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ECORD Geophysical and Geotechnical Hazard Site Survey Offshore Yucatan, Mexico. Cruise 2013/4_ECORD.

Marine Geosciences

Commissioned Report CR/13/049

BRITISH GEOLOGICAL SURVEY

MARINE GEOSCIENCES

COMMISSIONED REPORT XX/00/00

ECORD Geophysical and Geotechnical Hazard Site Survey Offshore Yucatan, Mexico. Cruise 2013/4_ECORD.

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Keywords

Geohazards; Chixculub; Surface Tow Boomer; Magnetometer; Side scan sonar; multibeam echosounder.

Front cover

Image of the *R/V Justo Sierra* alongside in Progreso, Mexico.

Bibliographical reference

STEWART, H A, GULICK, S, GOFF, J, DUNCAN, D, SAUSTRUP, S, DAVIS M. 2013. ECORD Geophysical and Geotechnical Hazard Site Survey Offshore Yucatan, Mexico. Cruise 2013/4_ECORD. *British Geological Survey Commissioned Report*, CR/13/049. 110pp.

Edinburgh British Geological Survey 2013

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Foreword

This report provides information on the University of Texas, Institute for Geophysics (UTIG) led ECORD (European Consortium for Ocean Research Drilling) geophysical and geotechnical hazard site survey offshore Yucatan aboard the *R/V Justo Sierra* which took place from the 16th April to the 23rd April 2013 over a study area within the Chixculub impact crater. The cruise has been carried out under contract for ECORD comprising the acquisition of geophysical data (surface tow boomer, side scan sonar, multibeam echosounder, magnetometer and CHIRP data) and geotechnical data (cone penetrometer tests (CPT)), ahead of scheduled ECORD led drilling of the Chixculub impact crater. The survey was undertaken in joint collaboration between UTIG and Universidad Nacional Autonóma de México (UNAM). Seafloor Geotec, LLC, was commissioned to carry out CPTs at selected sites within the survey area.

Acknowledgements

The scientists would like to express their gratitude to the crew and officers of the *R/V Justo Sierra*.

H. A. Stewart wrote Sections 1, 3-7 and 10; Appendices 2-6 and 9.

S. Gulick co-wrote Section 2 and Appendix 10, and edited entire document to produce final version.

J. Goff co-wrote Section 2 and Appendix 10; Figure 18; the cover photograph.

J. Sanford provided the photograph used in Figure 9.

The entire scientific party contributed to Sections 8 and 9; Appendices 1, 7 and 8.

UNAM provided Appendix 11.

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1 Introduction

The aims of the cruise (cruise number 2013/4_ECORD) were to acquire high resolution geophysical data (multibeam echosounder, side scan sonar, surface tow boomer, magnetometer and CHIRP) and geotechnical data (CPT) in an area of the Chixculub impact crater. The cruise was carried out under contract for the British Geological Survey/ECORD Science Operator.

The study area area is approximately 10.58 km^2 located approximately 32 km northwest of Progreso, Mexico (Appendix 10 Figure 32). An acquisition programme of geophysical survey lines were undertaken to cross three proposed IODP drill sites (Table 1) in order to map seabed morphology, shallow sub-surface geology and the presence of magnetic anomalies, and the context in which they were found.

Site Name	Latitude (N)	Longitude (W)	Water Depth (m)
Chicx-4A	21° 28.6578	89° 57.4404	17 m
Chicx-3A	21° 27.0846	89° 57.0648	17 m
Chicx-2A	21° 27.33	89° 57.09	17 m

Table 1. Summary of proposed IODP drill site locations.

Data were acquired covering an area approximately 14.4 km^2 with complete coverage of multibeam echosounder and side scan sonar data acquired. Approximately 435 line kilometres of side scan sonar and CHIRP data, 204 line kilometres of magnetometer data, and 194 line kilometres of surface tow boomer data were acquired. All 625 line kilometres included concurrent acquisition of multibeam echosounder data. With overage, turns, and infill to ensure 100% coverage the survey acquired ended up being ~15.6 km^2. See Appendix 1 for the track charts from this cruise.

1.1 LINE NUMBERING SCHEME

The original survey plan was to run a grid of NS oriented lines at a line spacing of 72m (e.g. NS01) acquiring surface tow boomer and multibeam echosounder; a grid of NS oriented lines offset by half spacing to the surface tow boomer lines on which side scan sonar, CHIRP, magnetometer and multibeam echosounder were acquired (e.g. NS01a); a grid of 12 original EW oriented lines that on first pass acquired surface tow boomer and multibeam echosounder (e.g. EW01) and on second pass acquired the side scan sonar, CHIRP, magnetometer and multibeam echosounder suite of data (e.g. EW01a). Subsequent to these lines, any repeat lines retained the original line number but were suffixed ‘b’ (e.g. EW01b). Additional survey lines, at 72 m spacing, were added during survey acquiring side scan sonar, CHIRP and multibeam echosounder to a) extend the survey area to the north and northwest (included magnetometer acquisition), b) to better image the drill sites, and c) to infill small data gaps. These additional survey lines were simply numbered sequentially following those from the primary suite of lines. The final round of infill lines focussed on the drill sites did not include the magnetometer as these lines were to gain additional sidescan and multibeam coverage.

2 Chief Scientist Cruise Narrative

All times below are local unless otherwise specified.

April 17

Left dock around midnight to transit to start of survey. Stopped just northeast of survey and did a CTD cast. Water velocity a very consistent 1538 m/s in ~18 m of water. Transited to start of patch test east of survey. Had troubles with the currents and maintaining a line during the patch test and thus ran the same line three times. Then deployed the boomer and streamer while heaing back towards survey area. Deployment successful using a-frame to lift boomer and tag lines to lower into water and then pull to port side to tow. Streamer and boomer deployed from the hawsers on opposite rear corners of fantail. The streamer and the boomer are both ~18 m behind the stern and thus the midpoints for imaging are directly after of the center of the fantail by 18 m. Started first line of survey at 04:52.

Continued survey doing boomer and multibeam bathymetry simultaneously with port turns between lines such that each successive line is 5 lines apart. Some concern about the lengths of run-ins and run-outs being done by the bridge. So as of the end of line 24 we asked that they start turning to port immediately at the end of the line as long as they can keep a >4.5 kts speed.

12:00. New line-turning procedures are working well. Now down to ~45 minutes from start of one line to end of next.

Zooming in on multibeam reveals bedforms ~1m high and 100's m across oriented NE-SW (shoreline oblique), with greater expression in the north of survey. Primary horizon below seafloor ~0-3 m deep – likewise seems to be thicker cover to the N of survey box. Also, horizon is quite flat w/o evidence of karst.

13:15. Dan has successfully imported ship's multibeam files into Caris. Quality is good – very few artifacts. No doubt limited swath width decreases outer beam artifacts.

At 72 m line spacing we are not getting 100% coverage because of the single-head multibeam (128 degrees max swath width). However, we will run chirp/ss lines in between these lines and concurrently run multibeam, and that will get us lots of overlap.

18:00. Watching Marcy ping edit – lots of pits, ~1 m deep, maybe 10's of m wide. Erosional windows through sand to hard bottom a la rippled scour depressions? Likely to find analogs of shallow stratigraphy here (shallow oblique ridges and erosional pits) to west Florida shelf – see refs of SD Locker. Or are they cenotes w/expression at the seafloor. Needs to be carefully investigated. But so far haven't seen any expression on the subseafloor reflector in the boomer.

18:30. Seas have picked up quite a bit and boomer data quality is suffering.

20:00. Seas calming, data quality improving. May need to reshoot critical lines if data quality too poor.

April 18

00:00. Continuing the boomer and multibeam survey on the N-S profiles. All logs brought up to date with the numbering and a graphic made showing all the turns and line directions and files numbers.

03:30. Switched to running E-W lines. Discovered to fix the multibeam depths in CARIS where the SVP needed updating you also need to reapply the waterline correction.

07:30. Created basemap of first portion of the bathymetry data and observe feastures resembling karst which may explain the poor penetration of the boomer.

08:45. Completed E-W boomer and multibeam lines. Finished this portion of the survey. Recovered boomer. Deployed first magnetometer and then chirp/ss with tow point on lift bar but a fairlead to block system on that lift line rigged to lower the tow point to just above the stern rail. Layback of fish is ~25 m from stern and calculated 45.6 m from primary GPS. Magnetometer layback is 21.5 m behind chirp/ss.

10:20. Completed deployment of chirp/ss and testing systems. Chirp working well including GPS: 2-15 kHz, 20 ms, ping rate 5 Hz, pulse power 100%, acquired to 50 m. Based on altitude chirp and echosounder depth the chirp is towing 7-8 m below sealevel. Sidescan looks amazing however GPS string not coming through. Decided to start acquiring and keep working on GPS problem since we are getting the GPS on the chirp.

10:38. Starting on line 31a of new survey heading north.

11:48. In trying to diagnose the Maggie an error has caused the sidescan to quit functioning. Shutdown computer. Took opportunity to slow ship down and move tow point 4 m to port of center line to get out of prop wash. Continuing straight while we diagnose issues.

12:20. Able to get GPS on both sidescan and chirp by plugging two different inputs into two different com ports. Have turned boat around to point toward survey, but not ready to start yet. Still working on Maggie issues.

13:00. Having trouble getting laptop to communicate with Maggie through com5. Steffen decides that he needs to manufacture a serial cable.

13:30. Cable didn’t work. Calling Edgetech customer support for help on Skype. They went through some diagnostics and decided they would need to send a work-around bit of software.

16:00. Still waiting on Edgetech support to send us instructions.

18:00. All attempts to hook up magnetometer through the Edgetech topside failed, despite instructions from Edgetech support. Brought up chirp, disconnected magnetometer, and hooked it up independently to a laptop with long cable. That worked fine, and were able to sync to another gps antenna using older NMEA protocols. Redeploy chirp and Maggie and start on line 01a. Do racetrack all the way to middle.

We will redo all lines done before because we were not recording Maggie. Also, on those lines the lateral layback was mistakenly set to 40 m, when it should be 0 because chirp is right behind the antenna we were using. So those navigation points were all messed up.

19:00. Recomputed sidescan layback to be 39 m rather than 46.5, taking proper account of angle of wire. Will keep with 46.5 m for current line (01a), but set all subsequent laybacks to 39 m. 23 m cable out, 10 m water depth and 3 m from sea surface to tow point. 23**2 – 13**2 = 19 m + 20 m from antenna to stern = 39 m.

The magnetometer is, with its own cable, ~41 m behind the stern of the ship, or ~61 m behind the gps antenna it is getting its nav information from. That puts it 21 m behind the chirp. Although we are towing it toward the starboard side of the ship, the magnetometer is drifting toward the centerline.

19:35. Sidescan is giving appearance of hard bottom for the most part – high backscatter, pitted in appearance. Lower backscatter strands oriented NE-SW are present (same orientation as the topographic lineaments) – presumably a thin veneer of sand atop the hard bottom.

April 19

00:00. Continuing doing the multibeam/sidescan/chirp/Maggie survey.

01:45. Space on the bathy processing computer (IG-838823) is to small, so moved the CARIS project over to MBeambackup (laptop) and requested assistance in re-partitioning the IG-838823 laptop to increase the windows partition.

02:09. Having to remind bridge about speed. Trying to keep it between 4.5 and 5 knts. Discovered a deeper spot in the seabed but still north of site Chicx04.

04:35. Consistent that northward lines have higher data quality than southward lines. So after all operations in this phase are completed, we will reshoot southward oriented lines over the drillsites in a northward direction. This will improve the quality of those critical areas and also provide data to correct the magnetometer for ship effects.

04:45. Measured the offsets to the small GPS antenna (GPS #4) that is connected to the Maggie. Added all offsets into the mobilisation report.

08:32. Multibeam program crashed. Continuing south acquiring of the sidescan and CHIRP and backing up the data on the multibeam computer.

08:50. Multibeam successfully rebooted and back surveying. We will fill in the gap on this line (24) later.

09:00. All surveying going well.

12:00. Shift change to Goff; surveying going well throughout day.

18:11. Finished the N-S profiles and starting the E-W profiles.

20:00. Had meeting between Chief Scientist, Captain, Dr. Perez, SGL techs, and UNAM techs to discuss CPT operations. Some concern about ability to keep stern of vessel steady during operations and so designed a test where we will use the buoys from the boomer on a rope attached to a weight and try to keep steady.

Cruise Plan from Apr 20 on: Finish E-W Profiles, Gap Fill, Extend survey box in areas of interest, return to port at 16:00 on Apr 20 to arrive at 18:00 to pick up rest of SGL team and Dr. Urrutia. Leave port on Apr 21 at 06:00 to arrive at daylight in survey area. CPT operations testing and then CPT operations Apr 21st on.

April 20

00:11. Finished E-W profiles. Starting to infill gaps. Based on multibeam coverage from CARIS identified that we need to reshoot 24a, 11a, 13, and 31a. Designed this so that we are shooting 24a and 11a in the opposite direction. Calling of these reshoots "b" such as 24b is a reshoot of 24a and 13b is a reshoot of 13.

03:25. Finished reshoots. Now shooting a line 32 north and then will do shortened (northern half only) of NS lines 33-42. We will also do EW lines 13-23. Noted that Maggie data is more emergent.

04:14. Measured hawse pipe distances which were 3.81 m on either side of center line.

07:30. At line change noticed Maggie not transmiting data. Check all connections and then got it working again by resetting ports. Maggie file yucatan0413_055 probably has bad data at the end.

07:47. Maggie functioning again although Maggie string does not seem to include GPS. GPS is being logged correctly in a different file.

07:50. Got Maggie to include GPS in the data string again.

08:27. On last N-S line. Maggie line got switched at end of turn.

09:01. Lost heading for a couple of minutes so may be an error in the multibeam.

09:58. Some intermittent heading errors due to a Frigate bird sitting on antenna.

11:07. Packed up the boomer cables and streamer to avoid them getting damaged by the CPT ops.

13:30. Many of the pits have bright-backscatter sediments – much brighter than the linear patches - with regular bedforms.

After finishing E-W lines on top, will finish up by expanding the eastern side of the survey with NS lines, starting with number NS45.

13:42. Sidescan file name went haywire when we started NS45. Instead of starting with 2013, it starts with 1980. GPS is also going haywire – giving strange directions and speeds. Ship's GPS is working fine, so MB data ok. Also Maggie, which is off a different antenna. But sidescan and chirp will have incorrect navigation. Mid-way through line we got gps hooked up to the mushroom antenna that was the Maggie is running off of. It looks like the previous line (EW18) was not affected - we can see where it went haywire on the Fugawi track.

14:35. Will end on NS46 at the North end. A tad early, but we want to do the last CTD cast in deeper water to the north. So we will continue to head to the north as we recover, and then do cast before heading back to port.

1450. End last line. All sonars shut down. Maggie unplugged. Steffen and Heather recovering Maggie.

15:10. Sidecan/Chirp on deck

15:15. Deploy CTD

15:26. CTD to deck.

15:27. Transit to Progreso.

18:00. Alongside in Progreso. Picked up two SGL techs and Jaime Urrutia.

18:30 to Midnight. Shore leave.

April 21

06:00. Transit to site Chicx-04a.

07:55. Arrived at site Chicx-04a.

09:05. Started station keeping test using buoys on surface and weights on a rope on seabottom to simulate CPT. Excursion ranges from <1-7 m. SGL crew chiefs agree to try with these parameters. Current is 4 knts and water depth 17.5 m so a challenge for station keeping, but going to give it a try.

10:06. Rigging the gravity core and placed a GPS antenna (move #4) on the fantail.

10:23. Tried gravity core at max winch out. Failed, not fast enough.

10:29. Tried gravity core at free fall. Penetrated 4-5 cm based on scraping on the head of the barrel, but not enough to close fingers on core catcher. What grains were present were white and fine sand sized.

10:35. Switching to CPT.

11:15 First deployment of CPT. On bottom at 11:06. Hit rock – bent cone. The cone is bent 180 degrees right at the base, which means that whatever sediment is there is no more than a few cm thick.

01:20. CPT repaired and put overside.

01:26. On bottom. No response on CPT laptop despite motor and pump running. Lost positioning requiring to cut the wires at the high-voltage box for safety.

01:40. Recovered CPT. It appears to have been drug but not damaged. Sampled a tiny bit of sand sized shelf fragments and coral fragments.

02:00. Called doing any more CPTs due to lack of sediment, and issues with station keeping. Decided to try the the Justo Sierra's Smith-McIntyre instead.

14:45. Moved GPS antenna #4 to 3 m aft of the starboard a-frame to better record grab positions.

14:54. Planning how to get better coverage of sidescan over the drill sites and will reshoot N-S lines that were noisy as well as add some new E-W lines.

15:04. Acquired grab sample at -89.95468, 21.47709 in a dark backscatter patch.

15:20. Acquired grab sample #2 approximately 39 m from Chicx04 at -89.957107, 21.477353.

15:35. Acquired grab sample #3 approximately 50 m from Chicx04a at 21.477435, -89.956925.

15:52. Acquired grab sample #4 approximately 30 m from Chicx04a at 21.47755, -89.95705.

16:25. Acquired grab sample #5 at 21.47898, -89.95621 in a light patch, fragments of live and dead coral. Realizing we will need to move drillsites off of high reflectance locations if these prove to be colonized.

17:07. Acquired grab sample #6 at 21.45549, -89.95144 in a medium reflective patch at Chicx-02a. Found sand and one small sponge, so probably okay to keep this site.

17:33. Acquired grab sample #7 21.45582, -89.95151 in low reflectance location, 10 cm of find grained well sorted sand.

17:44. Acquired grab sample #8 at 21.451325, -89.95101 at Chicx-03A high reflectance path at drill site. Had live sea urchin, two species of sea grass, corals, and a scallop all of which were returned to the sea. Based on this result, the drillsite will need to be moved.

18:09. Acquired grab sample #9 at 21.453108, -89.950157 in a dark patch north of Chicx-03a as an alternate to the drillsite. Fine grained sand 10 cm thick, well sorted. Located 210 m NNE of Chicx-03a.

18:25. Acquired grab sample #10 at 21.449278, -89.951002 in a dark patch south of Chicx-03a. Fine grained sand 3-4 cm scoop of fine sand. Located 240 m S of Chicx-03a.

Thru 1830: 10 grabs in all. Low backscatter areas correlated with fine grained carbonate sand, up to 10 cm thick in the grabs (the grab is big and we think it probably could have taken more if the sand were thicker). High backscatter areas correlated to considerable marine flora and fauna, including live corals. Very little to no sand were found in these grabs. Coral is important concern because of protected status. Will almost certainly need to guide drilling to the low backscatter/ sandy patches.

