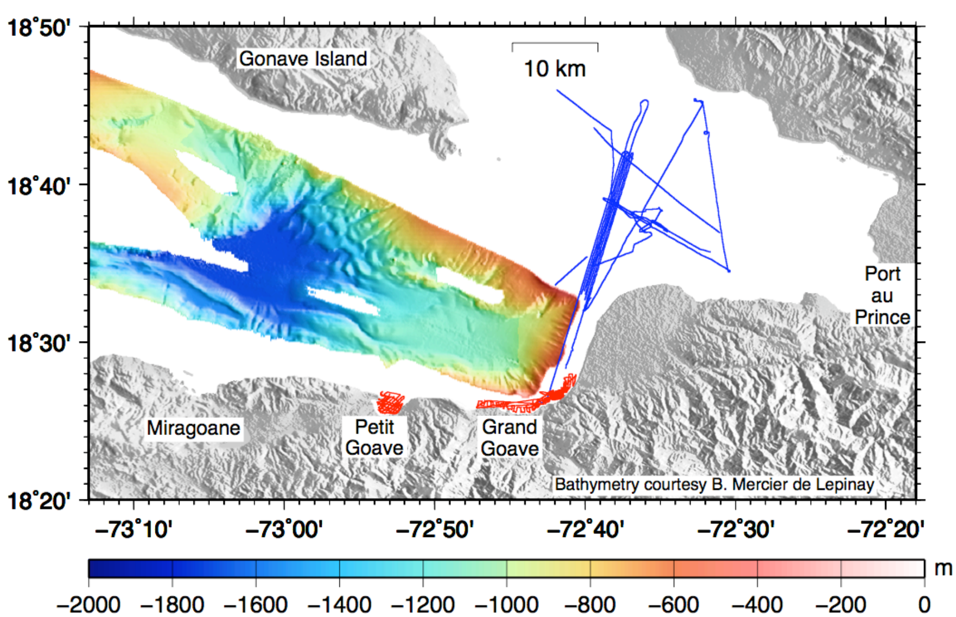
Fig. 24. 12 kHz crossing of the Canal du Sud

VIII. Sidescan Report

The Klein 3900 towed sidescan sonar owned by University of Missouri was used to ensonify in water depths of < 100 m (Fig. 25). It was towed from a point aft of the ship and starboard from the Edgetech chirp profiler, using a small battery-operated winch. The sidescan sonar was also deployed from a small Zodiac boat used to survey the areas that were too shallow for safe navigation with the R/V *Endeavor*, along the coast of Grand Goâve Bay and Petit Goâve Bay. Data were all acquired using the lower frequency signal (445 kHz), with a pulse length of 100 μs. A lateral range of 125 m (a full swath width of 250m) produced good imagery most of the time. The speed of sound used during recording was 1540 m/s, based on sound velocity profiles acquired at the beginning of the cruise. A magnetic declination of -9.38° was applied to the fish compass for correction to the fish heading. The fish was also calibrated for its internal magnetic field prior to deployment. The data are being mosaiced using the software SonarWiz.

Fig. 25. Left: The Klein 3900 sidescan sonar system.

Below: Sidescan survey tracks. Blue lines indicate the shipboard survey tracks, red lines correspond to the small boat survey tracks.



<u>*Shipboard survey*</u>

The sidescan sonar performed well at a speed of 4 knots when deployed alongside the 512i Edgetech chirp profiler (Fig. 26). Pings from the Edgetech and the hull-mounted Knudsen profilers did interfere somewhat with the sidescan data, resulting in streaking on the imagery, but the data remained interpretable nonetheless and we decided to proceed and tow them simultaneously whenever possible. Even though 100 m of cable was available with the K3900 sidescan, the fish would not sink deeper than 11m below the sea surface, independent of the length of cable we unreeled. Therefore, we generally towed it with a fixed cable length of 25m, which provided sufficient distance from the wash from the ship propeller and enough separation from the Edgetech chirp profiler. In water depth greater than 80 m, the sidescan sonar did not provide useful imagery. Therefore, it was deployed only in Port-au-Prince Bay, Grand Goave Bay, and Petit Goave Bay. The starboard side produced very crisp imagery that nicely highlights bioherms, pockmarks, small landslides, scarps, and what appear to be lateral spreading. The port side on the other hand produced an imagery that was more“washed out”, and may need repair.

Data have been recorded in the XTF proprietary format. Data files were limited to 10 minutes of data acquisition, and their names include the prefix "HAT" followed by year, month, day, hour, minute, and "00" at beginning of the recording (ex. February 27, 2010, 7:36pm UTC would be HAT100227193600.xtf). GPS positioning was provided by the ship's NorthStar 952X antenna. The offsets of that antenna to the tow point were as follows:

X = 1 meter (starboard from GPS antenna, to sidescan sheave)
Y = -24.7 meters (aft from GPS antenna, to sidescan sheave)
Z = -5.1 meters (down from GPS antenna, to sidescan sheave)
The GPS antenna height above the water was 7.6 meters

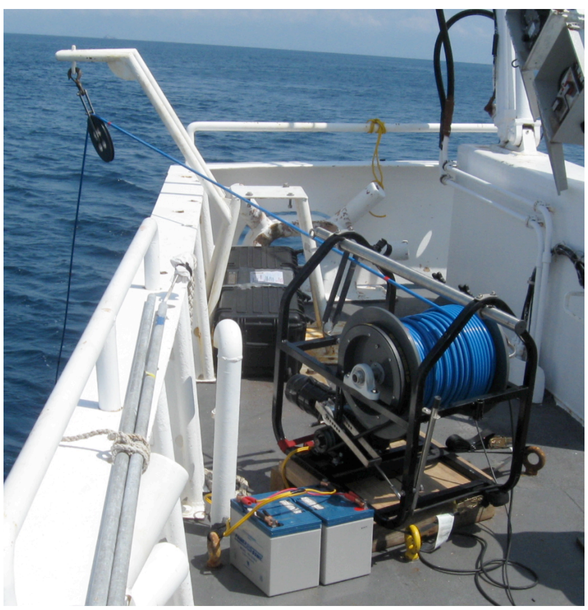


Fig. 26. Towing configuration of the K3900 sidescan sonar aboard the R/V Endeavor.

<u>*Zodiac Survey*</u>

The small boat operations in Grand Goave Bay and Petit Goave Bay made use of both the minichirp and the sidescan sonars, operated with three marine no-spill batteries (Fig. 27). GPS positioning was provided to the topside sidescan unit by a Garmin GPSMap 431 GPS unit. Four people aboard the Zodiac managed the navigation, minichirp, and sidescan operations. Due to obvious space restrictions, the sidescan portable electric winch was not used. Instead, the tow cable was unspooled from the winch and placed in a container, then secured to the Zodiac at a static length of 2.5 meters. The towfish was lowered manually over the port rubber gunwale of the Zodiac leaving approximately 2 meters of cable in the water. The layback of the GPS antenna to the towfish was as follows: -1 meter in the X direction (port), -1 meter in the Y direction (aft), -2 meters in the Z direction (below sea level). The GPS antenna was 1 meter above sea level.