19:30. Begin set up for continued ss/chirp. Will first reshoot four n-s lines that were poor sidescan quality: 19a – 22a (we'll call the reshoots 19b-22b). Then we will fill in some e-w lines around the drill sites: from 9-11 and 3-5.

20:30. Everything's set up and fish is in the water. Everything working fine after jiggling wires and rebooting to get sidescan talking to top side.

20:44. GPS #4 moved from starboard a-frame to port-stern and is being logged on Fugawi; chirp and sidescan are back to being logged by POS/MV (primary antenna).

2050. Starting line ns19b

23:40. Finished with the four N-S lines, and moving to additional EW lines. Starting with EW2b.

Apr 22

00:14. Continuing EW lines. Decided to number any reshoots (2,3,4) with a b to designate this fact. All the others were numbered from 24 northwards sequentially.

06:56. Finished southern EW survey except for one line and heading to northern EW survey.

07:35. Starting northern EW survey with turns to starboard. Includes reshoots of 9,10, and 11.

12:03. About to enter last line when heading lost (bird suspected). Waiting for improvement before entering line.

12:55. End of last line. Pulling in fish. Noticed in backing up files that date and time on files after ew31, starting with ew24, got messed up. Dates are listed as April 6 rather than April 22. Sidescan file names also have incorrect dates. Also noticed that file sizes on all chirp lines that we started taking after grab sampling are much smaller. Perhaps a shorter record length? Everything looks fine on playback – will investigate back in the lab.

3 Navigation

Primary navigation and positioning for the *R/V Justo Sierra* multibeam echosounder was by the Seatex Seapath 200 positioning system (see Appendix 10). The multibeam echosounder received time stamps from this navigation signal. All data acquisition systems received time stamps from the UTIG Pos MV positioning system and UTIG GPS Antenna (see Table 3 in Appendix 4) ensuring seamless positioning of all data types acquired during this cruise. The details of all GPS antenna, IMU, and steering nodes (Table 2) are included in Appendix 4, Figure 24 (vessel offset diagram), Appendix 10 (vessel mobilisation report) and Appendix 11 (Fleetway Facility Services survey report for the *R/V Justo Sierra*).

Equipment	Steering Node
Side scan Sonar	A-frame. Layback applied during acquisition.
Surface Tow Boomer	A-frame. Layback applied during acquisition.
Magnetometer	Cleat on starboard side of the A-frame. Layback applied during acquisition.
Multibeam Echosounder	Hull mounted transducer reference point.
CHIRP	Part of the side scan sonar.

Table 2. List of equipment utilised during the cruise and which steering node each item utilised, for offsets please see Appendix 4 (vessel layback diagram) and Appendix 10 (vessel mobilisation report).

4 Geophysical Survey Equipment

4.1 SURFACE TOW BOOMER

4.1.1 Source

The surface tow boomer (STB) (Figure 1) comprises a towed catamaran (model number AA200, serial number 2030769) incorporating a 'boomer plate' (transducer) and high voltage power supply. The acoustic energy is generated by discharging high voltage direct current directly into the boomer plate. The system uses an Applied Acoustics CSP-300 high voltage power supply.

The STB was towed 18m astern the vessel from the port hawse pipe, located 3.81m from the vessel centre line, floating on the surface. Normal vessel speed for data acquisition using the STB is between 4 and 5 knots. Layback was applied during acquisition.

4.1.2 Hydrophone

An Applied Acoustics 8-element hydrophone was used during this cruise. The streamer is an active section which comprises a series of hydrophones enclosed in a plastic boot filled with silicone oil for neutral buoyancy. The hydrophone is 25mm in diameter, has 365mm spacing between hydrophone elements, and has an overall sensitivity of -176dB ref 1v per µPa. The streamer signal is fed into the Applied Acoustics AH 360/8 amplifier which boosts the signal to compensate for acoustic losses within the water column. The hydrophone was deployed from the starboard hawse pipe located 3.81m from the vessel centre line.

4.1.3 Acquisition

The recording system is a CODA DA500 (Figure 2). The data were stored digitally onto the hard drive and backup copies were made to two external hard drives in CODA and SEGY format. The STB system signal was sampled at 20,000 Hz with 10,000 samples which gave a depth of 500ms from the acoustic source.

4.2 EDGETECH 2000-DSS SIDE SCAN SONAR AND CHIRP

The side scan sonar data were collected using an EdgeTech 2000-DSS dual frequency system with integral CHIRP system (Figure 3 and 4). For the purposes of this survey, only the high frequency was used. The side scan sonar system operated at a frequency of between 385 and 435 kHz. The CHIRP system operated at a frequency of 2-15 kHz. The ping rate was 6.27 Hz, sample rate of 21.701 Hz. Both the side scan sonar and CHIRP data were acquired using EdgeTech's own Discover software and were monitored in real-time by shipboard scientists and technicians (Figure 5). All side scan sonar data were stored electronically in EdgeTech JSF format (.jsf) and .xtf format, all CHIRP data were stored electronically in EdgeTech JSF format (.jsf). All data were saved to hard drive and back-up drives.

QC of these data was carried out during and post acquisition. Processing of the data will be carried out post-cruise by UTIG. Side scan soar data were reviewed at frequent intervals with respect to quality, resolution and spatial coverage to ensure that the acquisition programme would provide adequate data to meet the objectives of the survey.

The side scan sonar was towed 19 m astern the vessel approximately 8 m above the sea bed. Layback was applied during acquisition.

>150% coverage with the side scan sonar was achieved during the course of this survey (for examples see Section 8).

Figure 1. The Applied Acoustics surface tow boomer catamaran used during the course of this survey on the deck of the *R/V Justo Sierra*.

Figure 2. Acquisition set up for the CODA DA500 on board the *R/V Justo Sierra*.

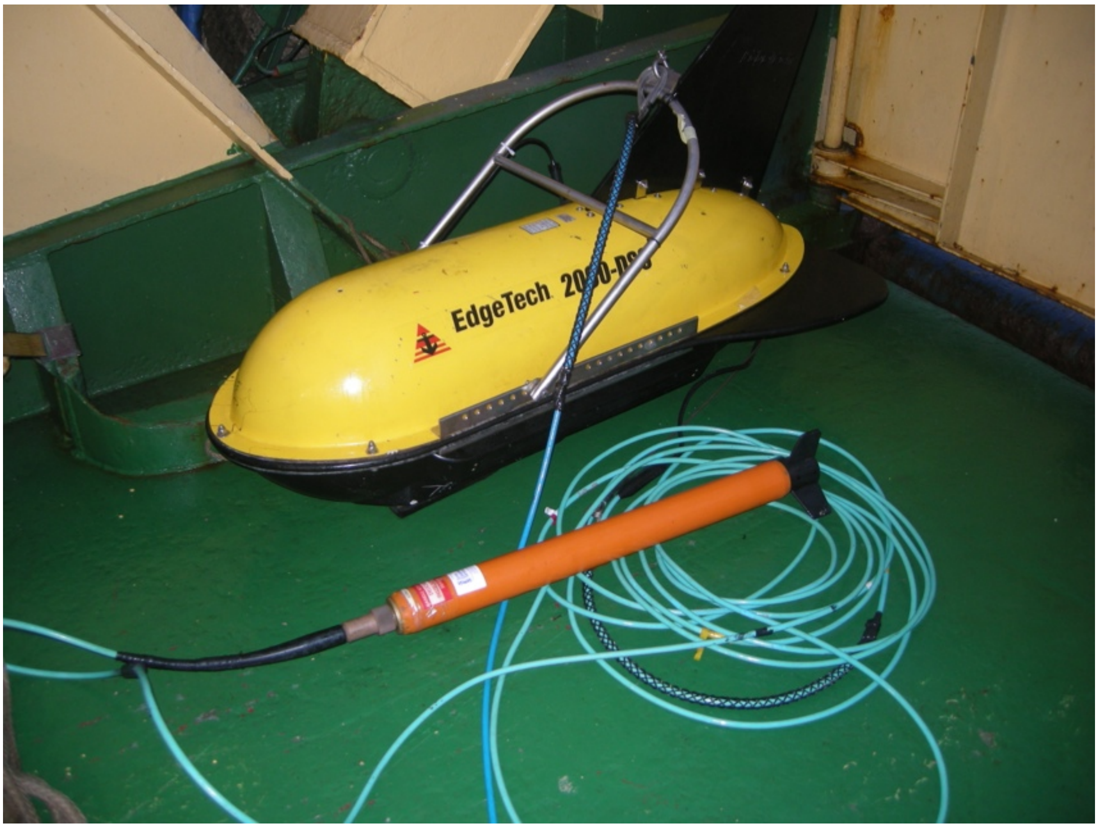


Figure 3. The EdgeTech 2000-DSS side scan sonar and Marine Magnetics magnetometer (closest to the camera) used during the course of this survey on the deck of the *R/V Justo Sierra*.

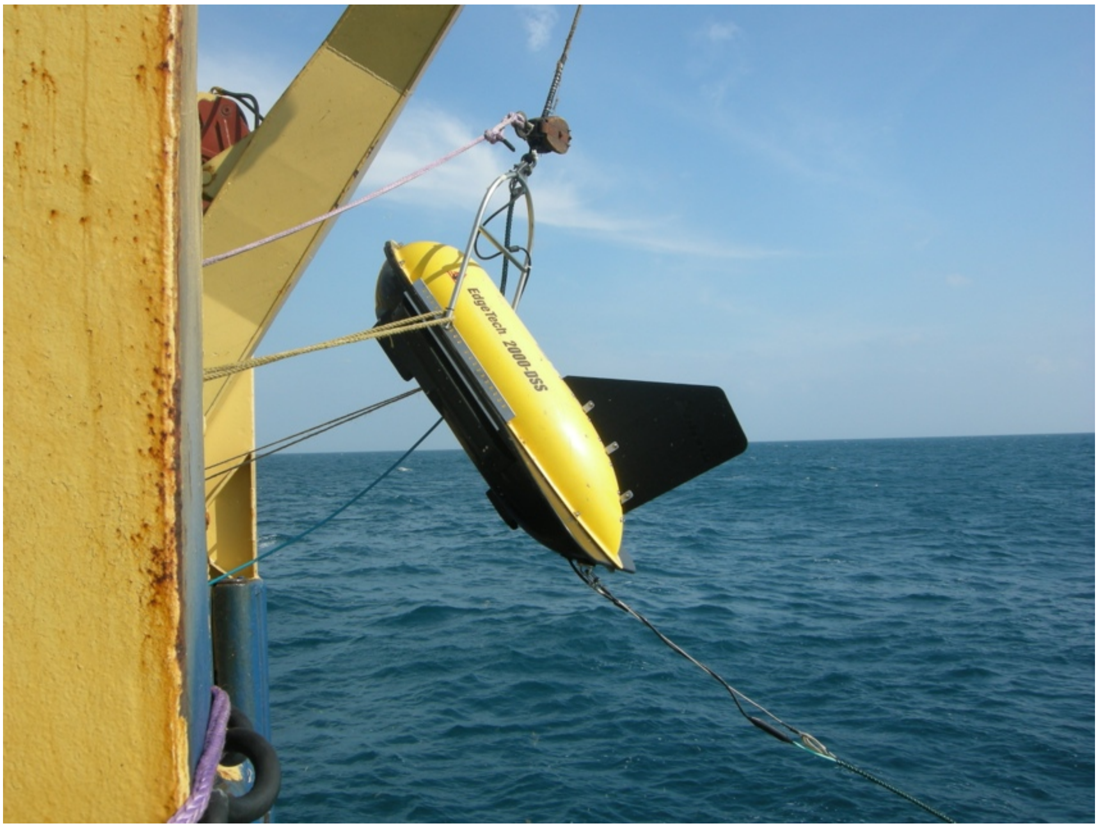


Figure 4. The EdgeTech 2000-DSS side scan sonar being deployed from the *R/V Justo Sierra*.

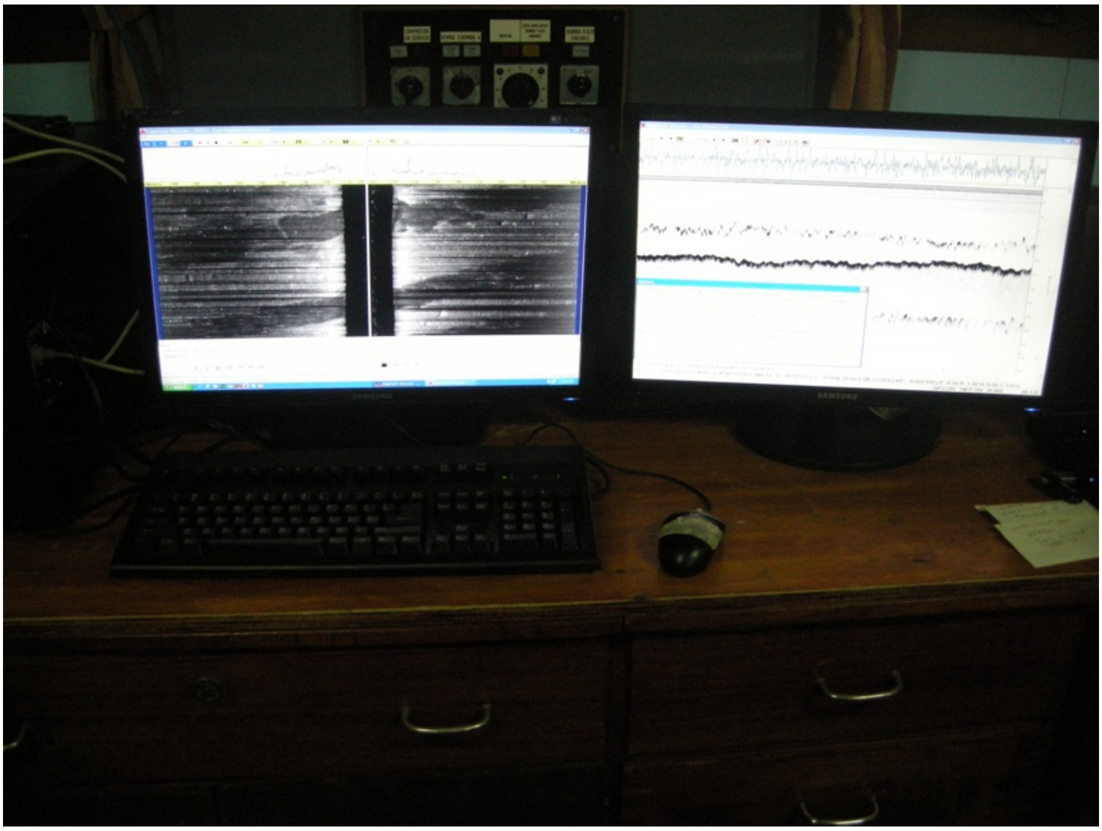


Figure 5. The acquisition set up for the EdgeTech 2000-DSS side scan sonar and integrated CHIRP system.

4.3 MARINE MAGNETICS MINI-MAGNETOMETER

The Marine Magnetics Explorer Mini-Magnetometer System (Figure 3) comprises an Overhausen total field sensor and electronics module with larmour counter encased in a 'bottle' at the end of a combined Co-Ax power/signal and tow cable. The small surface electronics box interfaces with a standard PC where the data is logged in SeaLINK software, combined with a GPS string, and saved to hard drive and back-up drives.

The magnetometer has an accuracy of 0.1 nT and achieves a high-resolution output with a noise level of 0.02 nT, counter sensitivity of 0.001 nT, and resolution of 0.001 nT. To create an anomaly map we will subtract the Total Field background value. Based on the US National Geophysical Data Center (NOAA), the estimated Total Field for these dates and this location based on IGRF2011 was 41929 nT.

The magnetometer was towed 41m astern the vessel approximately 1m below sea surface. Layback was applied during acquisition.

5 Multibeam Echosounder Survey

The *R/V Justo Sierra* is fitted with a Kongsberg EM3002 multibeam echosounder system with data acquisition using the Kongsberg SIS multibeam acquisition software (Figure 6). The operating frequency of the system is 280-310 kHz. A patch test was carried out on the 17th April, en route to the survey area to verify calibration for the system. All real-time data were monitored closely by surveyors and a QC of data was carried out during acquisition as well as post-cruise during processing by UTIG.

CTD casts for sound velocity profiles were carried out three times during the cruise (Appendix 5). This allowed sound velocity measurements to be applied for beam-forming at the multibeam echosounder heads.

The multibeam echosounder data acquired during this cruise will be processed by UTIG staff post-cruise and supplied to all partners once the processing is completed. Good quality data were obtained. Data quality was reduced slightly due to uncorrected ‘roll’ which could not be corrected during the patch test but is deemed to be of adequate quality for mapping purposes.

Good multibeam data were acquired on all survey lines (Appendix 8) with uncorrected water depths ranging from around 16 m to 19m. The shallowest water depths were in the northwestern corner of the survey area and the deepest water depths coincident with hollows in the karst topography (Appendix 8).

The multibeam echosounder data will be processed by the UTIG and supplied to the BGS at a time agreed by both parties.

Figure 6. Acquisition set up for the EM3002 (left) on board the *R/V Justo Sierra*.

6 Sampling/Geotechnical Equipment

6.1 SEAFLOOR GEOTEC MINIATURE CONE PENETROMETER SYSTEM

The CPT system is a 2 cm^2 cone penetrometer deployed from a light-weight (1300 kg) frame (Figure 7). The maximum penetration depth below mud line that can be achieved is approximately 12 m and the CPT system uses a coiled tubing system to advance the probe into the subsurface (Figure 8). The coiled rod is straightened and advanced using a thrusters unit in the frame. The entire unit is controlled remotely from the surface via an umbilical cable and incorporates Schilling telemetry and control systems. The test itself measures tip pressure and sleeve pressure (friction) to interpret the composition of the material encountered sub-seafloor. Maximum tip resistance is approximately 35MPa and measured parameters are depth, q_c, f_s and u.

The CPT system was launched from the A-frame of the *R/V Justo Sierra* with positioning via the repositioned UTIG GPS antenna 4 (details for UTIG GPS antenna 4a can be found in Table 3 Appendix 4).