Fig. 27. Small boat operations of sidescan sonar and minichirp.

Data Examples

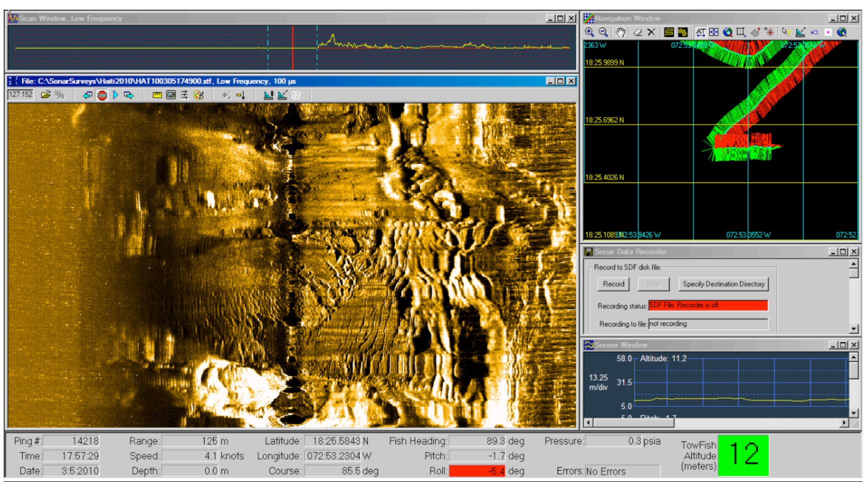


Fig. 28. Signs of underwater lateral spreading in Baie de Petit Goave

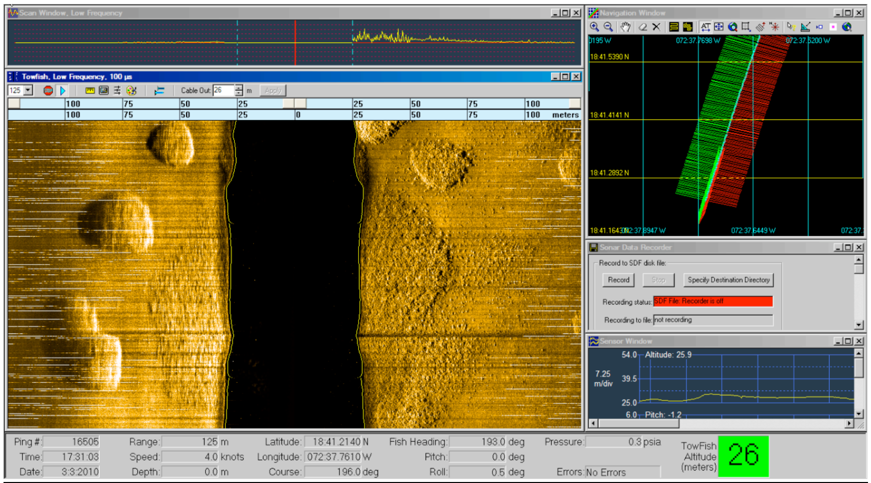


Fig. 29. Bioherms (?) in 32m water depth at the western edge of Baie de Port-au-Prince

Table 4. Sidescan line summary

Area	Start date & time (GMT)	End date & time (GMT)	west longitude	east longitude	north latitude	south latitude
calibration test SW corner of Port-au-Prince Bay	March 3 14:00 jd062	March 3 16:08 jd062	72°37.5'	72°34.5'	18°38'	18°39'
Port-au-Prince Bay to Grand Goave Bay Line 107, N107°	March 3 17:19 jd062	March 3 22:57 jd062	72°42'	72°36'	18°26'	18°42'
Grand Goave Bay to Port-au-prince Bay Line 105, N017°	March 4 01:82 jd063	March 4 07:39 jd063	72°41'	72°37'	18°33'	18°42'
Port-au-Prince Bay to Grand Goave Bay Line 104 N107°	March 4 07:47 jd063	March 4 12:55 jd063	72°40'	72°37'	18°33'	18°40'
WSW-ENE lines Grand Goave Bay	March 4 12:55 jd063	March 4 21:58 jd063	72°46.5'	72°41'	18°26'	18°28'
Entrance to Petit Goave Bay V-shaped tracks	March 5 17:54 jd064	March 5 23:35 jd064	72°54.5	72°50.5'	18°26.5'	18°28.5'

Grand Goave Bay to Port-au-prince Bay Line 106 N017°	March 6 22:39 jd065	March 7 04:37 jd066	72°42.5	72°31'	18°27'	18°46'
Port-au-Prince Bay to Grand Goave Bay Line 103 N107°	March 7 04:57 jd066	March 7 10:53 jd066	72°42'	72°35.5'	18°27'	18°46'
Grand Goave Bay to Port-au-prince Bay Line 102 N017°	March 7 11:19 jd066	March 7 17:15 jd066	72°42'	72°35.5'	18°27'	18°46'
Area	**Start date & time (GMT)**	**End date & time (GMT)**	**west longitude**	**east longitude**	**north latitude**	**south latitude**
Port-au-Prince Bay to Grand Goave Bay Line 101 N107°	March 7 17:23 jd066	March 7 23:30 jd066	72°42'	72°35.5'	18°27'	18°46'
Grand Goave bay, and west of it ("knit")	March 8 09:35 jd067	March 8 22:49 jd067	72°50'	72°42'	18°26'	18°27.5'
Coast survey Grand Goave Bay toward Miragoane	March 9 00:03 jd068	March 9 07:33 jd068	72°43'	73°05'	18°26'	18°29'
Reef edge, SE Gonave Island	March 10 06:23 jd069	March 10 12:55 jd069	72°50.5'	72°40'	18°33'	18°41.5'
Zig-zags across Port-au-Prince Bay	March 10 12:55 jd069	March 11 16:36 jd070	72°40.5'	72°24'	18°32'	18°46'
South rim of Port-au-Prince Bay WNW-ESE tracks and across west platform	March 11 16:36 jd070	March 12 03:34 jd071	72°38.5'	72°32'	18°35.5'	18°39.5'
south of St Marc coast-following tracks	March 12 06:07 jd071	March 12 07:46 jd071	72°51'	72°37'	18°37'	19°10'N

St Marc coast-following tracks	March 12 08:21 jd071	March 12 15:26 jd071	72°51'	72°37'	18°37'	19°10'M

IX. Small Boat Operations with the Portable Chirp Unit

The Chirp System

The small chirp system consists of a portable 320 B/R echosounder made by Knudsen Engineering. The transducer, made by MASSA, sweeps through a range of frequencies spanning from 1-10 kHz, with a peak amplitude occurring at a frequency of 3.5 kHz. The chirp was mounted vertically along the starboard side of the orange zodiac owned and operated by the R/V Endeavor (see diagram and photographs of set-up; Figs. 30, 31). The transducer was mounted to a two inch steel pipe with an elbow connection that ran across the bow of the ship. The steel pipe was secured with two cargo straps, and two cargo straps were also secured outboard, directly to the chirp frame-structure to keep the system vertical while the zodiac was in motion. Once deployed, the transducer had a draft of 0.81 m, and this value should therefore be added to all converted depth values. Data collection on the zodiac generally occurred at speeds between zero and 5 knots, with most data collection occurring at speeds of ~4 knots. For all data, we had a chirp source length of 6 ms, a recording window of 200 m (assuming water velocity of 1500 m/s in Knudsen conversion), and a pulse power setting of 1. Like all Knudsen systems, shot interval time is variable and is directly dependent on water depth, such that only one "ping" is in the water at any given time.

Fig. 30. Photo of the R/V Endeavor Zodiac resting in a cradle on the fan tail of the R/V Endeavor. The photo shows how the chirp transducer was mounted on the side of the ship. A cable supplying both data and power to the transducer runs through the 2-inch steel pipe, and out a pipe hole in the center of the pipe where it connects to the Knudsen control box. The entire system was deployed as shown into the ocean using the ship's crane. Because the system was already set-up for data collection before deployment off the fan tail, we were able to start acquiring data immediately following deployment, with minimal time wasted for set-up.

Data Format and Depth Corrections

All files were originally saved in Knudsen (.KEB) format. These were ultimately converted to standard Rev.0 SEGY format using Knudsen "Sounder Suite" version 1.79 conversion software. The converted SEGY files are all saved in time, but, importantly, this is ONE-WAY TRAVEL TIME. The data range during recording was viewed in depth, assuming a water-velocity of 1500 m/s. During recording, we always set the recording window at 200 m, and nearly all lines are saved from the 0-200 m depth interval. Only in very deep water was this depth shifted such that the shallowest depth value was not sea level. Lines are saved in the following format: U_Linenumber_year_julianday_centralstandardtime.sgy. In reality, sound velocities in the upper 100 m of the water column (where the small chirp system was predominantly used) measured ~ 1540 m/s based on SVPs and CTDs taken during the cruise, and this value should be used for proper depth conversion of the SEGY data. Tidal corrections will be minor for these data (on the order of 40 cm at most), and therefore, corrections may not be necessary given that swells were often 40-50 cm peak-to-trough during each day of surveying. Given that much of these data were collected in less than 10 m of water, the depth of the transducer (0.81 m) is significant enough that it should be added to all bottom conversions.

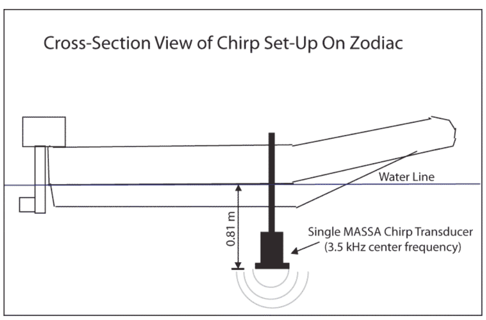
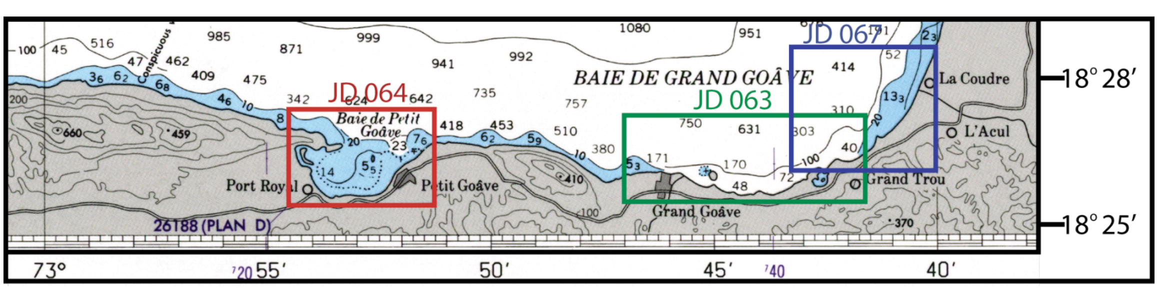


Fig. 31. Simple schematic cross-section showing the depth of the chirp tranducer below the waterline during operation.

Location and Timing of Small Chirp Operations

We conducted small chirp operations for three days during the cruise (Fig. 32). These days were 063, 064, and 067 (Julian Days). These surveys were used to (1) determine regional seafloor structure and subsurface geology, as well as (2) generate regional seafloor charts that could be used by the R/V Endeavor to determine where the ship might approach more closely to shore to collect multibeam (current regional nautical charts of Haiti are low resolution, poorly constrained, and at some locations inaccurate).

Fig. 32. The general location for each day's survey is shown below.



Julian Day 063:

We collected data from the zodiac from approximately 9 am to 5:30 pm on Julian Day 063 along the coastline of Baie de Grand Goave. The primary goal of the survey was to broadly characterize geology in the near-shore across the entire bay, with the ultimate goal of finding active faults that tie to land and deep-water observations. Lines were generally shot perpendicular to shore, with line spacing at approximately 200 m. The lengths of each line were controlled by the water depth; we shot in minimum depths of ~4 m, and maximum depths of ~100 m. Once we reached minimum depths, we would generally skirt along the shoreline approximately 200 m before starting the next line (Figs. 33, 34). A significant amount of fishing gear as well as uncharted fringe and pinnacle reefs were encountered during the survey, and this caused us to change the trajectory or jog several of the lines during shooting.

In general, data were of high quality. We were able to clearly discern the seafloor, and in several locations, we observed shallow subsurface reflectors to 20 m below the seafloor. Interpolated seafloor maps generated from these data reveal several near-shore bathymetric highs that clearly link with deeper-water multbeam data. These features appear tectonic, and the small boat chirp data allowed us to link these features with deeper-water multibeam features and on-shore faults (Figs. 33, 34). Of particular interest were subsurface reflections in the most eastern line shot in this survey, which clearly indicates recent active faulting (Fig. 31). As a result of this discovery, much of Julian Day 067 small chirp operations focused near this site.

In addition, initial interpolation of the small chirp data revealed several local near-shore highs that aligned well with mapped land-based faults that intersect the shoreline (Fig. 32).