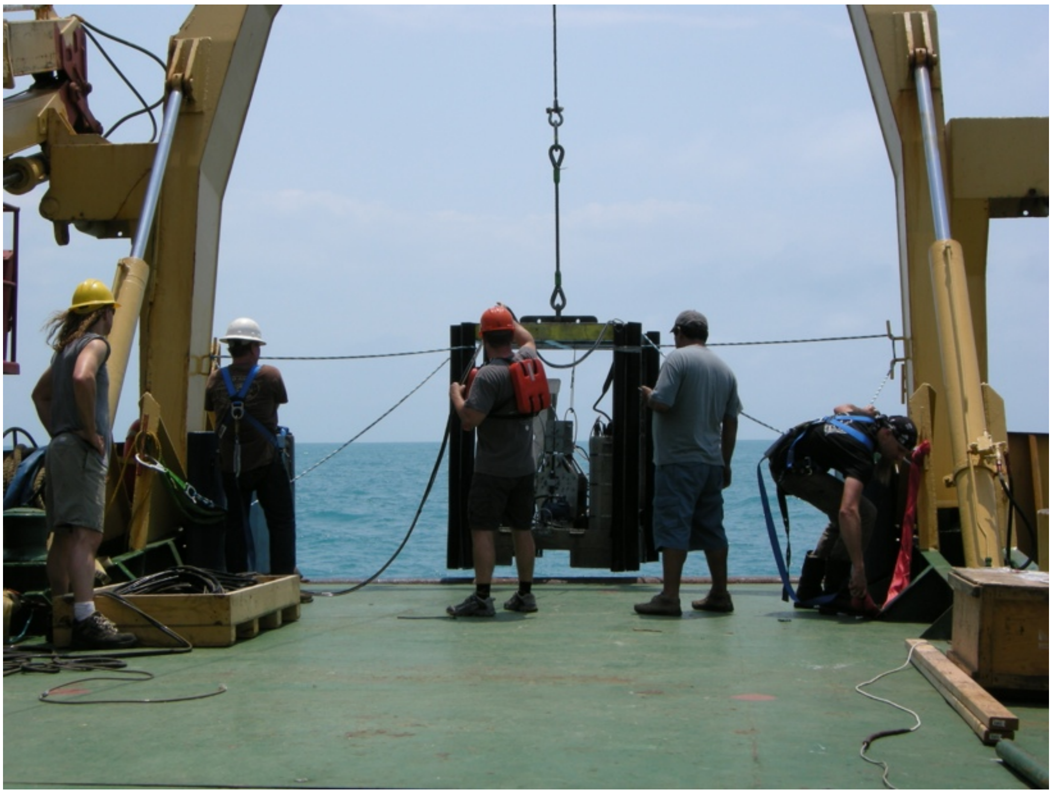


Figure 7. Recovery of the Seafloor Geotec CPT system to the deck of the *R/V Justo Sierra* at site CPT 1.

Figure 8. Detail photograph of the Seafloor Geotec CPT system used during the Yucatan 2013 cruise on board the *R/V Justo Sierra*.

6.2 SMITH-MCINTYRE GRAB

A Smith-McIntyre bucket grab sampler obtains a sample from the top 20cm of sediment on the sea bed (Figure 9). Positioning for the grabs was via the UTIG GPS antenna 4 which was moved to the starboard gantry where grabs were deployed from.

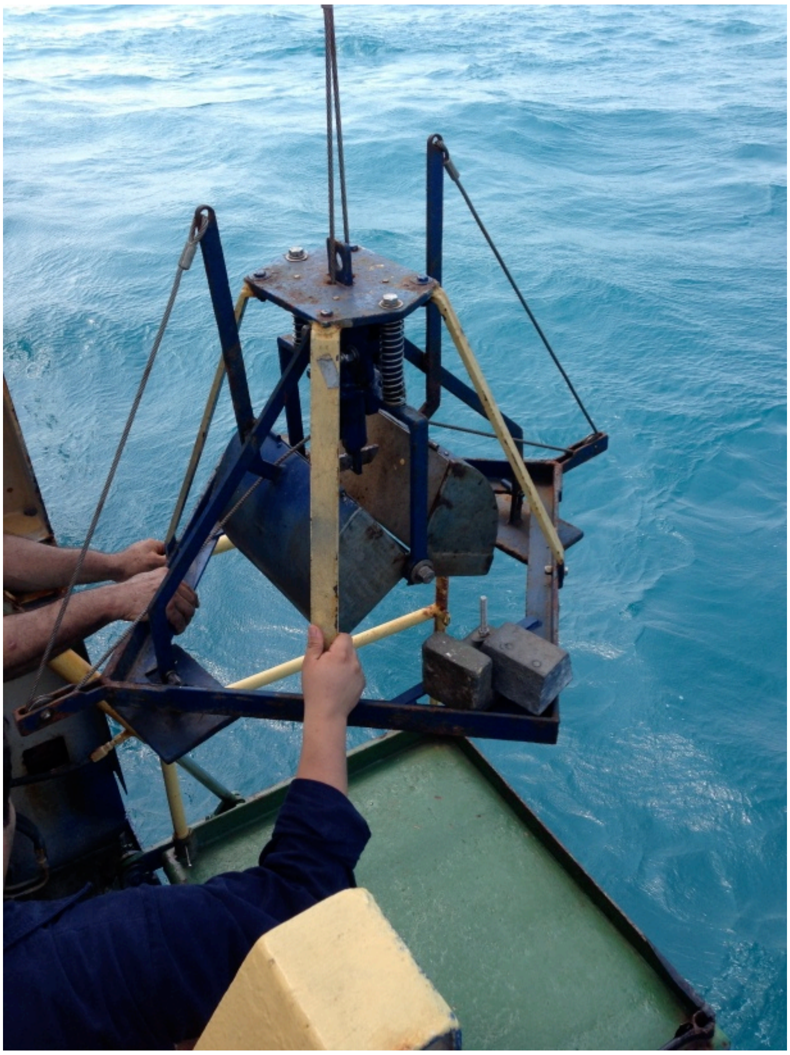


Figure 9. Photograph of the Smith-McIntyre grab being deployed from the *R/V Justo Sierra*.

7 Data Processing

All data processing will be carried out by UTIG with final corrected data delivered to the BGS at a time agreed by both parties.

8 Geophysical Data Examples

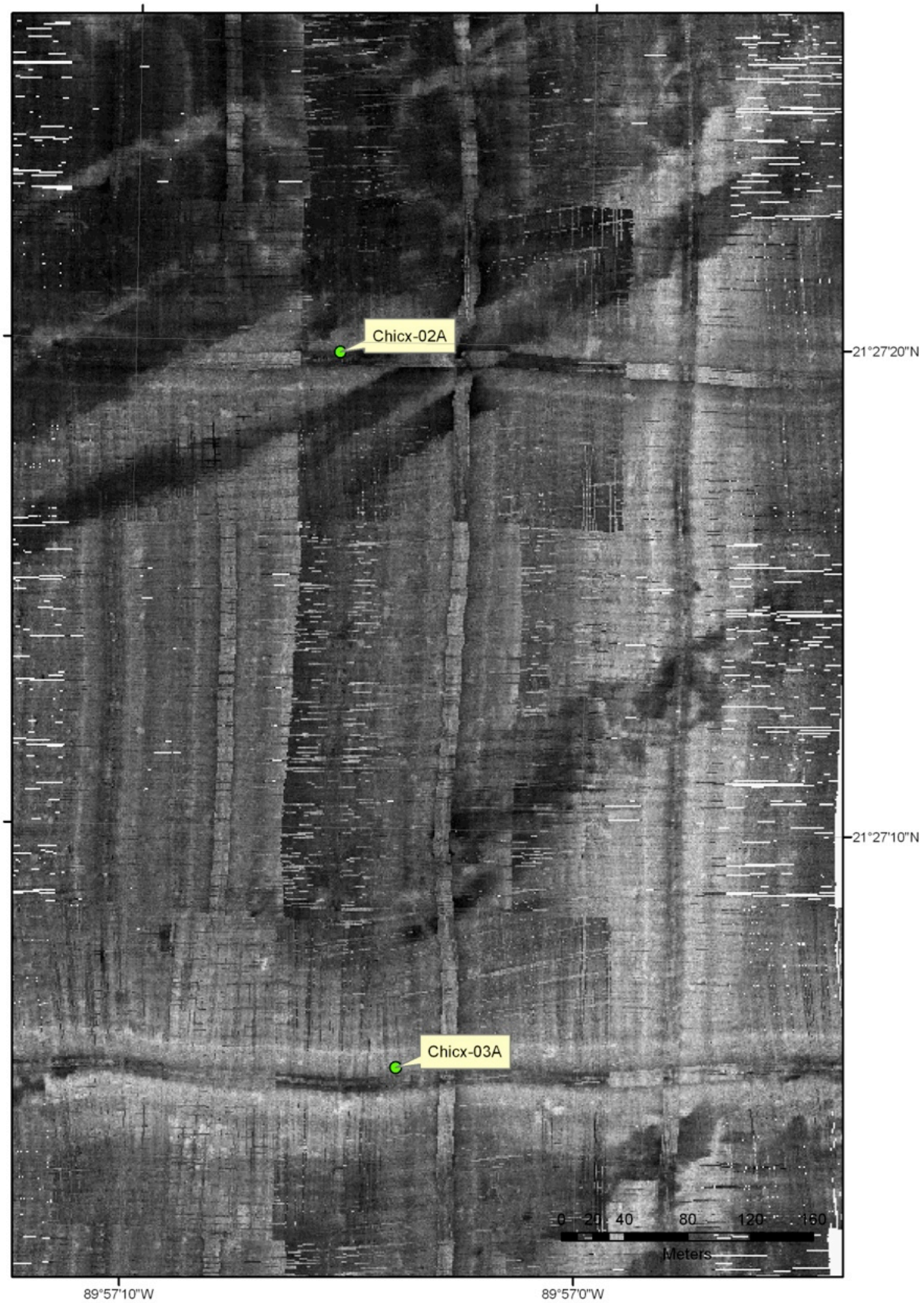


Figure 10. Selected side scan sonar data around proposed drill sites Chicx-2A and Chicx-3A.

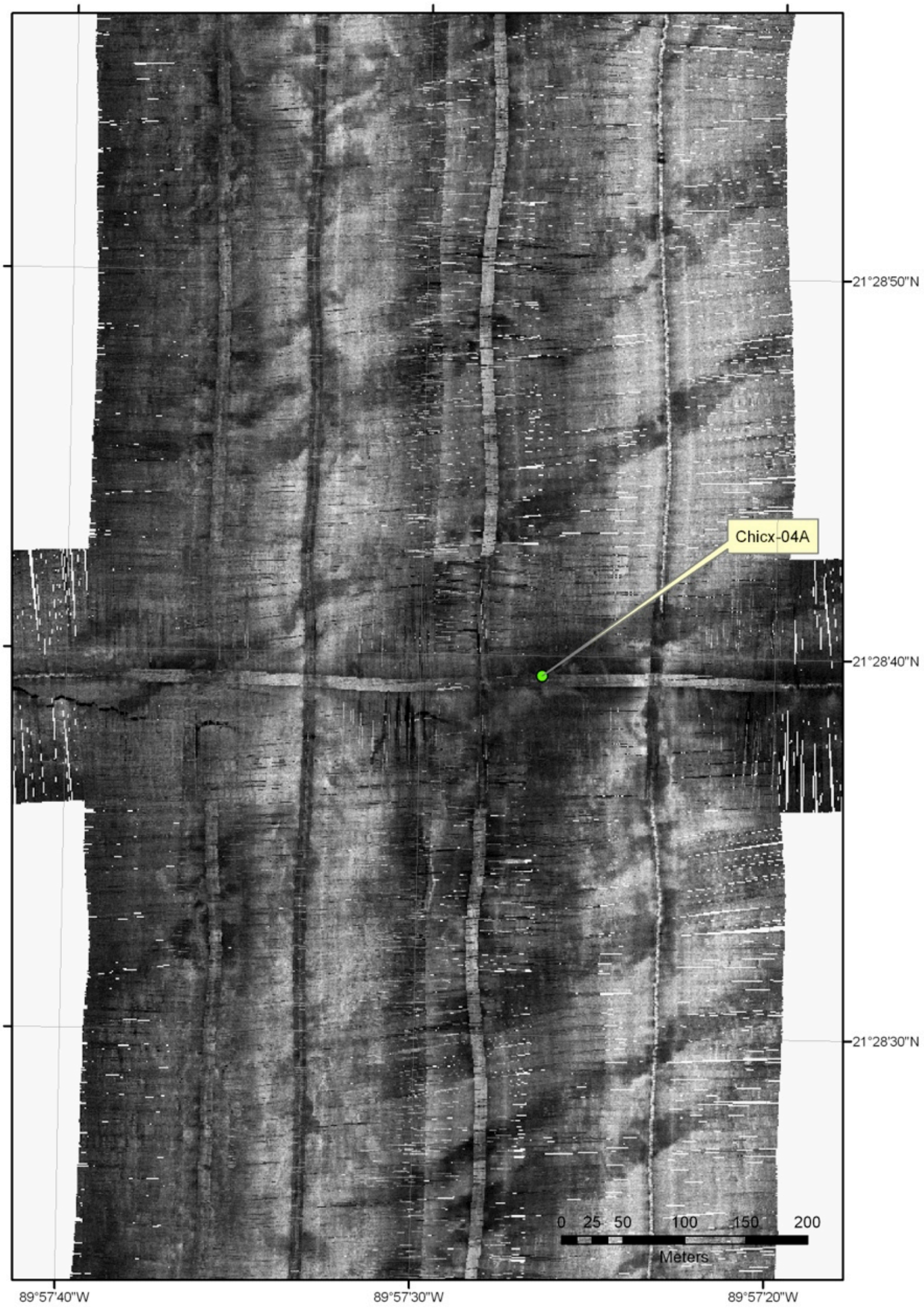


Figure 11. Selected side scan sonar data around proposed drill site Chicx-4A.

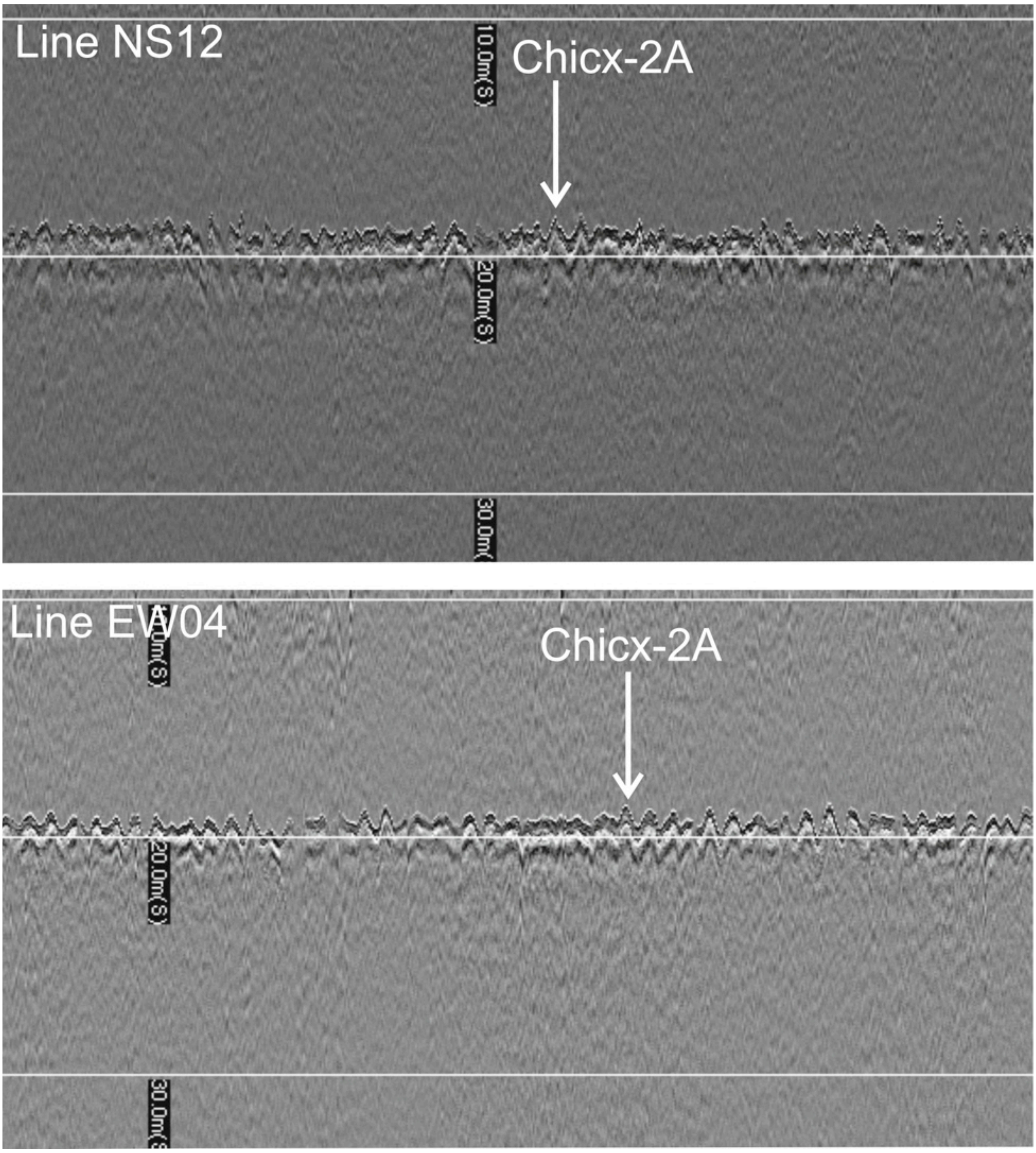


Figure 12. Example of surface tow boomer data coincident with proposed drill site Chicx-2A.