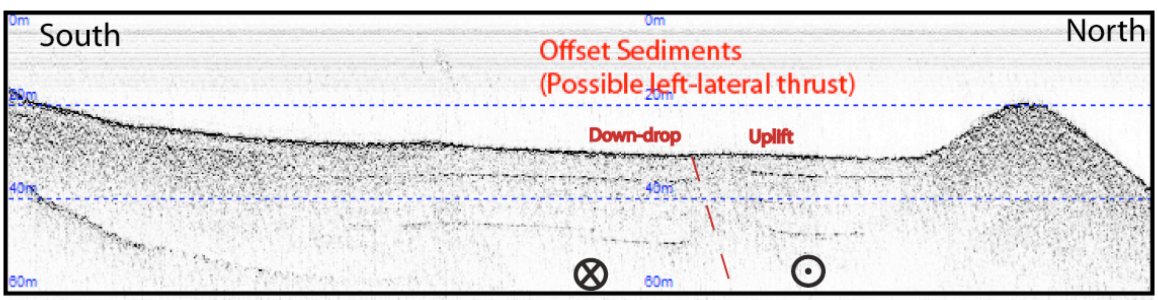


Fig. 33. Southern end of Line U_2010_063_1020.keb.segy showing 20 m of penetration into a small perched basin near shore. Sediments are clearly offset vertically, and changes in sediment layer thickness may indicate fault orientation and strike-slip motion. Seafloor deformation extends to the seafloor with a slight (<50 cm) rise on the north side of the section. A much more detailed study of this area was conducted with the portable chirp system on day 067.

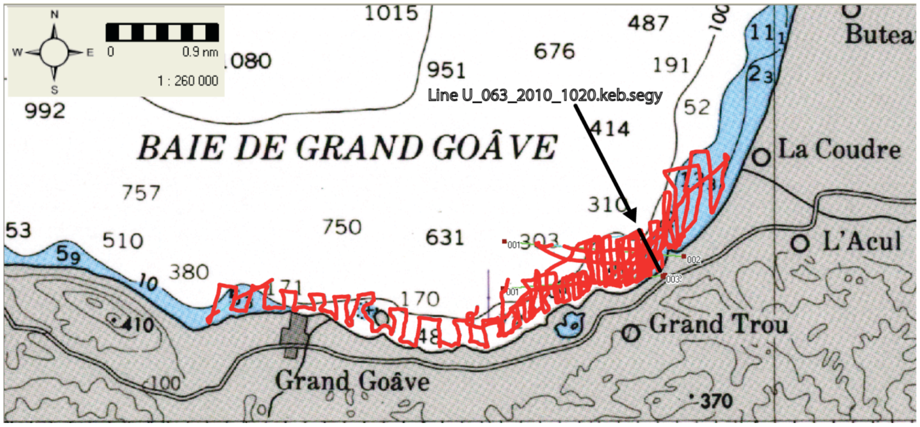


Fig. 34. Red lines show the location of chirp lines collected on days 063 and 067. The lines to the west were all collected on 063; nearly all lines to the east were collected on day 067.

Julian Day 064:

We spent day 064 collecting chirp in the Bay of Petit Goave (Figs. 35, 36). The data were shot in a widely-spaced gridded pattern (approximately 200 m line spacing), and were used to generate a general seafloor bathymetry that we tied to multibeam data collected outside the harbor. Data were collected from ~10 am to 5:30 pm. The data were of high quality, and we were again able to observe very clear surface and subsurface highs in the harbor, as well as several subsurface sedimentary reflectors. In some locations, we achieved depth penetration > 20 m. The data also clearly reveal the location and degree of seafloor slumping in the bay. In particular, two well defined slumps are observed in the bay, both along the south side, and both near river mouths (one south of the town of Petit Goave, the other east of Port Royal). Evidence for possible east-west running faults extending through and north of the harbor also exists, however, further data analysis is necessary to confirm this as well as the existence of other faults within the harbor.

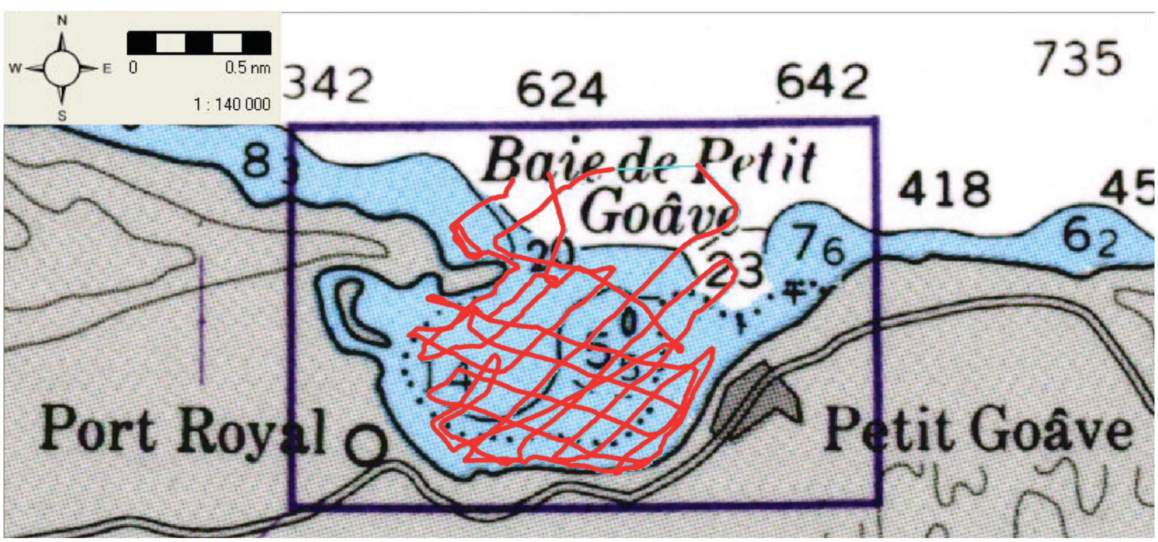


Fig. 35. Location of chirp lines collected on JD 064 in the Bay of Petit Goave.

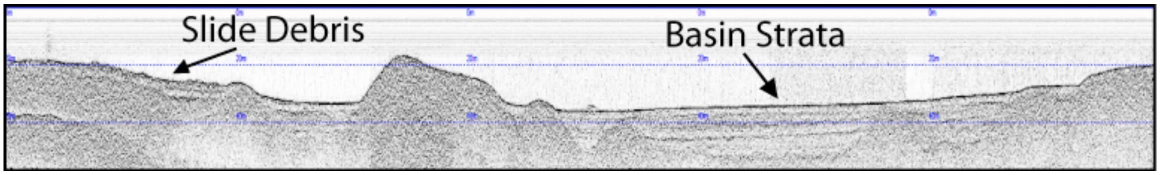


Fig. 36. Chirp line 00019_2010_064_1400.keb collected in the Bay of Petit Goave. Slide debris as well as basin sedimentation and infill are clearly recognized in the data. Future analysis of these data should reveal key insight into structure of the bay.

Julian Day 067:

Chirp operations focused on the eastern third of the Bay of Grand Goave during day 067, with particularly emphasis placed on tracking the location and character of the fault observed on JD 063, shown in Figure 33. Operations and data collection began approximately 8:30 am and ran through 5 am that day. Data quality was again high, and multiple line crossings of the fault were made during the course of the day. There was some concern from Paul Mann, Carol Prentice and other on-shore geologists that the Plantain Garden fault may extend offshore to the north of where this fault was discovered. To address this, we shot several additional lines to the north in search of any clear evidence of recent faulting in this region. So far, preliminary analysis of chirp (as well as side-scan data) show now clear evidence for recent active faulting in this region (i.e., west of La Coudre). In contrast, clear evidence for faulting exists both on and off shore due west of La Acul where we observed the fault in the zodiac chirp data. Using rough coordinates for the faults from the chirp data, we have determined the general location of the fault, as well as the fault strike, and where it should make land fall. Perhaps most striking, Google Earth images acquired immediately following the January 12th earthquake clearly reveal evidence for either left-lateral motion, uplift/downdrop from north-to-south, or both, along the shoreline precisely where we predict this fault makes landfall (Figs. 37, 38, 39). A USGS/UT land survey team were given the coordinates of this location and were able to trace the fault. They found a south facing scarp with clearly discernable offsets (in some places several meters according to their initial reports). However, their preliminary study indicates no clear evidence for rupture during the January 12th event on shore. Their study also suggest that of all potential fault traces found in this region, this appears the sharpest and perhaps most recently active. Our preliminary assessment is that this fault may have ruptured during the January 12th earthquake just off shore (see Figure 33).

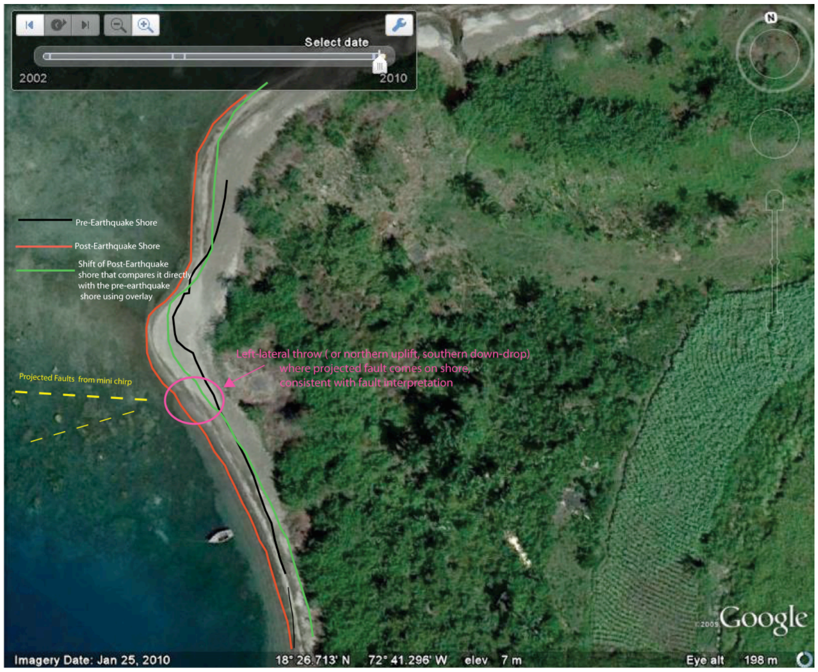


Fig. 37. Google Earth image taken January 25th, 2010. The Black line shows the location of the shoreline in photos taken before the earthquake (in 2005). The orange line shows the current shoreline location. The Green line, an offset of the current shoreline, shows the poor match between the shoreline before and after the event. Although we cannot rule-out beach erosion and other long-shore processes affecting the coastline. The observation is consistent with either left-lateral motion, or northern uplift and southern downdrop across this region (or both). The Yellow dashed lines show our projection of faults imaged during the zodiac chirp operation. The faults converge on shore where a left-lateral offset appears to exist along the shoreline, noted with the pink circle.

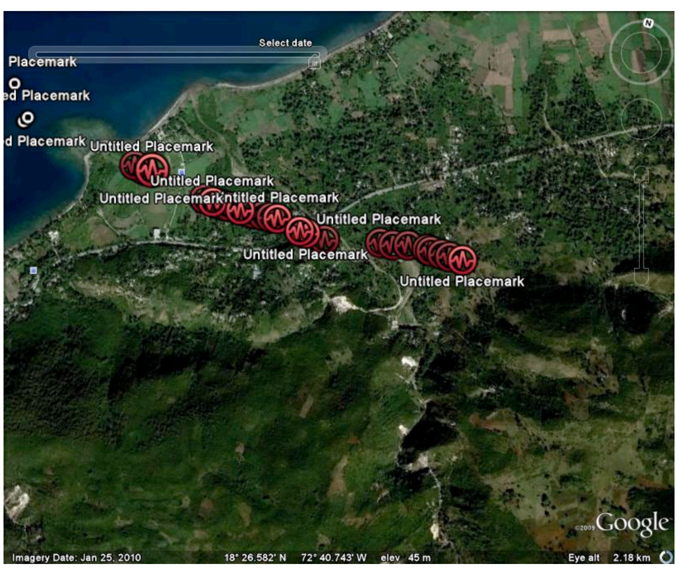


Fig. 38. Image taking from Google Earth an interpreted location for one of several possible fault traces (red earthquake indicators) that may merge with offshore fault tracked with the zodiac chirp data. Although hard to see in these data, a clear left-lateral step exists in the river that this fault trace crosses (see below).

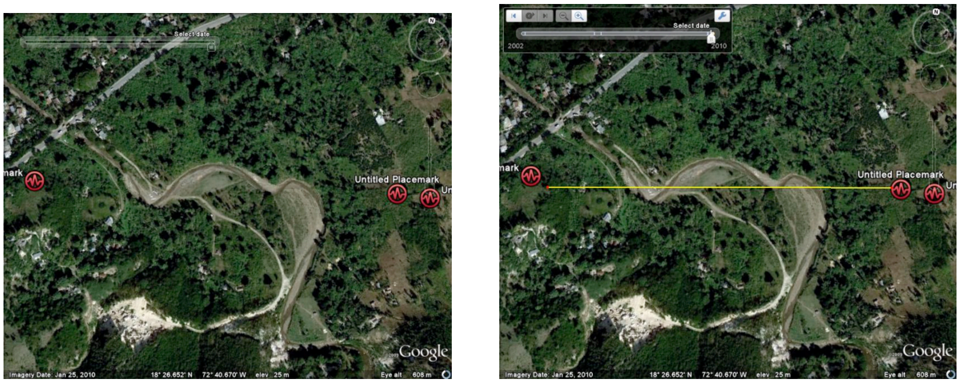


Fig. 39. Uninterpreted versus interpreted location of one fault trace that may link to the fault imaged by the portable chirp system. Note the clear left-lateral offset of the river.