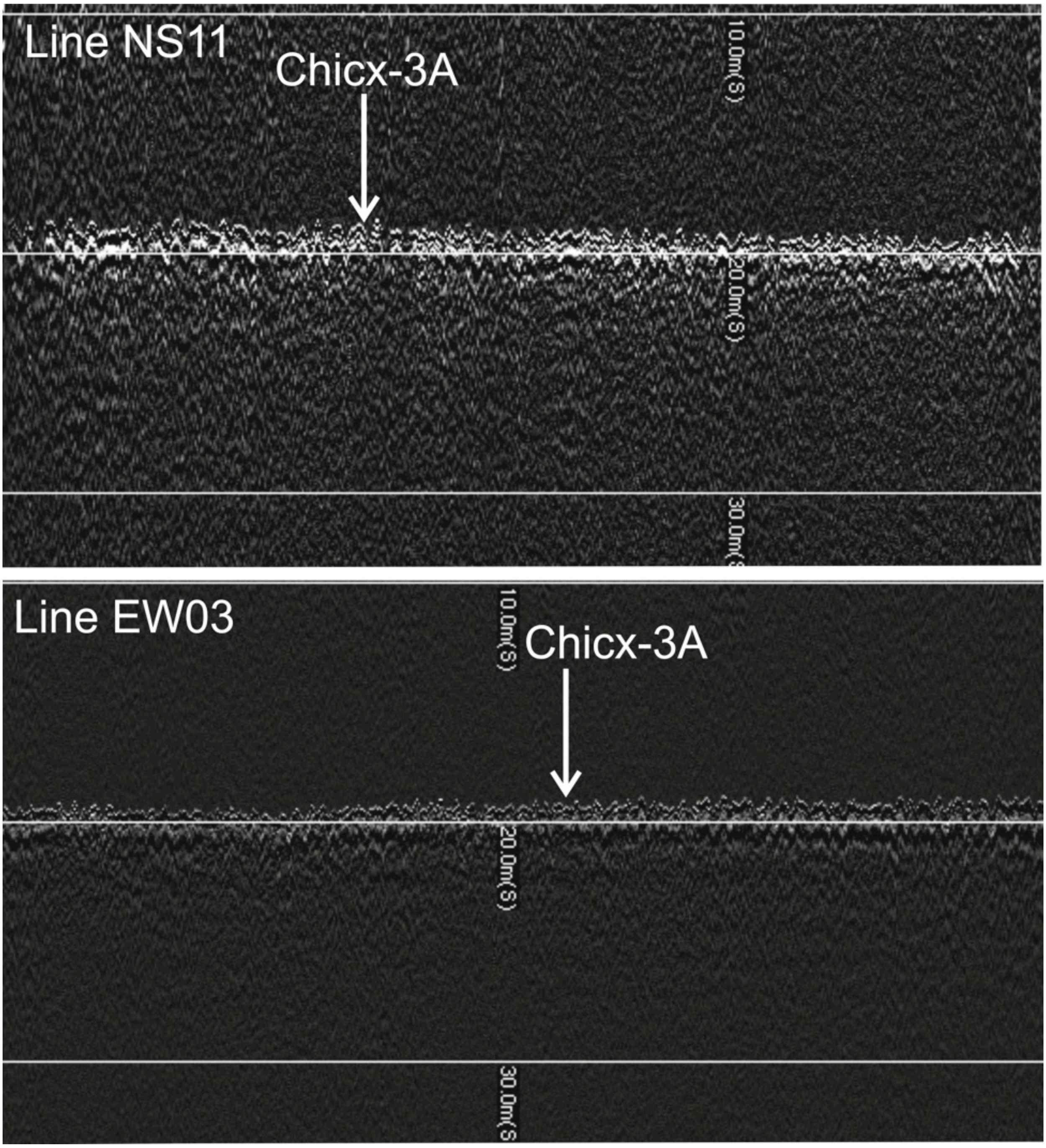


Figure 13. Example of surface tow boomer data coincident with proposed drill site Chicx-3A.

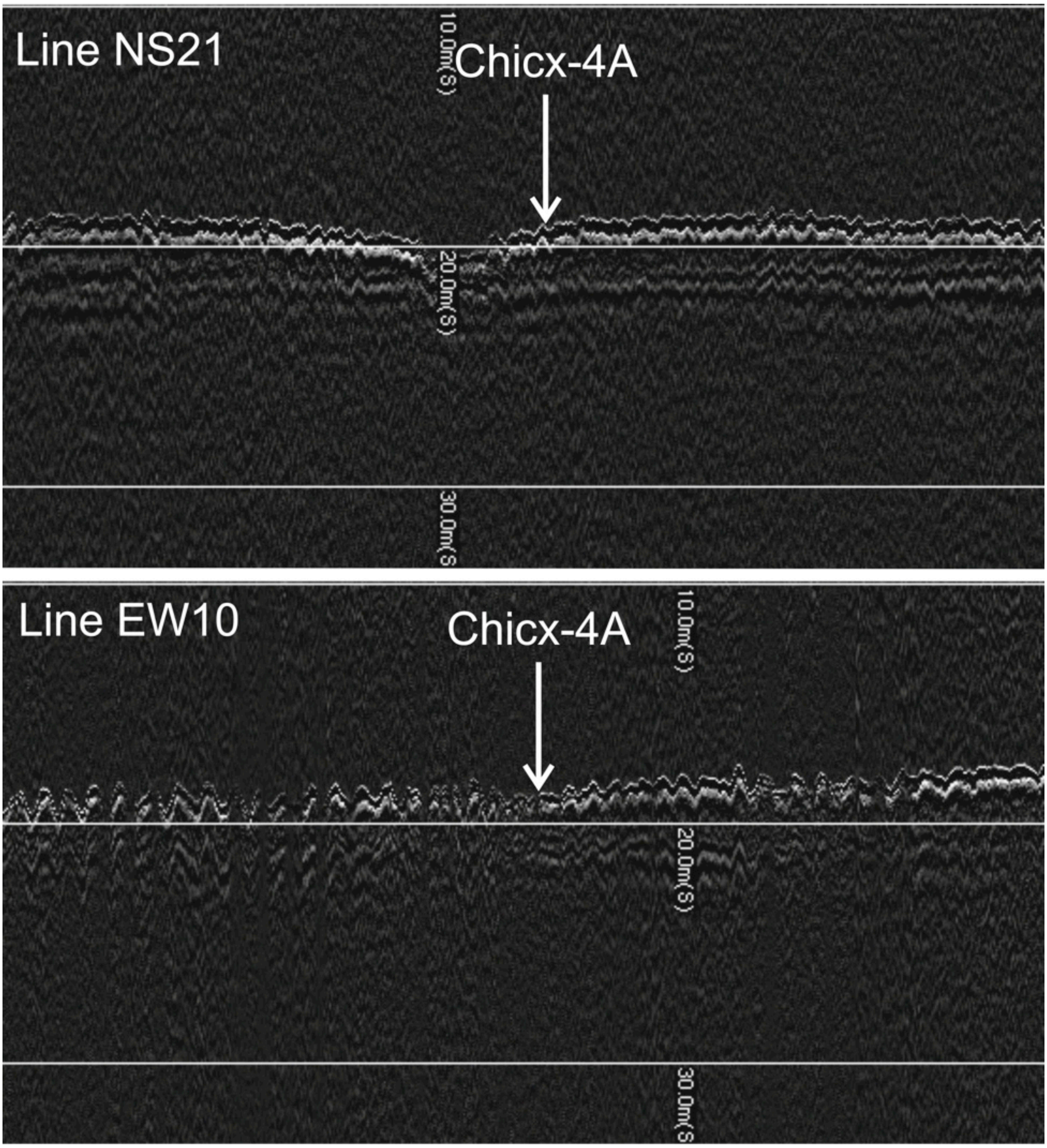


Figure 14. Example of surface tow boomer data coincident with proposed drill site Chicx-4A. Reflectors within ~4ms of the sea bed are proposed to represent variation within the bedrock and not layers of softer sediment overlying rock head as proved by CPT 1.

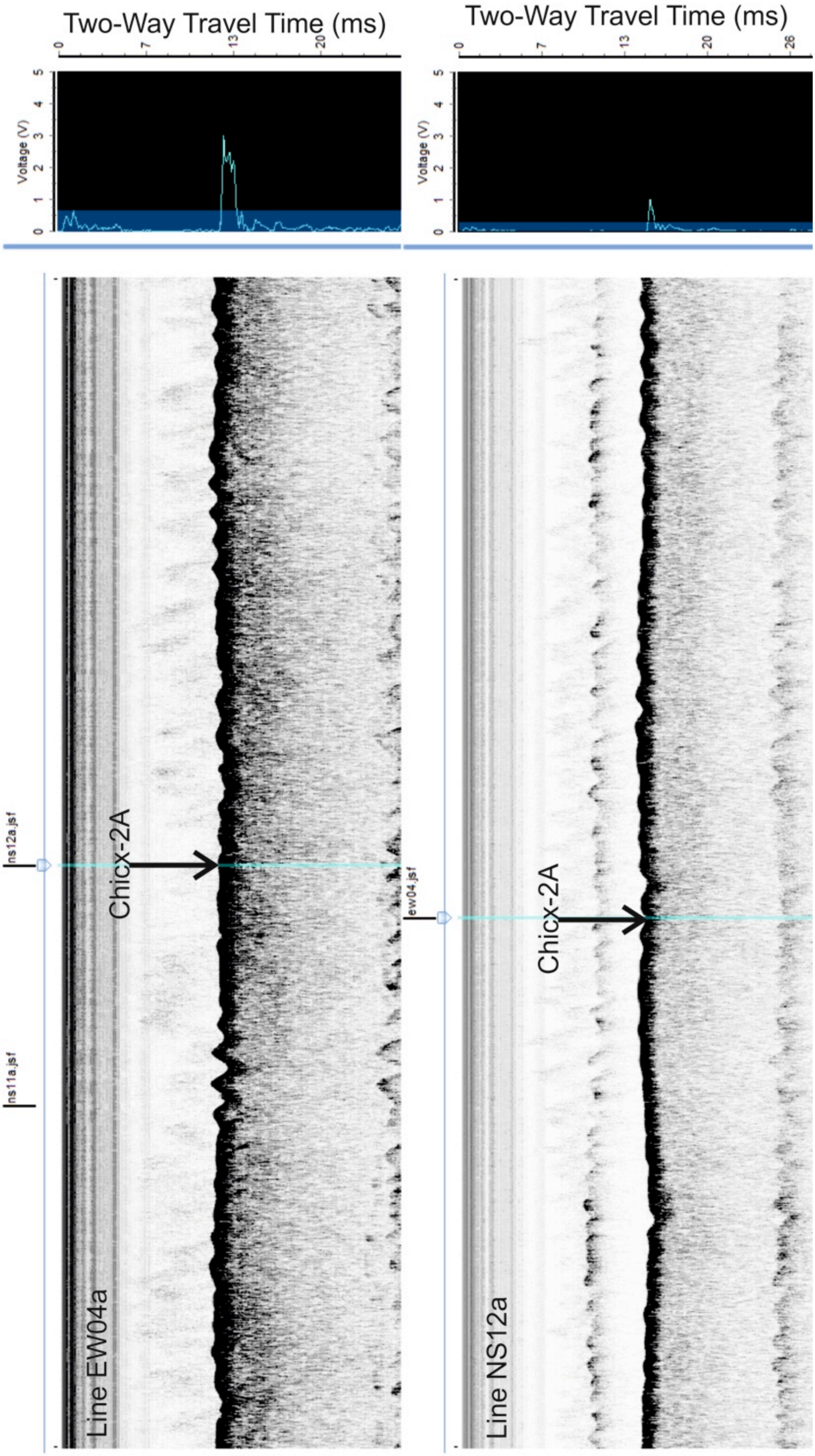


Figure 15. Example of CHIRP data coincident with proposed drill site Chicx-2A.

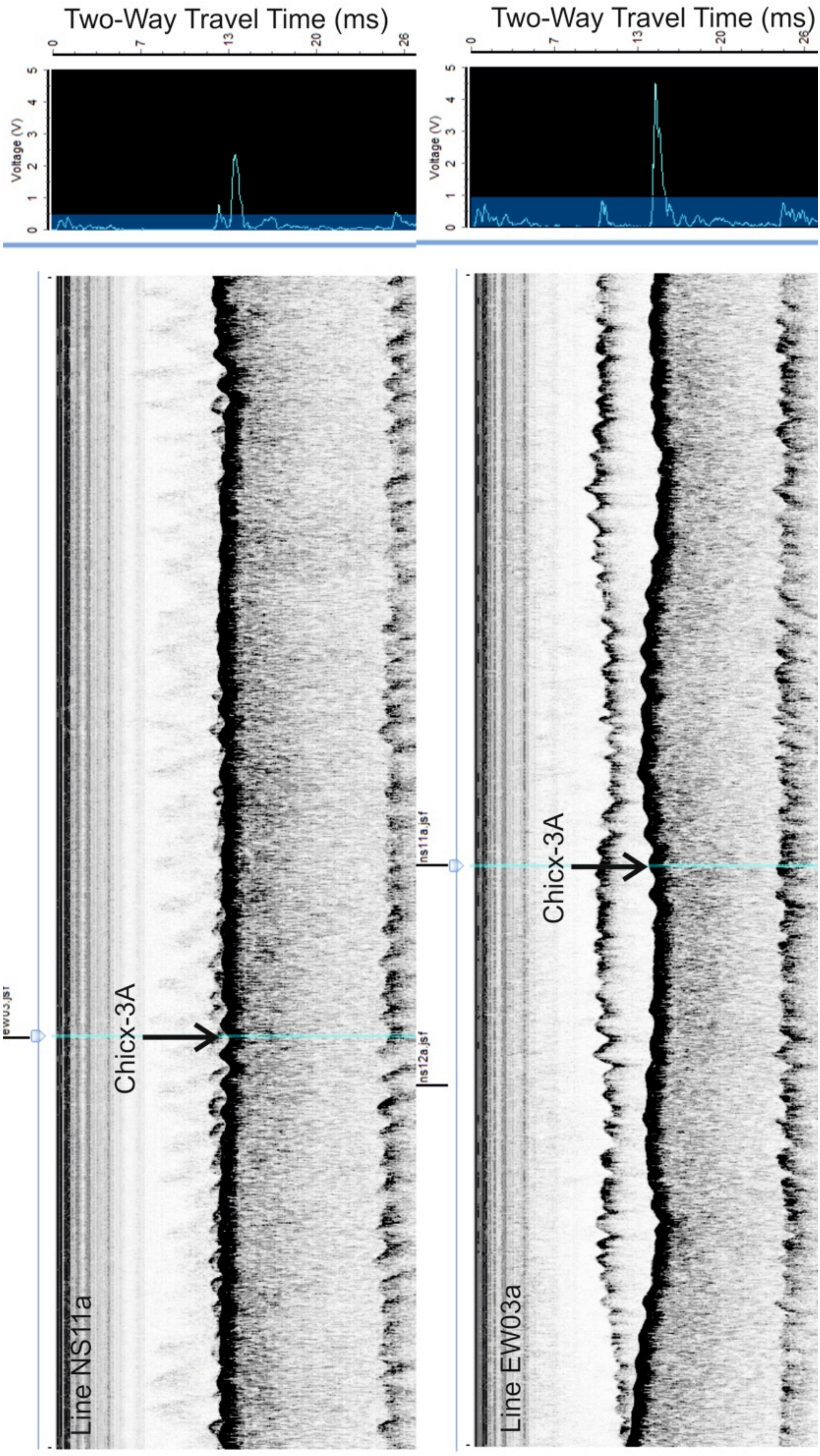


Figure 16. Example of CHIRP data coincident with proposed drill site Chicx-3A.

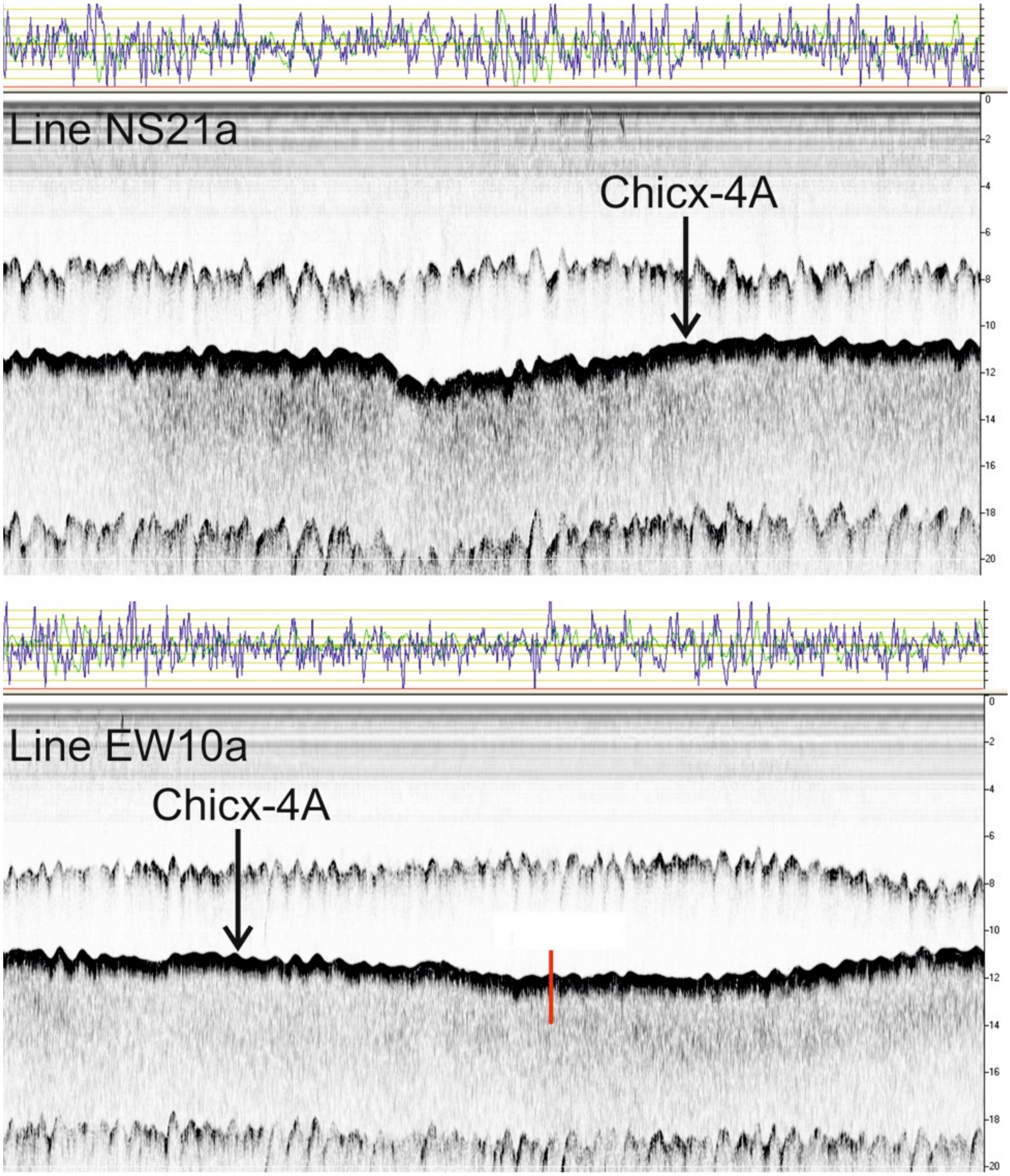


Figure 17. Example of CHIRP data coincident with proposed drill site Chicx-4A. Redline denotes location of CPT-1.