X. Sediment Sampling Program

The goal of the sampling program was to document potential sea-floor ruptures such as fault scarps, and mass-wasting and gravitational flows related to the January 12, 2010 earthquake and locally reported tsunami sediment disturbance. The plan was to precisely position cores in areas associated to the EPGF. This included the trace of the fault along the shelf, and to recover mass-wasting and gravity flow deposits from the slope and the deepest part of the basin or "depocenter" where turbidity flows were expected to settle (Fig. 40). Additional targets for sampling were fault basins similar to sag ponds on land. These basins tend to be perched along the trace of a fault and isolated from terrestrial drainage. Previous studies from the Marmara Sea, Turkey have shown that the sediments in these basins recorded fault ruptures and that unraveling the history of sedimentation in these basins can be critical for understanding the paleoseismic history of the fault (McHugh et al., 2006). The Baie du Port au Prince has a larger basin that was also targeted for sampling but in this case the sampling was geared for evidence of neotectonic deformation such as tilting and for paleoenvironment (Fig. 39).

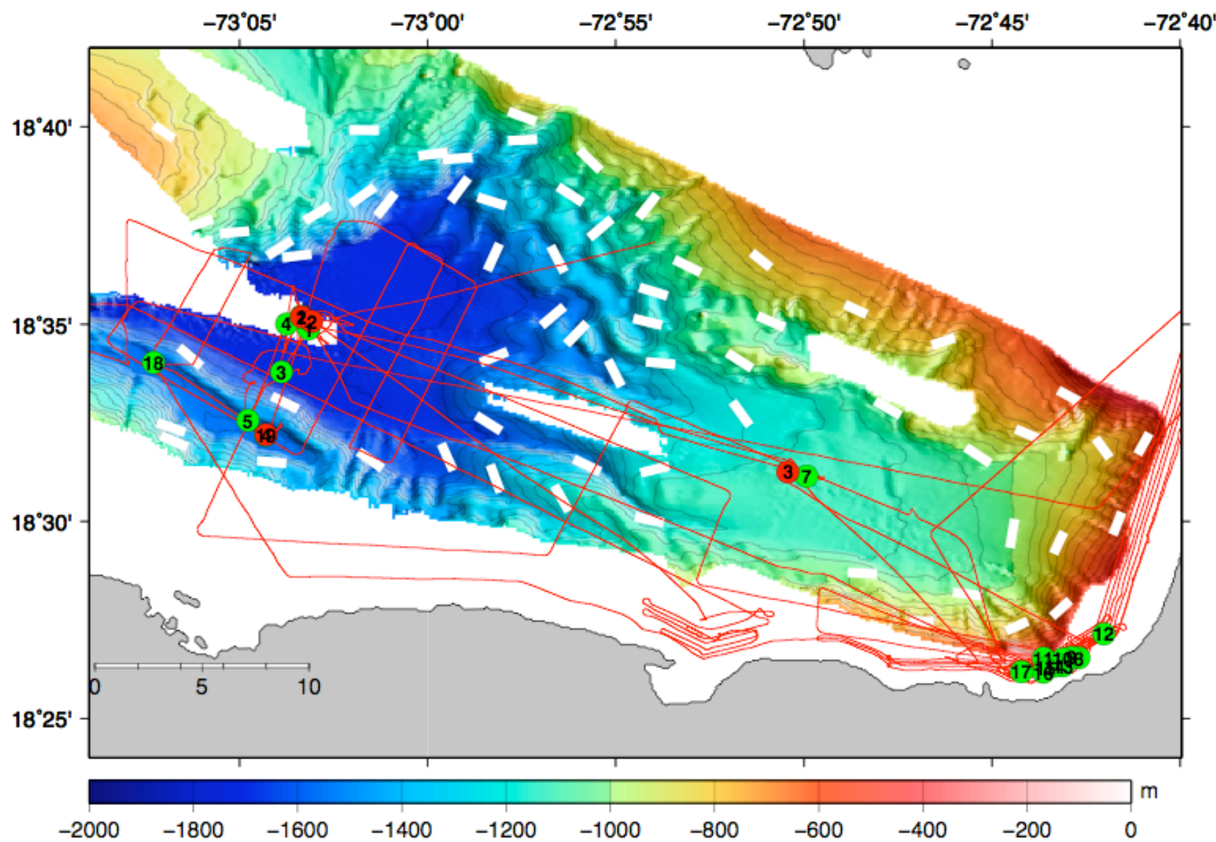


Fig. 40. Location of gravity cores (green circles) and multicores (red circles) at intermediate water depths (1000- 1100 m) and the deepest part of Canal du Sud (1750 m), perched basins (1500 m), and within the Baie de Grand Goave adjacent to the Enriquillo fault trace (100- 300 m).

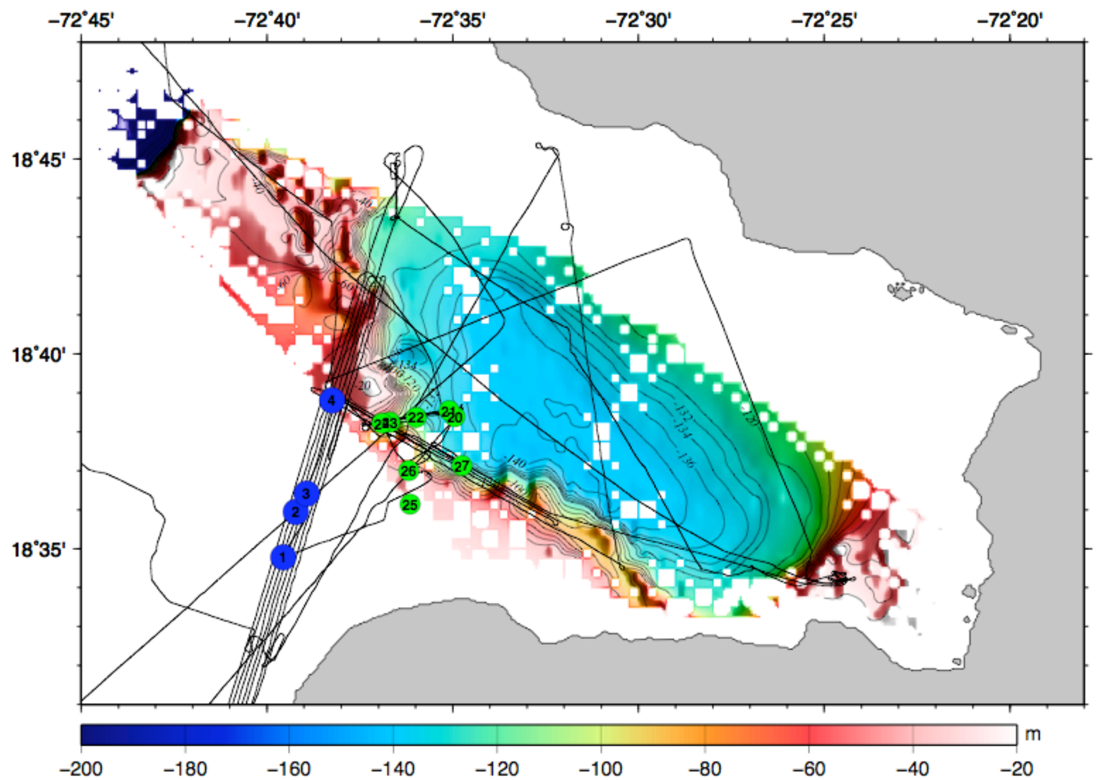


Fig. 41. Baie de Port au Prince showing chirp, sidescan sonar, and multibeam navigation tracks and core (green circles) and grab (blue circles) locations.

<u>*Sampling Equipment*</u>

The tools used to recover the sediment were a Multi-Corer MC-400, a gravity corer, and sediment grab. When operating at depths greater than 200 m, a pinger was attached to the cable 75 m above the instrument. This permitted us to track the path of the instrument across the water column and document the precise time in which it penetrated the sea-floor and the topography and water depth of the seafloor at that particular location. The tension, speed, and length of the wire were tracked through a monitor in the laboratory. A large and rapid decrease in the tension was another indication that the instrument was being pulled from the sea-floor. Coring operations took place initially during the day but later during the expedition we changed to night. This change was due to the fact that there were many small sail boats with Haitians in them possibly fishing during the night with no lights and it was dangerous because the Captain and/or Mates of the *R/V Endeavor* could not see the small vessels.

<u>*Multi-Corer MC-400*</u>

The system used is a Multi-Corer MC-400 produced by Ocean Instruments Inc. The MC-400 carries four sample tubes 10 cm x 60 cm with an effective penetration up to 45 cm (Fig. 42). The tubes penetrate into the sediment then the corer is lifted with the cable and the tubes are slowly withdrawn. Just as the tubes begin to withdraw, the capping devices spring to the tops of the tubes and seal the sediment sample and overlying water inside the tube. This creates a powerful vacuum, which holds the muddy sediment and water in place. This allows the sediment water interface to be recovered with the least disturbance.

The MC-4 was used to recover the sediment water interface at three locations: 1) in intermediate water depths (1000 m to 1100m), where turbidites with dark-colored sands and occasional wood fragments were present; 2) in the deepest basin within the Canal du Sud (1750 m) where a thick layer (30 cm) of water saturated sediment was recovered; 3) and in a perched basin (1500 m) associated to a ridge and narrow (500 m) canyon trending parallel to the shoreline. To constrain the age of events, the top of the sediment will be dated with the short-lived radioisotope ^{7}Be with a half-life of 53 days. We had excellent recovery with the multicore in the Canal du Sud at intermediate water depths and in the perched basin. However, in the deepest part of the Canal du Sud the multicorer either recovered too much sediment or did not close up. We realized that the floor in this deep part of the basin was covered by an ~50 cm thick drape of water saturated sediment that made conditions for recovery with the multicorer difficult. Nevertheless, after several tries we were able to recover the sediment water interface.

Fig. 42. The MC-4 with the four liners showing recovery of the sediment water interface.

Gravity Corer Model 2171

The Mooring Systems Inc. Model 2171 Gravity Corer is designed to obtain bottom samples from a great variety of depths and sediment conditions (Fig. 43). A positive, O-ring sealed valve at the top of the core tube prevents washing of the sample. A core catcher at the bottom of the core tube retains the core with minimum disturbance to the sample. For this setting we used weights from 188 lbs to 288 lbs depending on the water depth and nature of the substrate (muddy or sandy). We recovered 27 gravity cores ranging in length from 25 cm to 186 cm (Table 4). Gravity cores were targeted in the shallow upper slope (100-300 m) adjacent to fault-related, linear ridges, where clear turbidites with coral debris were sampled; 2) in mid water depths (1100 m) of the Canal du Sud where turbidites with dark sand and woody material were recovered; 3) in a perched basin at 1500 m associated to a ridge and canyon trending parallel to the shoreline; 4) in the depocenter of the Canal du Sud (1750 m); and 4) in the Baie de Port au Prince in water depths ranging from 75 m to 130 m. It is the expectation that sediments recovered by gravity coring will provide stratigraphic information and reached older horizons, possibly related to earlier earthquakes that will be radiocarbon dated. In this carbonate rich setting, radiocarbon should be an effective means of determining the timing of other earthquake related events such as sea floor failures or fault offsets.

Fig. 43. Gravity corer being retrieved with the A-frame winch.

The gravity cores will have their physical properties measured with a GeoTech logger at Lamont-Doherty Earth Observatory where they will be split, photographed and curated in refrigerated facilities. The Lamont-Doherty Earth Observatory Core Repository is partly subsidized by NSF and the curation of the cores is at no cost to the grant. Once the cores are split and photographed, they will be described following the Integrated Ocean Drilling Program procedures and will sampled for analyses. The data will be entered into a database and will be readily accessible for use by the scientific community.

Smith-McIntyre Grab

This grab obtained sediment samples that ranged in grain size from gravel to mud. It has spring-loaded jaws and two bottom contacts that trigger them ensuring penetration into the sediments (Fig. 44). Sediment grabs were obtained in four locations to verify sidescan sonar images that revealed mounds from several meters to tens of meters high, depressions that surrounded the mounds from a few meters to 60 m deep, and "pockmark" features. Grabs were recovered in water depths ranging from 30 m to 70 m and recovered primarily shells, shell hash and rubble composed of gravel size cemented carbonate, corals and coral fragments, coarse sand and carbonate mud. One of the samples recovered within the field of pockmarks contained algae attached to coral fragments.

Fig. 44. Smith McIntyre grab was used to verify the sidescan sonar backscatter.

Table 4. Core number, latitude N in degrees and decimal minutes, longitude west in degrees and decimal minutes, water depth in meters and the length recovered in centimeters. GC gravity core, MC multicore, GB grab.