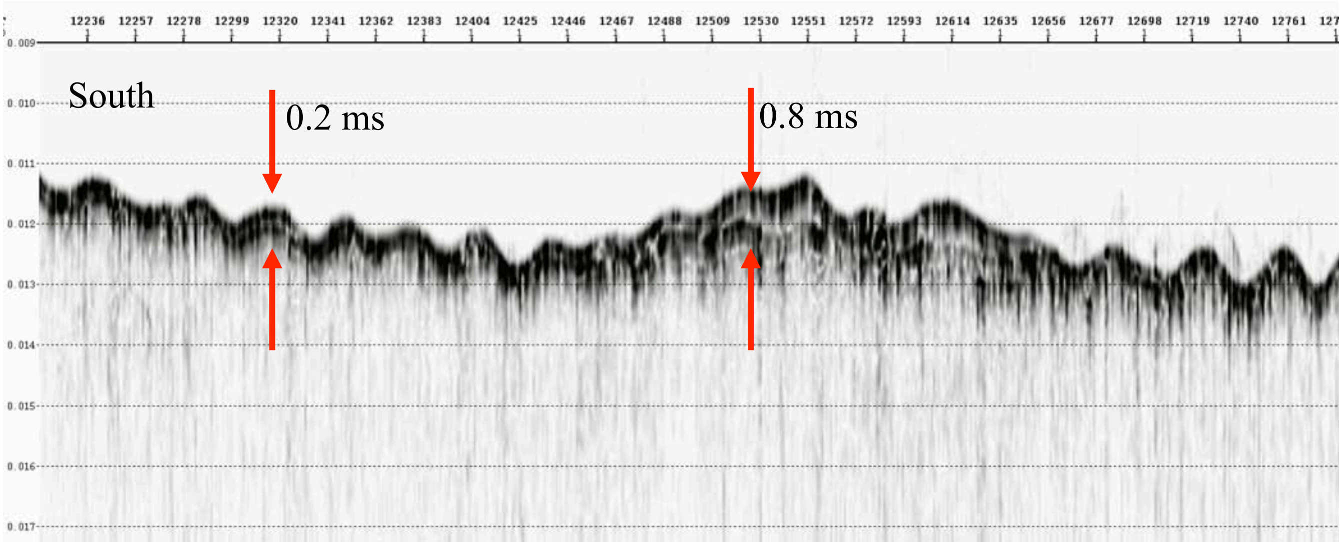


Figure 18. Example of CHIRP data from the southern section of Line NS19b. The section illustrates the presence of sediment accumulations on top of the bedrock. For location see Appendix 1.

9 Geotechnical Data Examples

No CPT data were acquired during the course of this cruise. Two sites (CPT 1 and CPT 2; Appendix 6; Figure 25) were selected within 60m of drill site Chicx-4A and both 'failed' due to rock located at or within centimeters of the sea bed. At CPT 2 a small sample of white, sand-sized grains of biogenic sediment (shell and coral fragments) was recovered from the CPT frame indicating that the darker SW-NE oriented areas observed on the side scan sonar data (Figures 10, 11, 25 and 26), and multibeam backscatter data (Figure 28) may be sediment ribbons comprising only a veneer of sediment possibly <15cm in thickness at that location.

Based on these results and examination of the sidescan sonar and CHIRP data, no additional CPT were attempted as the interpretation is that there are no accumulations of sediment thick enough for a reasonable CPT reading. Rather the area is characterized by hard limestone bedrock at the surface or only buried by at most 10s of centimeters of biogenic sediment.

To assess these seafloor sediment in further detail, a series of grab samples using the Smith-McIntyre grab sampler were taken around each of the three drill sites. These results are described in Appendix 6 and amount to the primary data for the seabed geotechnical characterization in concert with the geologic interpretation forthcoming from high-resolution geophysical data.

10 Health & Safety

All participants had to adhere to *R/V Justo* Sierra health and safety procedures and protocols. All staff recovering and deploying equipment at the stern of the vessel were required to wear lifejackets. Seafloor Geotec staff wore harnesses during CPT operations whilst working at the stern of the vessel and the stern gates were open.

Only one health and safety incident occurred during the course of operations on the 21st April 2013 between 13:26 (18:26 GMT) and 13:40 (18:40 GMT). At 13:26 the Seafloor Geotec CPT system was on the sea floor (site CPT 2), however, the vessel lost the ability to hold position at the CPT site resulting in the CPT system being dragged along the sea floor. Power was cut to the umbilical and it was disconnected to allow more slack in the umbilical whilst recovery of the vessel position was attempted. This failed and the CPT was dragged up off the bottom on the winch. Minor damage to the CPT system frame occurred. The lead Seafloor Geotec engineer (John Simmons) and the Party Chief (Prof. Sean Gulick) declared that no further CPT work would be undertaken as the vessel could not be trusted to hold position on site and that personnel and equipment safety was at risk. The client representative (Heather Stewart) concurred.

Note that prior to commencing CPT work a 35 minute test was undertaken to see whether the vessel could hold position to a weighted buoy deployed from the stern of the vessel. The Seafloor Geotec engineers deemed this test a success.

No other health and safety incidents or near misses were reported during the course of this cruise.

Appendix 1 **Track Charts**

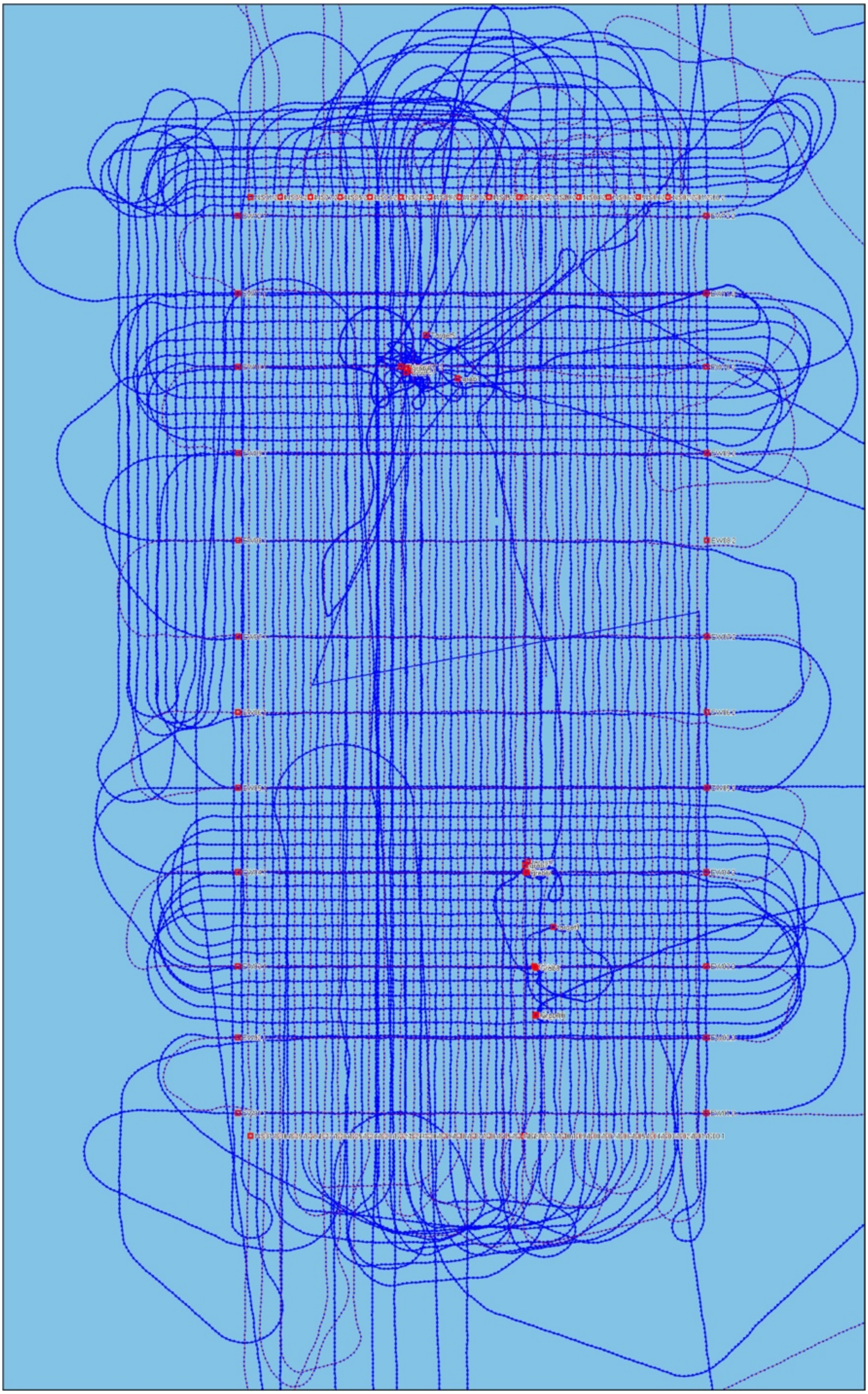
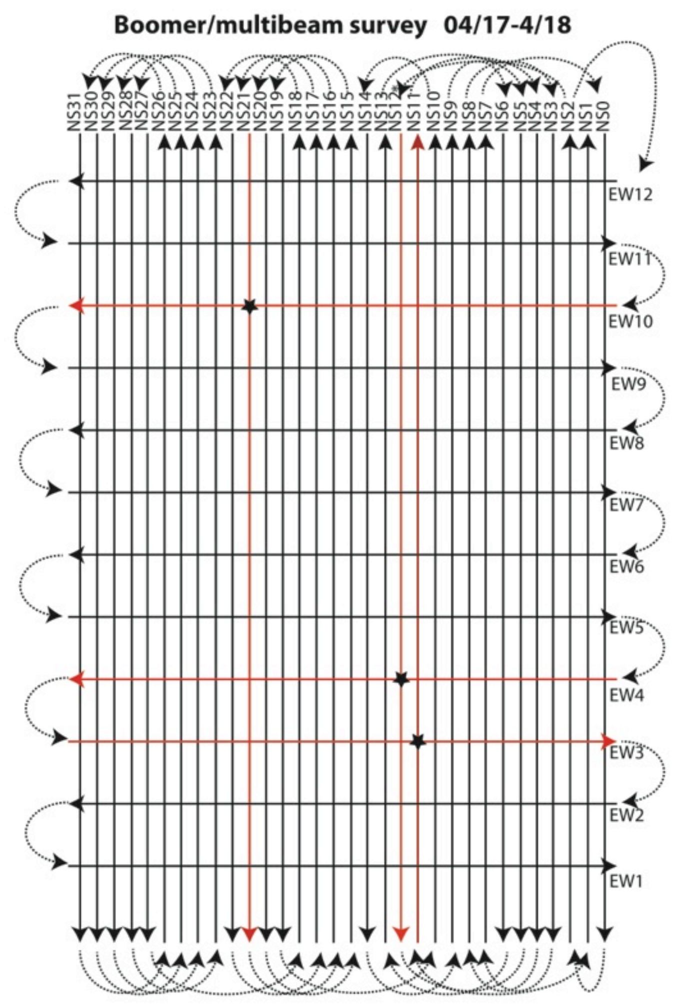


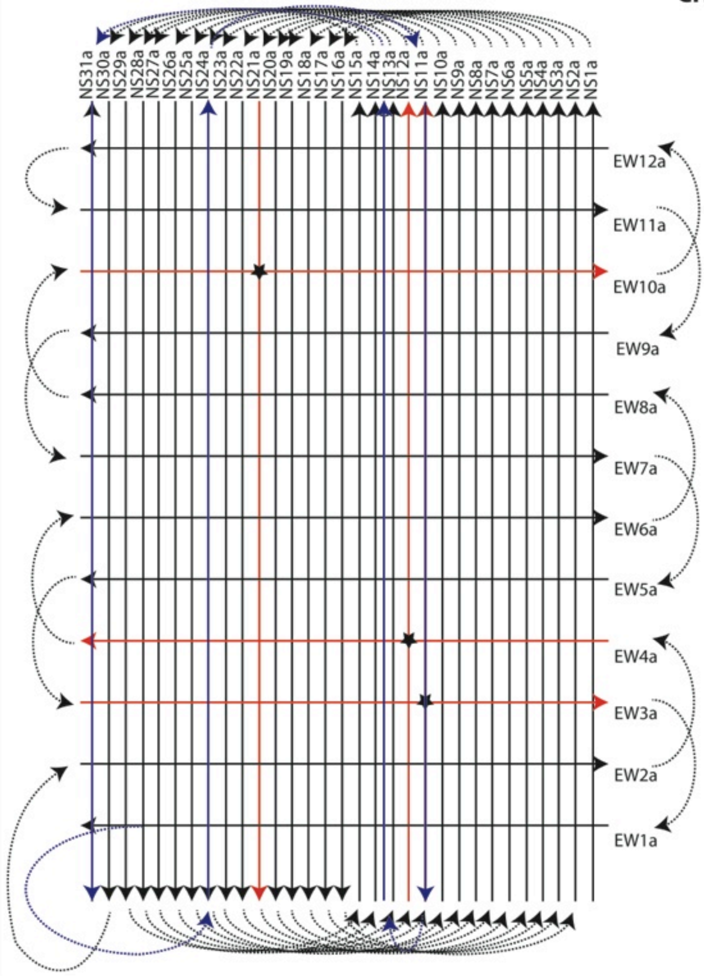
Figure 19. Track chart exported from Fugawi Marine ENC showing the navigation data acquired during operations. For geographic location see Appendix 10, Figure 33 and for line numbers see Figures 20-23.



Line order	Direction	Multibeam files	Boomer files	Qinsy files
NS31	S		0951,1035	4
NS26	N		1049	4
NS30	S		1144	4
NS25	N		1235,1318	4
NS29	S		1327,1410	4
NS24	N	11	1416	5
NS28	S	13,14	1458	6
NS23	N	15,17	1536	7
NS27	S	18,19	1614	8
NS18	N	19,20	1654	9
NS22	S	20, 22	1729	10
NS17	N	22,23	1808	11
NS21	S	24,26	1846	12
NS16	N	28,29	1923	13
NS20	S	29,32	2004	14
NS15	N	34,35	2043	15
NS19	S	37,38	2127	16
NS10	N	40,41	2211	17
NS14	S	43,44	2255	18
NS9	N	46,47	2333	19
NS6	S	49,50	0009	20
NS13	N	52, 53	0054	21
NS5	S	53, 54	0141	22
NS11	N	54,56,56	0220	23
NS4	S	56, 57	0303	24
NS8	N	57, 58	0340	25
NS3	S	58, 59, 60	0422	26
NS7	N	60,61	0500	27
NS0	S	63,64	0541	28
NS2	N	66,67	0623	29
NS12	S	69,70	0704	30
NS1	N	72	0751	31
EW12	W	75	0845	32
EW11	E	77	0905	33
EW10	W	79	0943	34
EW9	E	81	1005	35
EW8	W	83	1030	36
EW7	E	85	1054	37
EW6	W	87	1121	38
EW5	E	89	1144	39
EW4	W	91	1213	40
EW3	E	93	1240	41
EW2	W	96	1305	42
EW1	E	97	1328	43

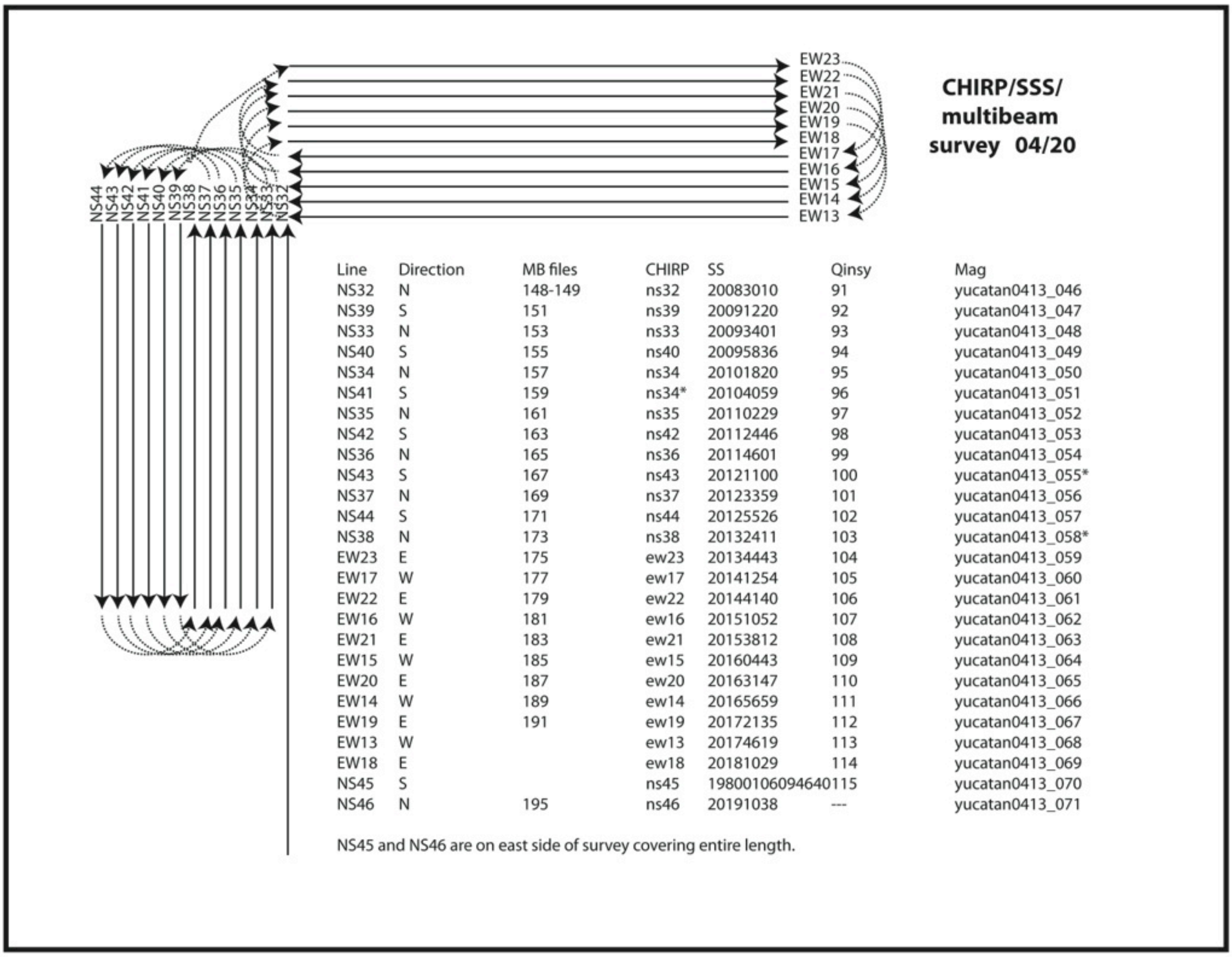
Figure 20. Line plan for 17th and 18th April 2013 during simultaneous surface tow boomer and multibeam echosounder data acquisition.

CHIRP/sidescan/mag/multibeam survey 4/18-4/19



Line	Direction	MB files	CHIRP	SS	Qinsy	Mag
NS01a	N	22-23	ns01a	18235333	46	ns1a, ns1a_001
NS16a	S	25-26	ns16a	19005413	48	ns16s, ns16a_000
NS02a	N	28-29	ns02a	19013602	49	ns16a_001
NS17a	S	31-32	ns17a	19022032	50	yucatan0413
NS03a	N	34-35	ns03a	19030634	51	yucatan0413_000
NS18a	S	37-38	ns18a	19035309	52	yucatan0413_001,002
NS04a	N	40-41	ns04a	19044017	53	yucatan0413_003,004
NS19a	S	43-44	ns19a	19053025	54	yucatan0413_005
NS05a	N	46-47	ns05a	19062054	55	yucatan0413_006
NS20a	S	49-50	ns20a	19070706	56	yucatan0413_007
NS06a	N	52-53	ns06a	19075313	57	yucatan0413_008
NS21a	S	55-56	ns21a	19083643	58	yucatan0413_009
NS07a	N	58-59	ns07a	19092401	59	yucatan0413_010,011
NS22a	S	61-62	ns22a	19101620	60	yucatan0413_012
NS08a	N	64-65	ns08a	19105133	61	yucatan0413_013
NS23a	S	67-68	ns23a	19115252	62	yucatan0413_014
NS09a	N	70-71	ns09a	19123746	62	yucatan0413_014
NS24a	S	73,74*	ns24a	19132413	63	yucatan0413_015
NS10a	N	75-76	ns10a	19141457	64	yucatan0413_016
NS25a	S	78-79	ns25a	19150347	65	yucatan0413_017
NS11a	N	81-82	ns11a	19155155	66	yucatan0413_018
NS26a	S	84-85	ns26a	19163934	67	yucatan0413_019
NS12a	N	87-88	ns12a	19172523	68	yucatan0413_020
NS27a	S	90-91	ns27a	19180652	69	yucatan0413_021
NS13a	N	92-93	ns13a	19185034	70	yucatan0413_022,_023
NS28a	S	96-97	ns28a	19193531	71	yucatan0413_024
NS14a	N	99-100	ns14a	19202039	72	yucatan0413_025
NS29a	S	102-103	ns29a	19210511	73	yucatan0413_026
NS15a	N	105-106	ns15a	19215029	74	yucatan0413_027
NS30a	S	108-109	ns30a	19223559	75	yucatan0413_028
EW02	E	111	ew02	19232840	76	yucatan0413_029
EW04	W	113	ew04	19235702	76	yucatan0413_030
EW06	E	115	ew06	20002455	77	yucatan0413_031
EW08	W	117	ew08	20005608	78	yucatan0413_033
EW10	E	119	ew10	20012735	79	yucatan0413_034
EW12	W	121	ew12	20015622	80	yucatan0413_035
EW11	E	123	ew11	20022428	81	yucatan0413_036
EW09	W	125	ew09	20025609	82	yucatan0413_037
EW07	E	127	ew05	20032744	83	yucatan0413_038
EW05	W	129	ew05	20035708	84	yucatan0413_039
EW03	E	131	ew03	20042121	85	yucatan0413_040
EW01	W	133	ew01	20045114	86	yucatan0413_041
RESHOOT						
NS24b	N	135-136	ns24b	20052902	87	yucatan0413_042
NS11b	S	139-140	ns11b	20061719	88	yucatan0413_043
NS13b	N	142-143	ns13b	20070241	89	yucatan0413_044
NS31b	S	145-146	ns31b	20074615	90	yucatan0413_045

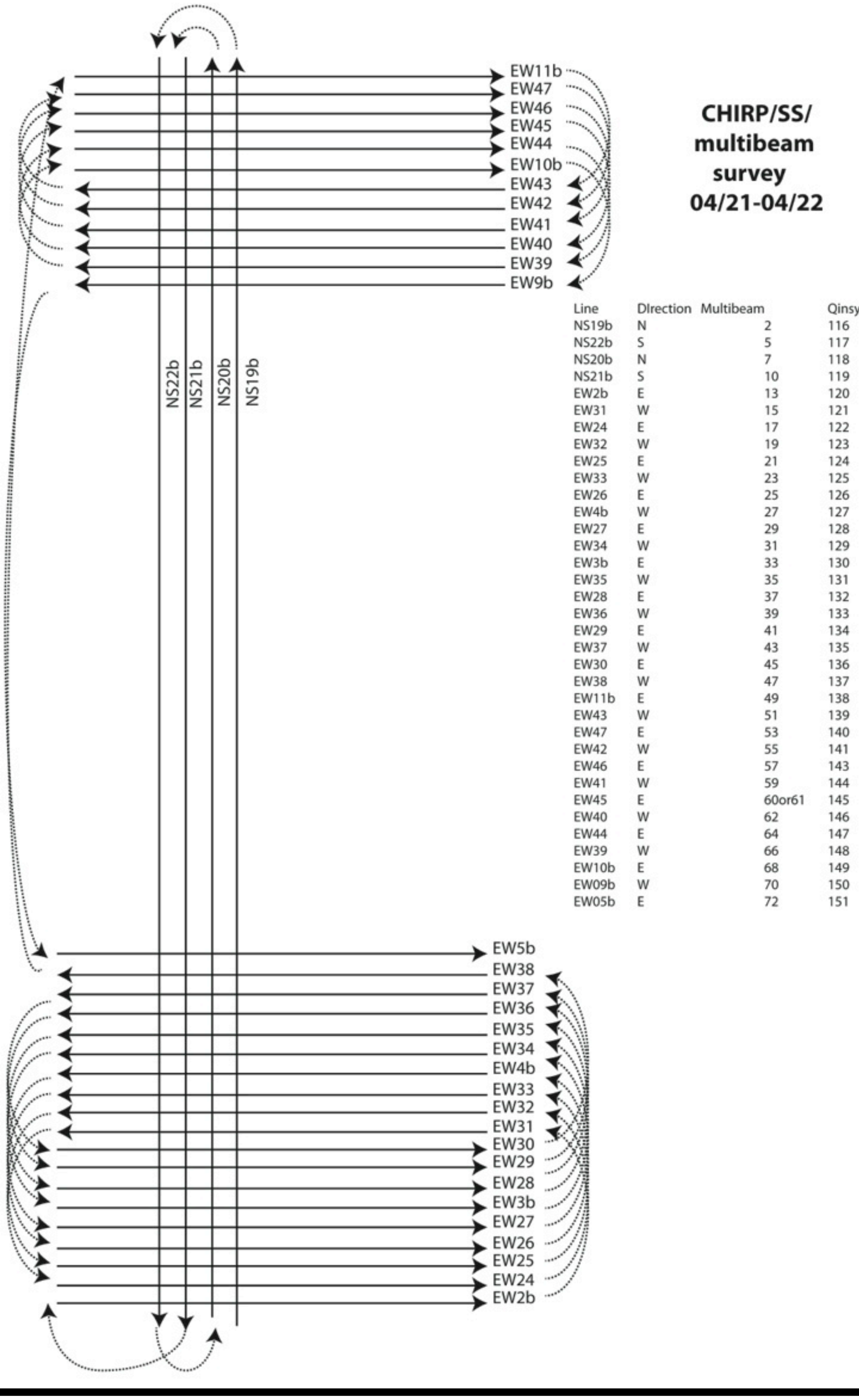
Figure 21. Line plan and line numbers for 18th and 19th April 2013 during simultaneous side scan sonar, CHIRP, magnetometer and multibeam echosounder data acquisition.



Line	Direction	MB files	CHIRP	SS	Qinsy	Mag
NS32	N	148-149	ns32	20083010	91	yucatan0413_046
NS39	S	151	ns39	20091220	92	yucatan0413_047
NS33	N	153	ns33	20093401	93	yucatan0413_048
NS40	S	155	ns40	20095836	94	yucatan0413_049
NS34	N	157	ns34	20101820	95	yucatan0413_050
NS41	S	159	ns34*	20104059	96	yucatan0413_051
NS35	N	161	ns35	20110229	97	yucatan0413_052
NS42	S	163	ns42	20112446	98	yucatan0413_053
NS36	N	165	ns36	20114601	99	yucatan0413_054
NS43	S	167	ns43	20121100	100	yucatan0413_055*
NS37	N	169	ns37	20123359	101	yucatan0413_056
NS44	S	171	ns44	20125526	102	yucatan0413_057
NS38	N	173	ns38	20132411	103	yucatan0413_058*
EW23	E	175	ew23	20134443	104	yucatan0413_059
EW17	W	177	ew17	20141254	105	yucatan0413_060
EW22	E	179	ew22	20144140	106	yucatan0413_061
EW16	W	181	ew16	20151052	107	yucatan0413_062
EW21	E	183	ew21	20153812	108	yucatan0413_063
EW15	W	185	ew15	20160443	109	yucatan0413_064
EW20	E	187	ew20	20163147	110	yucatan0413_065
EW14	W	189	ew14	20165659	111	yucatan0413_066
EW19	E	191	ew19	20172135	112	yucatan0413_067
EW13	W		ew13	20174619	113	yucatan0413_068
EW18	E		ew18	20181029	114	yucatan0413_069
NS45	S		ns45	19800106094640	115	yucatan0413_070
NS46	N	195	ns46	20191038	---	yucatan0413_071

NS45 and NS46 are on east side of survey covering entire length.

Figure 22. Line plan and line numbers for the 20th April 2013 during simultaneous side scan sonar, CHIRP, magnetometer and multibeam echosounder data acquisition.



Line	DIrection	Multibeam	Qinsy	Sidescan	Chirp
NS19b	N	2	116	22015228	ns19b
NS22b	S	5	117	22023730	ns22b
NS20b	N	7	118	22032108	ns20b
NS21b	S	10	119	22040048	ns21b
EW2b	E	13	120	22045053	ew02b
EW31	W	15	121	22051417	ew31
EW24	E	17	122	22053844	ew24
EW32	W	19	123	06060432	ew32
EW25	E	21	124	06062852	ew25
EW33	W	23	125	06065418	ew33
EW26	E	25	126	06071856	ew26
EW4b	W	27	127	06074319	ew4b
EW27	E	29	128	06080913	ew27
EW34	W	31	129	06083344	ew34
EW3b	E	33	130	08085846	ew03b
EW35	W	35	131	06092549	ew35
EW28	E	37	132	06095140	ew28
EW36	W	39	133	06101831	ew36
EW29	E	41	134	06104128	ew29
EW37	W	43	135	06110544	ew37
EW30	E	45	136	06112910	ew30
EW38	W	47	137	06115633	ew38
EW11b	E	49	138	06123520	ew11b
EW43	W	51	139	06125959	ew43
EW47	E	53	140	06132643	ew47
EW42	W	55	141	06135158	ew42
EW46	E	57	143	06141714	ew46
EW41	W	59	144	06144246	ew41
EW45	E	60or61	145	06150621	ew45
EW40	W	62	146	06153047	ew40
EW44	E	64	147	06155336	ew44
EW39	W	66	148	06161839	ew39
EW10b	E	68	149	06164206	ew10b
EW09b	W	70	150	06170651	ew09b
EW05b	E	72	151	06173614	ew05b

Figure 23. Line plan and line numbers for the 21st and 22nd April 2013 during simultaneous side scan sonar, CHIRP, magnetometer and multibeam echosounder data acquisition.

Appendix 2 # Daily Log

The daily logs were completed by Heather Stewart in conjunction with Prof. Sean Gulick, Party Chief. For a daily narrative of this cruise see Section 2.

Daily Log Sheet For:	**Yucatan 2013**		
Date:	16/04/2013	J.D.	106
Vessel:	R/V Justo Sierra	Main Task:	arrive at vessel mobilisation
Area:	Yucutan Peninsula GoM		
Time	Task / Description		
09:45 (local time)	Arrive in Progreso, Yucatan. Meet team from UTIG, UNAM and CPT engineers.		
10:30 (local time)	Join R/V Justo Sierra, initial project meeting with scientists and vessel staff.		
10:30-11:30 (local time) approx	D. Duncan and J. Sanford set up GPS base station to operate throughout cruise.		
11:00-20:30	Mobilisation of all geophysical, geotechnical and GPS equipment.		
Planned Operation for next 24 hours			
Slip line and sail at midnight. Wet test of Surface Tow Boomer and patch test of multibeam echosounder. Transit to survey area and begin acquiring STB and multibeam echosounder. data.			
Weather			
Windspeed			
Hours of Mobilisation	9.5	hours	
Hours of Transit	0		
Hours of Survey	0		
Hours of Weather Downtime	0		
Written By	H Stewart	**Date:**	16th April 2013
Sent to	D.McInroy		

Daily Log Sheet For:	**Yucatan 2013**		
Date:	17/04/2013	J.D.	107
Vessel:	R/V Justo Sierra	Main Task:	Wet test STB, MB patch test and begin acquisition
Area:	Yucutan Peninsula GoM		
Time	Task / Description		
00:00 (local time)	slip lines and begin transit to multibeam patch test area.		
01:55-02:00 (06:55-07:00 GMT)	CTD cast 21° 29' 28.320"N; 89° 56'34.460"W		
02:01-02:21 (07:01-07:22 GMT)	transit to multibeam patch test.		
02.22-02:29 (07:22-07:29 GMT)	Line 1 patch test multibeam.		
02:34-02:44 (07:34-07:44 GMT)	Line 2 patch test multibeam.		
02:44-02:52 (07:44-07:52 GMT)	Line 3 patch test multibeam.		
02:53 (07:53 GMT)	transit to start of surface tow boomer wet test area		
03:51 (08:51 GMT)	Deploy surface tow boomer for wet test.		
03:57 (08:57 GMT)	Deploy surface tow boomer hydrophone for wet test. Set up CODA for acquisition.		
04:52 (0951 GMT)	SOL NS31 surface tow boomer and multibeam echosounder acquisition.		
Rest of day	Acquisition of NS oriented lines throughout rest of day. See Line log for details.		

Planned Operation for next 24 hours			
Complete NS surface tow boomer/multibeam lines. Begin EW surface tow boomer/multibeam lines.			
Weather			
Windspeed			
Hours of Equipment Test	1.55	hours	
Hours of Transit	3.216666667	hours	
Hours of Survey	19.23333333	hours	
Hours of Weather Downtime			
Written By	H Stewart	**Date:**	17th April 2013
Sent to	D. McInroy		

Daily Log Sheet For:	**Yucatan 2013**		
Date:	18/04/2013	J.D.	108
Vessel:	R/V Justo Sierra	Main Task:	Complete STB survey Begin SSS/CHIRP/Mag
Area:	Yucutan Peninsula GoM		

Time	Task / Description
00:00-03:30 (05:00-08:30 GMT)	Continue acquisition of NS surface tow boomer and multibeam lines.
03:30 (08:30 GMT)	End of acquisition NS surface tow boomer and multibeam oriented lines.
	Transit to start of EW surface tow boomer and multibeam oriented lines.
03:45 (08:45 GMT)	Start acquisition of EW surface tow boomer and multibeam lines.
08:45 (13:45 GMT)	Complete acquisition of EW surface tow boomer and multibeam lines.
	Recover surface tow boomer to deck.
08:45-09:39 (13:45-15:39 GMT)	Transit to wet test site for sidescan sonar, CHIRP and magnetometer.
09:40 (15:40 GMT)	Sidescan sonar/CHIRP and magnetometer deployed, equipment test begins.
10:20 (15:20 GMT)	Start test acquisition line.
10:39 (15:39 GMT)	Complete acquisition of test sidescan sonar/CHIRP/magnetometer data.
10:40 (15:40 GMT)	SOL NS31a acquisition of sidescan sonar/CHIRP/magnetometer with GPS
	going to the CHIRP but not the sidescan sonar.
11:10 (16:10 GMT)	EOL NS31a
11:20 (16:20 GMT)	SOL NS22a acquisition of sidescan sonar/CHIRP/magnetometer with GPS still
	not going to the sidescan sonar.
11:48 (16:48 GMT)	End line early due to fishing vessel in way. Moved tow point 4m to port of
	centreline.
11:59 (16:59 GMT)	Equipment down while rectifying sending GPS to both the CHIRP and sidescan
	sonar. Also attempting to receive the magnetometer data and sync with
	GPS.
12:20 (17:20 GMT)	Solved issue of sending GPS to both CHIRP and sidescan sonar.
	Magnetometer still not working, in contact with manufacturers.
18:50 (23:50 GMT)	SOL NS01a with side scan sonar, CHIRP and magnetometer all back online.
	Magnetometer working with power directly from orange box and GPGGA
	rather than IGGGA.
to midnight (0500 GMT)	continue acquisition on NS oriented lines with side scan sonar, CHIRP,
	magnetometer and multibeam.

Planned Operation for next 24 hours			
Complete NS oriented lines and begin acquisition on EW oriented lines. Process areas of MB around drill sites to guide CPT work. Begin review of seismic to select CPT sites.			
Weather			
Windspeed			
Hours of Equipment Test	1	hours	
Hours of Transit	1.166666667	hours	

Hours of Survey	15	hours	
Hours of Equipment Downtime	6.833333333	hours	
Written By	H Stewart	**Date:**	18th April 2013
Sent to	D McInroy		

Daily Log Sheet For:	**Yucatan 2013**		
Date:	19/04/2013	J.D.	109
Vessel:	R/V Justo Sierra	Main Task:	Continue SSS, CHIRP,
Area:	Yucutan Peninsula GoM		Maggie and MB survey

Time	Task / Description
00:00-18:11 (05:00-23:11 GMT)	Complete acquisition on NS oriented lines with side scan sonar, CHIRP,
	magnetometer and multibeam.
08:24 (13:24 GMT)	Line NS24a Ship navigation/multibeam system crashed. All files backed up
	and system reboot.
08:50 (13:50 GMT)	Multibeam and navigation systems rebooted, contine acquisition on line
	NS24a
14:10 (19:10 GMT)	Line NS13a Magnetometer GPS dropped. Line NS13a completed at 19:25
	(14:25 GMT)
14:36 (19:36 GMT)	GPS synced with magnetometer, everything working again. First 3 minutes of
	Line NS28a no magnetometer data (SOL 19:35; 14:35 GMT).
18:11 (23:11 GMT)	End of acquisition of primary NS oriented lines.
18:12-23:59 (23:12-04:59	Acquisition on EW oriented lines with side scan sonar, CHIRP, magnetometer
GMT on 20th April)	and multibeam.