Core #	Lat	Long	Water Depth (m)	Core length (cm)
EN473-GC1	18°34.883'	73°03.168'	1753	46
EN473-GC2	18°35.196'	73°03.366	1753	182
EB473-GC3	18°33.790'	73°03.888'	1723	128
EB473-GC4	18°35.008'	73°03.752'	1754	80

EN473-GC5	18°32.568	73°04.791'	1507	135
EN473-MC1	18°35.189'	73°03.362'	1710	all four liners 50 cm
EN473-GC6	18°31.436'	72°50.280'	1136	66
EN473-MC2	18°35.075	73°03.088	1722	1.5 cm each liner
EN473-GC7	18°31.150'	72°49.924'	1120	34
EN473-MC3	18°31.249'	72°50.425'	1153	10 cm each liner
EN473-GC8	18°26.545'	72°42.689'	162	33
EN473-GC9	18°26.547'	72°42.885'	199	159
EN473-GC10	18°26.515'	72°43.114'	263	152
EN473-GC11	18°26.534'	72°43.631'	394	27
EN473-GC12	18°27.147'	72°42.024'	250	147
EN473-GC13	18°26.336'	72°43.101'	167	57
EN473-GC14	18°26.331'	72°43.324'	257	70
EN473-GC15	18°26.265'	72°43.567'	307	78
EN473-GC16	18°26.172'	72°43.625'	266	< 1
EN473-GC17	18°26.185'	72°44.216'	223	< 1
EN473-GC18	18°34.024'	73°07.296	1560	116
EN473-GC19	18°32.190	73°04.312	1567	103
EN473-MC4	18°32.201	73°04.300	1556	30 to 35 cm
EN473-GC20	18°38.389	72°34.946	138	156
EN473-GC21	18°38.544	72°35.102	136	111
EN473-GC22	18°38.371	72°35.983	137	186
EN473-GC23	18°38.247	72°36.688	113	23
EN473-GC24	18°38.226	72°36.905	102	<1
EN473-GC25	18°36.143	72°36.143	84	25
EN473-GC26	18°37.001	72°36.177	76	32
EN473-GC27	18°37.132	72°34.750	148	68
EN473-GB1	18°34.776'	72°39.560'	30	
EN473-GB2	18°35.940'	72°39.221	36	
EN473-GB3	18°36.414	72°38.926	31	
EN473-GB4	18°38.806'	72°38.244'	73	

□

XI. Oceanography

The CTD measurements were done with a Sea Bird Electronics SBE911. The CTD package during CTD01 through CTD09 has the following sensors/measurements: Pressure, dual temperature, dual conductivity, dual pumps, WET Labs C-Star 25cm transmissometer, Benthos Altimeter, Oxygen 1, Oxygen 2,WET Labs ECO Fluorometer, and 12 10L Niskin bottles using GSO's "small" frame (Fig. 45).

CTD measurements were conducted for calibration of sound velocity for the multibeam bathymetry, chirp, ship echosounders and side-scan sonar. In the Canal du Sud depocenter a CTD was deployed to the deepest part of this basin at 1750 m with the objective to detect suspended sediment anomalies associated to the January 12, 2010 earthquake. These measurements showed turbidity in the lower 600 m.

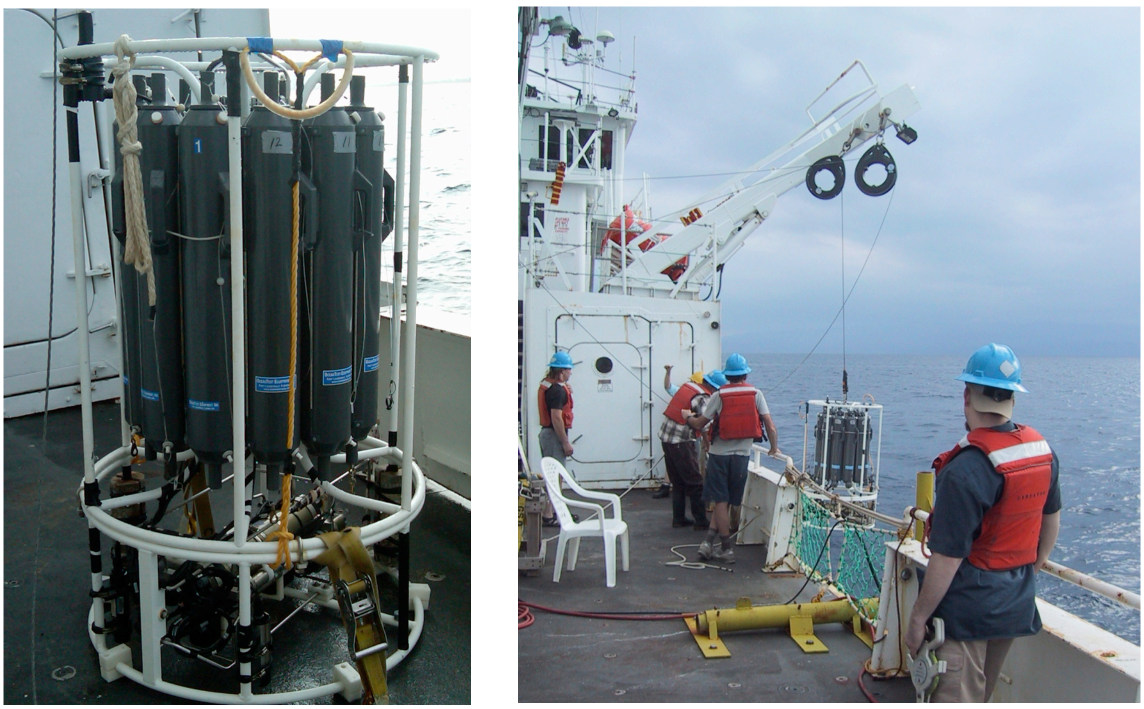


Fig. 45. Showing the Sea Bird Electronics SBE911, water bottles and sensors on the R/V Endeavor and about to be deployed.

XII. Land Operations and Collaborations

The program had a strong collaborative component with colleagues that were working both on the field on land and from the shore. Paul Mann and Fred Taylor from the University of Texas Institute of Geophysics, and Richard Briggs and Carol Prentice from the USGS were in daily communication with us and reported on their findings of where they thought the fault was located so that we can track its path offshore. In turn, we reported about our findings to guide their future trenching operations. Michael Steckler provided support from Lamont by providing analysis of coseismic changes from Google Earth images and coordinating interactions in LDEO.

Acknowledgments

We are grateful to the National Science Foundation for their support of this mission through the RAPID response grant #OCE-1028045. We acknowledge Sam De Bow for helping to put together this expedition quickly (2 weeks) and efficiently, obtaining the navy multibeam for Baie de Port au Prince, facilitating the clearance procedures, the logistics for delivering the humanitarian aid including aid by the USNS Cornhusker State, meeting our Haitian colleagues and delivering equipment to Paul Mann, Fred Taylor and Carol Prentice and Richard Briggs of the USGS collaborators working on land. We thank the Captain and crew of the R/V Endeavor for their professionalism and incredible support in this difficult mission of uncharted waters, small crafts and home made buoys. We acknowledge our collaborators Paul Mann, Carol Prentice, Fred Taylor, Richard Briggs and Eric Calais for their scientific input and facilitating contacts with our Haitian colleagues. Bernard M. de Le Pinay and collaborators provided the multibeam bathymetry that greatly facilitated our research. Mike Steckler and Colin Stark were our connection to the world.