Planned Operation for next 24 hours

Complete acquisition on EW oriented lines with side scan sonar, CHIRP, magnetometer and multibeam.
Begin filling in gaps in the dataset ahead of port call on evening of 20th April.

Weather			
Windspeed			
Hours of Mobilisation			
Hours of Transit	0		
Hours of Survey	24	hours	
Hours of Weather Downtime	0		
Written By	H Stewart	**Date:**	19th April 2013
Sent to	D McInroy		

Daily Log Sheet For:	**Yucatan 2013**		
Date:	20/04/2013	J.D.	110
Vessel:	R/V Justo Sierra	Main Task:	Complete EW lines.
Area:	Yucutan Peninsula GoM		Survey infill lines and
			extend survey area.

Time	Task / Description
00:00-14:46 (05:00-19:45 GMT)	Acquisition of lines with side scan sonar, CHIRP, magnetometer and
	multibeam.
07:30 (12:30 GMT)	Line NS43 - lost magnetometer data for approximately 30 minutes.
13:45 (18:45 GMT)	Problem discovered with UTIG primary Pos MV GPS (antenna 1) giving GPS
	feed to SSS, CHIRP, Qinsy. Line NS45.
13:50 (18:50 GMT)	Switched GPS for the SSS and CHIRP to the UTIG antenna 4 - same antenna

	as magnetometer. All acquisition systems now showing correct GPS. No
	Qinsy. Line NS45.
14:46 (19:46 GMT)	End of Side scan sonar, CHIRP, Magnetometer and multibeam survey.
14:50 (19:50 GMT)	Magnetometer recovered to deck.
15:10 (20:10 GMT)	Side scan sonar recovered to deck.
15:15 (20:15 GMT)	CTD deployed.
15:26 (20:26 GMT)	CTD recovered to deck. 89.946352°W; 21.483410°N
15:27 (20:27 GMT)	Start transit to Progreso.
18:00-23:59 (23:00-04:59	Alongside in Progreso.
on 21st April GMT)	

Planned Operation for next 24 hours

Planned to sail at 06:00 (local time) from Progreso. Identify CPT locations.
Wet test CPT equipment, start suite of CPT sites.

Weather			
Windspeed			
Port Call	6		
Hours of Transit	2.566666667		
Hours of Survey	14.95		
Equipment Recovery	0.483333333		
Written By	H Stewart	**Date:**	20th April 2013
Sent to	D McInroy		

Daily Log Sheet For:	**Yucatan 2013**		
Date:	21/04/2013	J.D.	111
Vessel:	R/V Justo Sierra	Main Task:	CPT test; vessel test; CPT acquisition.
Area:	Yucutan Peninsula GoM		

Time	Task / Description
00:00 (05:00 GMT)	Alongside in Progreso.
06:00 (11:00 GMT)	Slip lines and begin transit to CPT test area.
07:55 (12:55 GMT)	Arrive on site at Chicx-4A for CPT trials.
07:56 (12:56 GMT)	Equipment test on deck and preparation for buoy positioning test.
09:05 (14:05 GMT)	Buoy deployed for vessel holding station test.
09:40 (14:40 GMT)	Buoy recovered to deck. Vessel positioning test successful. Prepare for test core.
	Moved mushroom GPS (UTIG antenna 4, now named 4a in report) to the stern for CPT/gravity core positioning.
10:06 (15:06 GMT)	On station for gravity core (Chicx-4A)
10:13 (15:13 GMT)	Deploy gravity core (Chicx-4A)
10:23 (15:23 GMT)	Failed gravity core attempt. Not enough speed for successful core.
10:29 (15:29 GMT)	Free fall gravity core. Approximate penetration 4-5cm, recovered small
	amount of very white (coral?) sand (not enough for sample).
10:58 (15:58 GMT)	Deploy CPT
11:06 (16:06 GMT)	CPT on bottom (CPT 1: 21.477615°N; 89.957162°W). Hit rock bent cone.
11:20 (16:20 GMT)	CPT on deck. Replacing cone. Selecting subsequent CPT sites following
	discussion with engineers.
13:20 (18:22 GMT)	Deploy CPT
13:26 (18:26 GMT)	CPT on bottom (CPT 2: 21.477582°N; 89.956525°W).
13:40 (18:40 GMT)	CPT on deck. Catastrophic loss of control of vessel position in relation to the
	CPT on the sea bed, Further CPT operations deemed not safe as vessel has
	inadequate positioning,
	Small white, biogenic, sand-sized, sediment sample recovered from the CPT

	rig.
	Setting up grab
14:45 (19:45 GMT)	GPS antenna 4 moved 3m aft of the starboard gantry.
15:00 (20:00 GMT)	Grab 1: 21.47709°N; 89.95468°W
15:20 (20:20 GMT)	Grab 2: 21.477353°N; 89.957107°W
15:35 (20:35 GMT)	Grab 3: 21.477435°N; 89.956925°W
15:52 (20:52 GMT)	Grab 4: 21.47755°N; 89.95705°W
16:25 (21:25 GMT)	Grab 5: 21.47898°N; 89.95621°W
17:25 (22:07 GMT)	Grab 6: 21.45549°N; 89.95144°W
17:33 (22:33 GMT)	Grab 7: 21.45582°N; 89.95151°W
17:44 (22:44 GMT)	Grab 8: 21.451325°N; 89.95101°W
18:09 (23:09 GMT)	Grab 9: 21.453108°N; 89.950157°W
18:25 (23:25 GMT)	Grab 10: 21.449278°N; 89.9510017°W
18:26 (23:26 GMT)	Transit to start of side scan sonar/CHIRP lines to be re-shot.
20:37 (01:37 GMT)	Side scan sonar/CHIRP deployed and operatonal
20:44 (01:44 GMT)	Moved GPS antenna 4 from grab sample position to stern, port side.
20:52-23:59 (01:52-04:59	Start acquisition of side scan sonar, CHIRP and multibeam data on repeat
GMT on April 22nd)	and additional lines.

Planned Operation for next 24 hours			
Complete acquisition of side scan sonar, CHIRP and multibeam echosounder data. Take a CTD. Demobilisation. Transit to Progresso. End of cruise.			
Deploy/recover Kit	0.25		
Hours of Equipment/Vessel Test	3.033333333		
Port Call	6		
Hours of Transit	4.183333333		
Hours of Survey	3.116666667		
Hours of Sampling	7.416666667		
Written By	H Stewart	**Date:**	21st April 2013
Sent to	D McInroy		

Daily Log Sheet For:	**Yucatan 2013**		
Date:	22/04/2013	J.D.	112
Vessel:	R/V Justo Sierra	Main Task:	Complete acoustic survey, CTD, Port
Area:	Yucutan Peninsula GoM		

Time	Task / Description
00:00 (05:00 GMT)	Continue side scan sonar, CHIRP and multibeam acquisition.
12:52 (17:52 GMT)	Acoustic survey finished.
12:56 (17:56 GMT)	Side scan sonar/CHIRP recovered to deck.
12:57 (17:57 GMT)	Prepare CTD/transit to location.
13:56 (18:56 GMT)	Deploy CTD
14:02 (19:02 GMT)	CTD on deck. CTD 3: 21°26.6202'N; 89°54.0905'W
14:03 (19:03 GMT)	Transit to Progreso. Demobilisation.
18:00 (23:00 GMT)	Arrive in Progreso.
18:00 (23:00 GMT)	Finish Demobilisation for evening.

Planned Operation for next 24 hours			
Demobilisation. Truck arrives on 23rd April to offload equipment. End of operations.			
Weather			
CTD	0.1		
Hours of Demobilisation/ Transit	4.933333333		

Hours of Survey	12.86666667		
Recover Equipment	0.066666667		
Written By	H Stewart	**Date:**	22nd April 2013
Sent to	D McInroy		

Daily Log Sheet For:	**Yucatan 2013**		
Date:	23/04/2013	J.D.	113
Vessel:	R/V Justo Sierra	Main Task:	Demobilisation Disembark
Area:	Yucutan Peninsula GoM		
Time	Task / Description		
09:00-12:00 (14:00-17:00 GMT)	Demobilisation-delay due to shipping/customs truck being delayed for UTIG		
	kit. Was due 09:00, did not arrive until 13:00. GPS base station knocked		
	down in morning.		
14:15 (19:15 GMT)	All personnel leave vessel.		
Planned Operation for next 24 hours			
End of operations.			
Hours of Demobilisation	3		
Written By	H Stewart	**Date:**	23rd April 2013
Sent to	D McInroy		

Appendix 3 Scientific/Survey Personnel

Name	**Institute**	**Dates**	**Role**
Ligia Pérez Cruz	Universidad Nacional Autonóma de México	16-23rd April	Scientist
Marcy Davis	University of Texas, Institute of Geophysics	16-23rd April	Scientist
Justin Doronio	Seafloor Geotech	20-23rd April	Geotechnical
Daniel Duncan	University of Texas, Institute of Geophysics	16-23rd April	Scientist
Miguel Angel Diaz Flores	Universidad Nacional Autonóma de México	16-23rd April	Multibeam Technician
Jaime Urrutia Fucugauchi	Universidad Nacional Autonóma de México	20-23rd April	Scientist

John Goff	University of Texas, Institute of Geophysics	16-23rd April	Scientist
Sean Gulick	University of Texas, Institute of Geophysics	16-23rd April	Chief Scientist/ Party Chief
Jorge Luis Martinez Mérida	Universidad Nacional Autonóma de México	16-23rd April	Multibeam Technician
Francisco Ponce	Universidad Nacional Autonóma de México	16-23rd April	Multibeam Technician
Arturo Ronquillo	Universidad Nacional Autonóma de México	16-23rd April	Multibeam Technician
David Salas de León	Universidad Nacional Autonóma de México	16-23rd April	Multibeam Technician
Jason Sanford	University of Texas, Institute of Geophysics	16-23rd April	Scientist
Steffan Saustrup	University of Texas, Institute of Geophysics	16-23rd April	Scientist
Matthew Schubert	Seafloor Geotech	16-23rd April	Geotechnical
John Simmons	Seafloor Geotech	16-23rd April	Geotechnical
Daniel Steve	Seafloor Geotech	20-23rd April	Geotechnical
Heather Stewart	British Geological Survey	16-23rd April	Client Representative

Appendix 4 **Equipment Layback Diagram**

Vessel offsets were defined from the Fleetway Facility Services survey of the vessel undertaken in February 2007 (Appendix 11). Taped offset measurements were performed with reference to deck reference points from the vessel offset survey for all UTIG equipment, antennae and IMU. These measurements were used in the navigation software to calculate gantry positions, layback during acquisition, and post-processing for other pieces of data acquired. A summary of the primary offsets used during this survey are given in Table 3.

Equipment	X	Y	Z
UNAM IMU	35.016	0.000	-2.899
UNAM GPS Antenna 1	33.539	+0.065	-24.821
UNAM GPS Antenna 2	36.055	-0.053	-24.802
UNAM MB Head	31.955	-1.014	-0.061
UTIG IMU Position	21.35	-0.95	-7.323
UTIG GPS Antenna 1 (Primary to POS/MV)	20.278	-1.92	-10.081
UTIG GPS Antenna 2 (Secondary to POS/MV)	20.19	+2.095	-10.083
UTIG GPS Antenna 3 (For base station reference)	12.24	-2.56	-14.013
UTIG GPS Antenna 4 (For magnetometer)	21.228	-3.39	-9.703
Surface Tow Boomer Tow Point	0.000	-3.81	-7.183
Surface Tow Boomer Hydrophone Tow Point	0.000	+3.81	-7.183
Magnetometer Tow Point	0.000	+2.54	-8.313
SSS/CHIRP Tow Point	0.000	-1.92	-8.313
UTIG GPS Antenna 4a (for CPT sites)	0.000	-4.53	-8.563
Note that the vessel CRP (X=0; Y=0; Z=0) is located at the underside of the keel at the stern of the vessel on the vessel centre line.			

Table 3. Vessel offsets used during this survey.

Base Station Co-ordinates

At installation the coordinates of the base station were 21° 16’ 47.63”N; 89° 39’ 05.77”W. These coordinates will be improved post-cruise once the base station data has been downloaded and analysed.

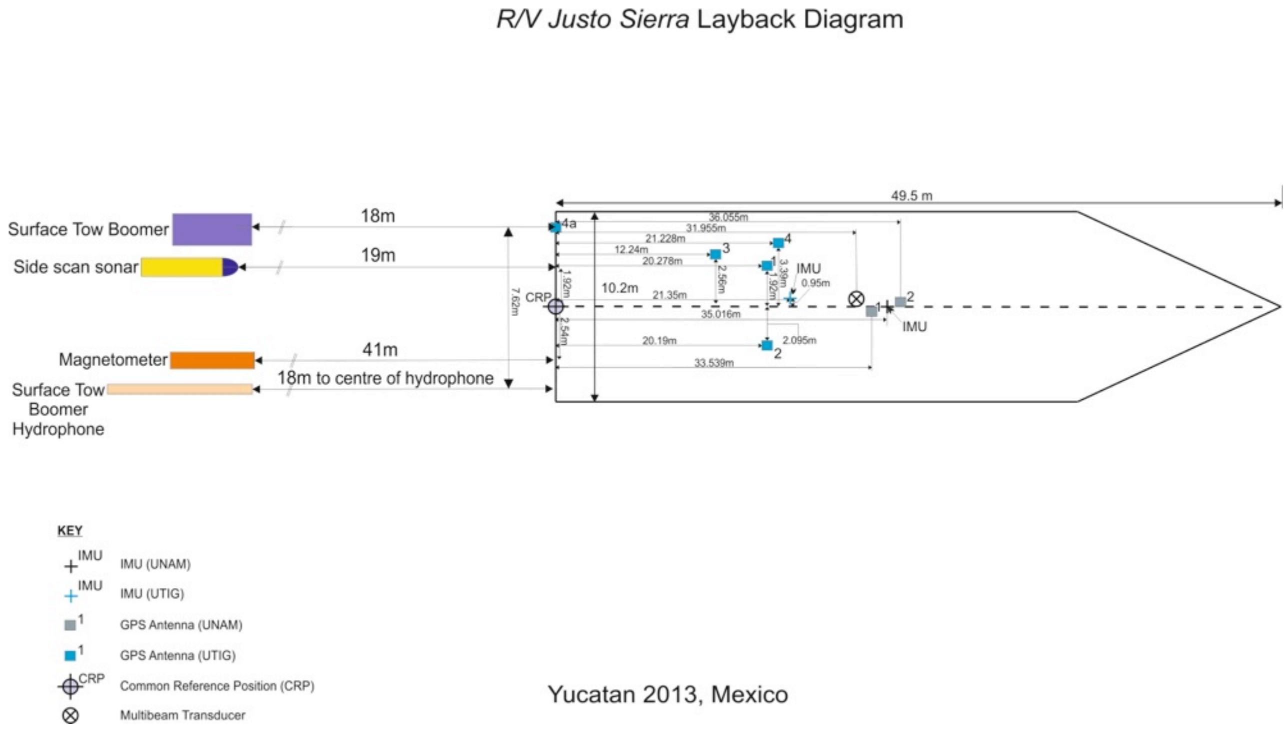


Figure 24. Layback diagram for the *R/V Justo Sierra*. See Table 3 for Y offsets for UNAM antennae 1, 2, the UNAM multibeam echounder head and UTIG GPS antenna 4a.

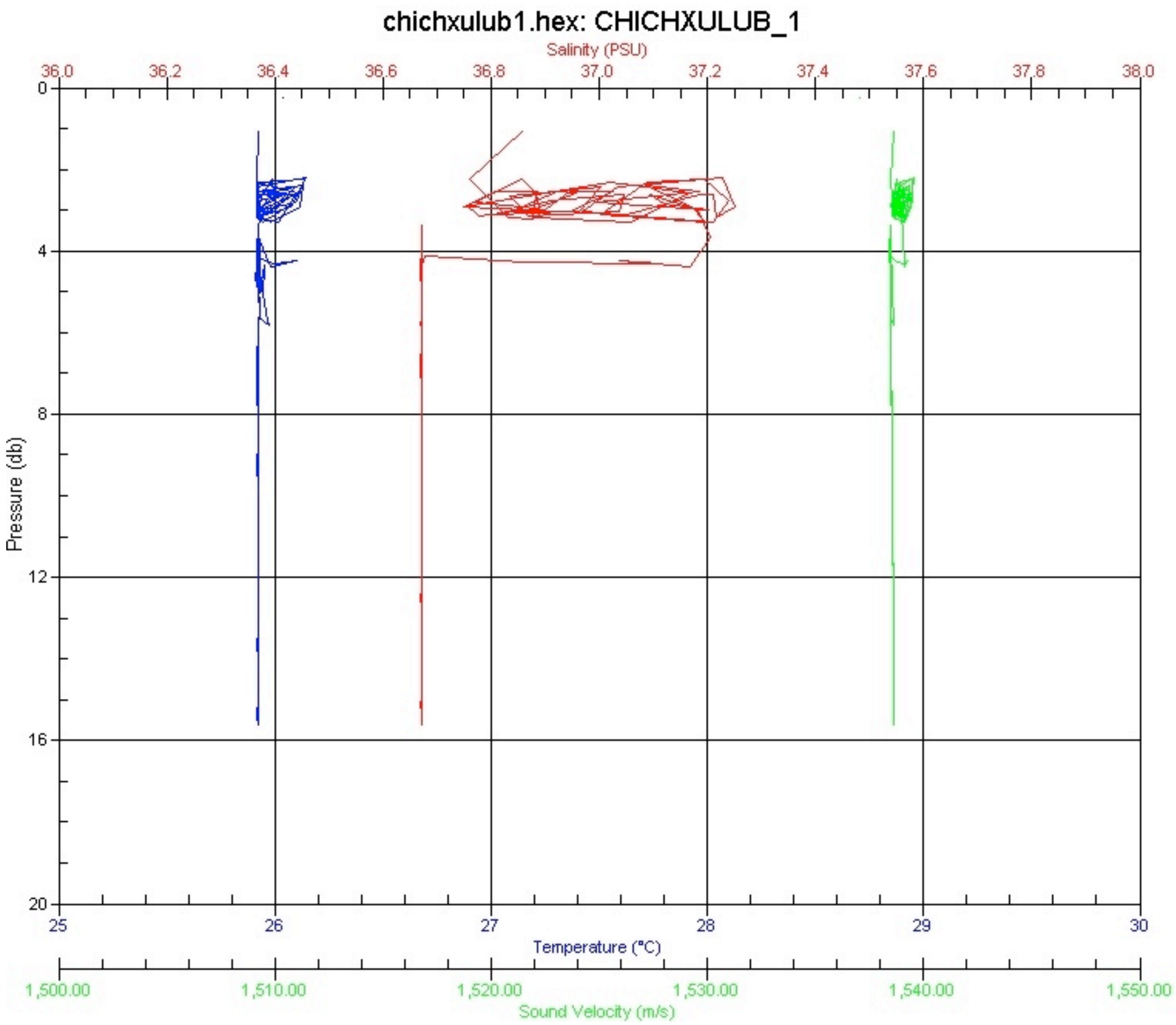
Appendix 5 **CTD Station List**

Time	Date	Latitude	Longitude
01:55 – 02:00 (06:55 – 07:00 GMT)	17/04/13	21.4912°N	89.9429056°W
15:15 – 15:26 (20:15 – 20:26 GMT)	20/04/13	21.483410°N	89.946352°W
13:56 – 14:02 (18:56 – 19:02 GMT)	22/04/13	21.44367°N	89.901508°W

Table 4. CTD stations acquired during the course of this survey.

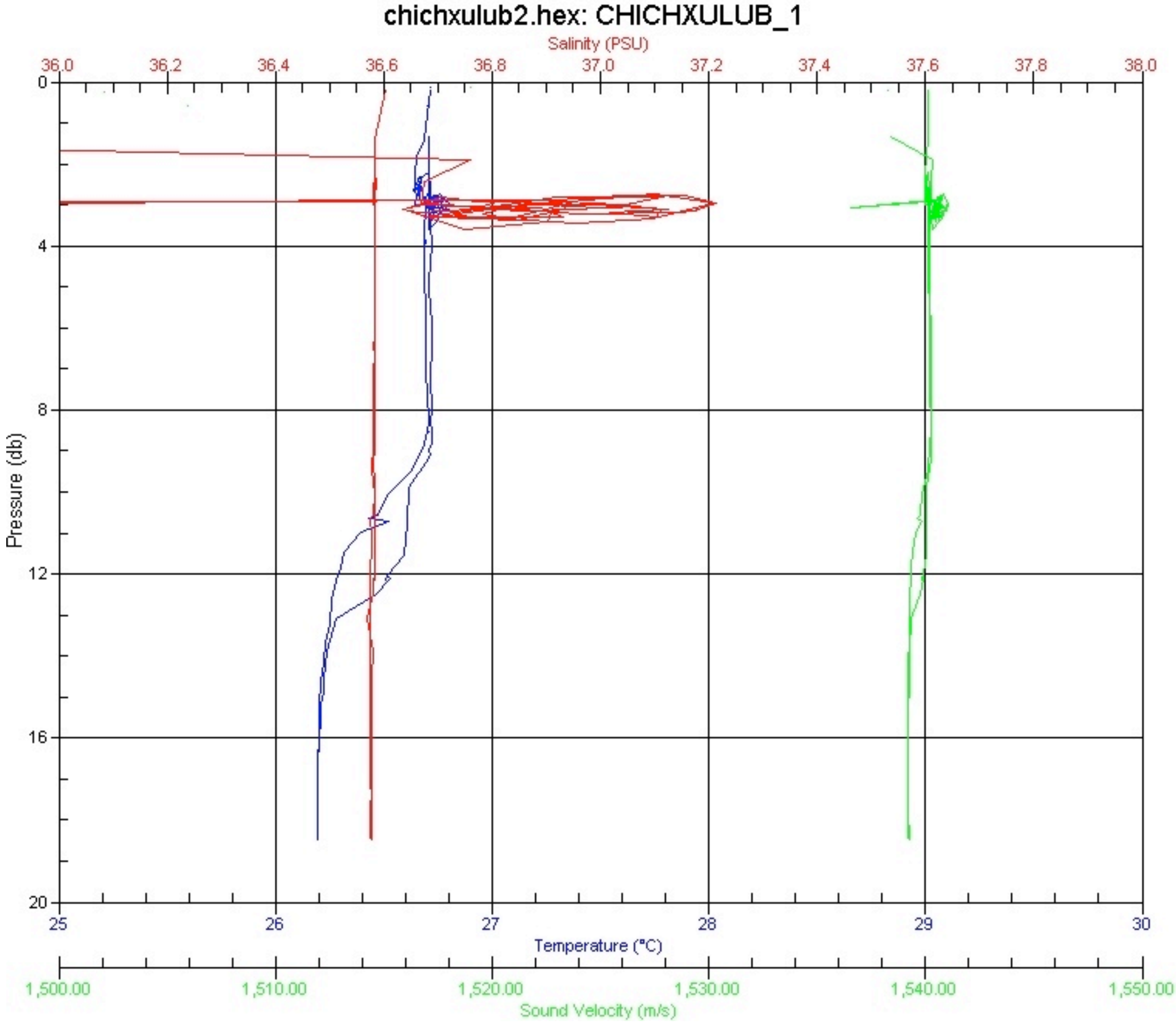
CTD 1

File: 20130417_start_survey_CTD_1.txt



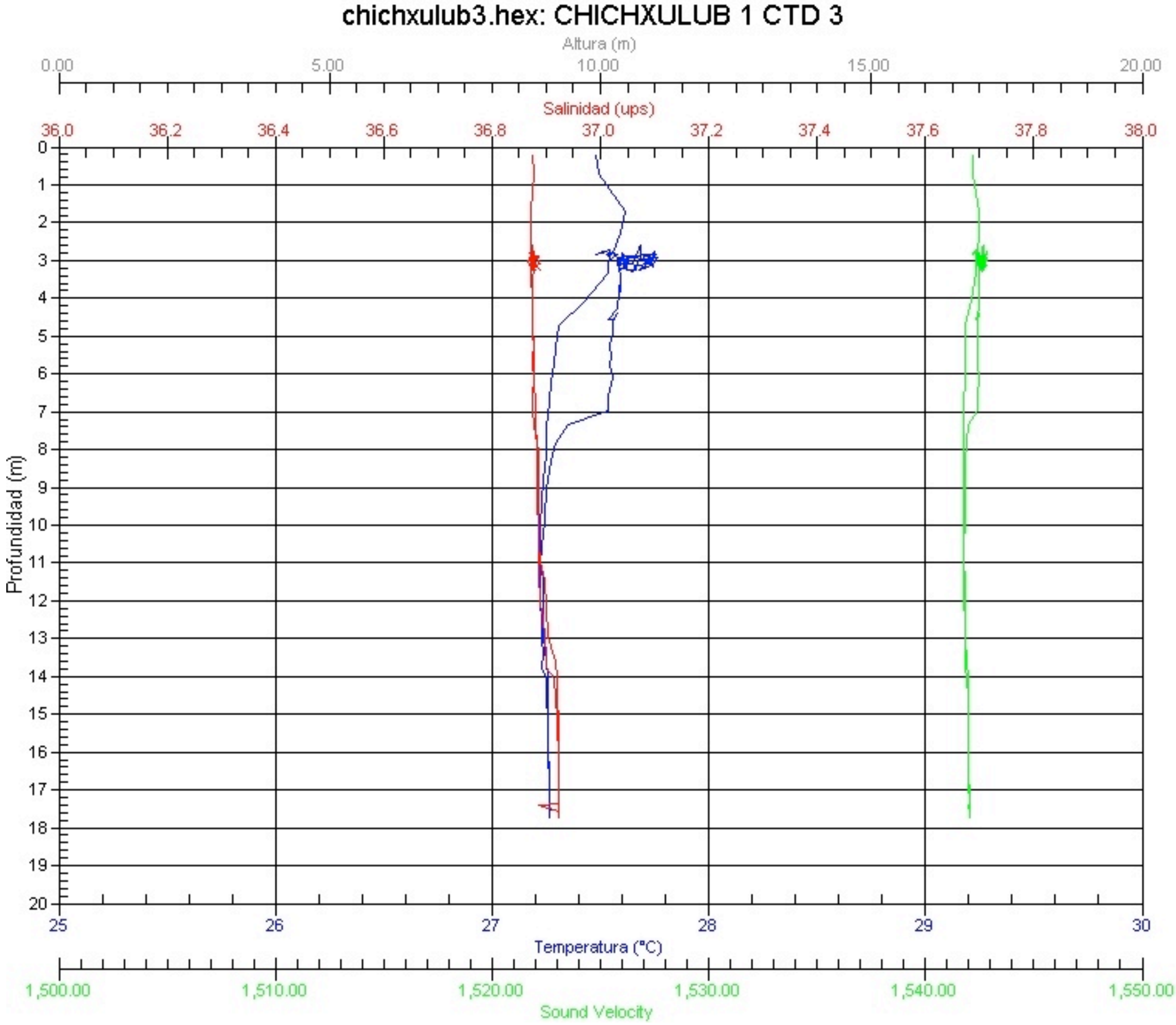
CTD 2

File: 20130420_mid_survey_CTD_2.txt



CTD 3

File: 20130422_end_survey_CTD_3.txt



Appendix 6

Sample Station List

Name	Date and Time	Latitude	Longitude	Summary
CPT 1	21st April 2013 11:06 (16:06 GMT)	21.477615° N	89.957162° W	Target was an area of low reflectance (dark) side scan sonar. Hit rock, bent cone.
CPT 2	21st April 2013 13:26 (18:26 GMT)	21.477582° N	89.956525° W	Target was an area of low reflectance (dark) side scan sonar. Hit rock, bent cone sleeve/ housing.
Grab 1	21st April 2013 15:00 (20:00 GMT)	21.47709°N	89.95468°W	Target was an area of low reflectance (dark) side scan sonar. Fine-medium grained sand-sized sediment. 1-2cm scoop with small coral fragments and unknown species of green seaweed/sea grass(?) attached to larger fragments. Poorly sorted.
Grab 2	21st April 2013 15:20 (20:20 GMT)	21.477353°N	89.957107°W	Target was an area of low reflectance (dark) side scan sonar. Fine-grained sand-sized sediment. 4-5cm scoop. Well sorted.
Grab 3	21st April 2013 15:35 (20:35 GMT)	21.477435°N	89.956925°W	Target was an area of low reflectance (dark) side scan sonar. Fine-grained sand-sized sediment. 4-5cm scoop. Well sorted.
Grab 4	21st April 2013 15:52 (20:52 GMT)	21.47755°N	89.95705°W	Target was an area of low reflectance (dark) side scan sonar. Fine-grained sand-sized sediment. Partial/broken sand dollar. 10cm scoop. Well sorted.

Name	Date and Time	Latitude	Longitude	Summary
Grab 5	21st April 2013 16:25 (21:25 GMT)	21.47898°N	89.95621°W	Target was an area of high reflectance (pale) side scan sonar. Small amount of poorly sorted, medium-coarse grained sand-sized sediment with fragments of live and dead coral, whole shells and a minor amount of broken shells. Rock at sea bed.
Grab 6	21st April 2013 17:07 (22:07 GMT)	21.45549°N	89.95144°W	Target was an area of medium reflectance side scan sonar coincident with site Chicx-02A. Thin layer (<2cm) of fine-grained sand-sized sediment with unidentified fauna species.
Grab 7	21st April 2013 17:33 (22:33 GMT)	21.45582°N	89.95151°W	Target was an area of low reflectance (dark) side scan sonar. Fine-grained sand-sized sediment. 10cm scoop. Well sorted.
Grab 8	21st April 2013 17:44 (22:44 GMT)	21.451325°N	89.95101°W	Target was an area of high reflectance (pale) side scan sonar coincident with site Chicx-03A. Diverse variety of living fauna and flora including live coral, sea urchin, at least 2 species of green seaweed/sea grass(?) and a scallop. The sample was not retained but returned to the sea from whence it came. Negligible sand-sized sediment recovered. Rock at sea bed.
Grab 9	21st April 2013 18:09 (23:09 GMT)	21.453108°N	89.950157°W	Target was an area of low reflectance (dark) side scan sonar. Fine-grained sand-sized sediment. 10cm scoop. Well sorted.

Name	Date and Time	Latitude	Longitude	Summary
Grab 10	21st April 2013 18:25 (23:25 GMT)	21.449278°N	89.9510017°W	Target was an area of low reflectance (dark) side scan sonar. Fine-grained sand-sized sediment. 3-4cm scoop. Well sorted.

10.1 POSSIBLE CONSIDERATION OF THE MARINE ENVIRONMENT

With increased pressure on the marine environment, the need for better spatial management of that environment is growing globally. The United Nations Convention of the Law of the Sea (UNCLOS) is an international agreement that provides the legal basis for Marine Protected Areas (MPAs) for the high seas (UNCLOS 1982). The Convention on Biological Diversity (CBD) is an international, legally binding treaty which includes the requirement for nations to establish a 'comprehensive, effectively managed and ecologically representative network of MPAs by 2020'.

It is unclear, at the time of writing this report, if the Mexican authorities have national level policies for implementing a strategic approach to protecting, maintaining and regenerating the marine environment to meet UNCLOS/CBD goals.

For example, the United Kingdom adheres to a range of policy drivers at a national and European level such as the Habitats Directive (92/43/EEC), the Marine Strategy Framework Directive (Directive 2008/56/EC) and the Marine (Scotland) Act (2010) to contribute to the planning and delivery of marine protected areas.

The Mexican authorities have been active in designating the Mesoamerican Barrier Reef System which is a marine region that extends from the tip of the Yucatan Peninsula down to Belize, Guatemala and the Bay Islands of Honduras. It is unclear from online research how many other such Marine Protected Areas exist, or are planned/candidate areas, within Mexican territorial waters.

Sampling acquired during the course of this survey suggests that areas of exposed, clean, bedrock at sea bed are likely to be colonised by live flora and fauna including corals. Given there were no marine biologists on board, a more detailed analysis of the samples could not be undertaken. Therefore it is unknown whether these species are of conservation interest or not. Areas of low reflectance side scan sonar in the vicinity of the three proposed drill sites, representing areas of sediment ribbons, were thoroughly ground-truthed and revealed no living flora and fauna. Preliminary interpretation suggests that all the proposed drill sites but Chicx-3A are located on areas sediment, devoid of living flora and fauna. It is recommended that during drilling operations a sea-bed camera or ROV should be used to confirm the location of drill sites and spud cans on areas of sediment rather than exposed bedrock to both minimise impact on the marine environment and to prevent damage to the spud cans that can be caused by spudding onto hard substrates.

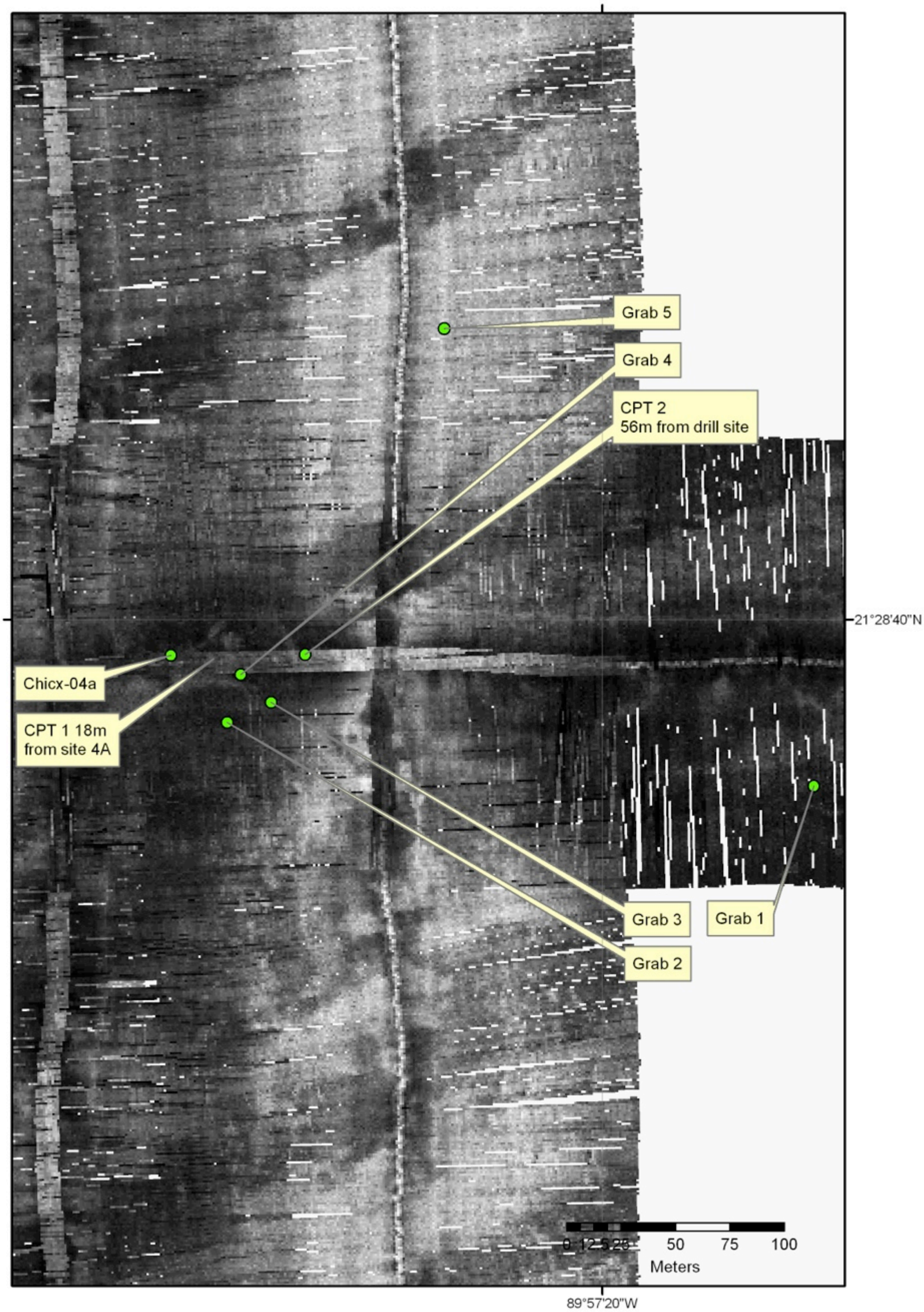


Figure 25. Location map of CPT and grab samples around site Chicx-4A on a mosaic of selected side scan sonar data.

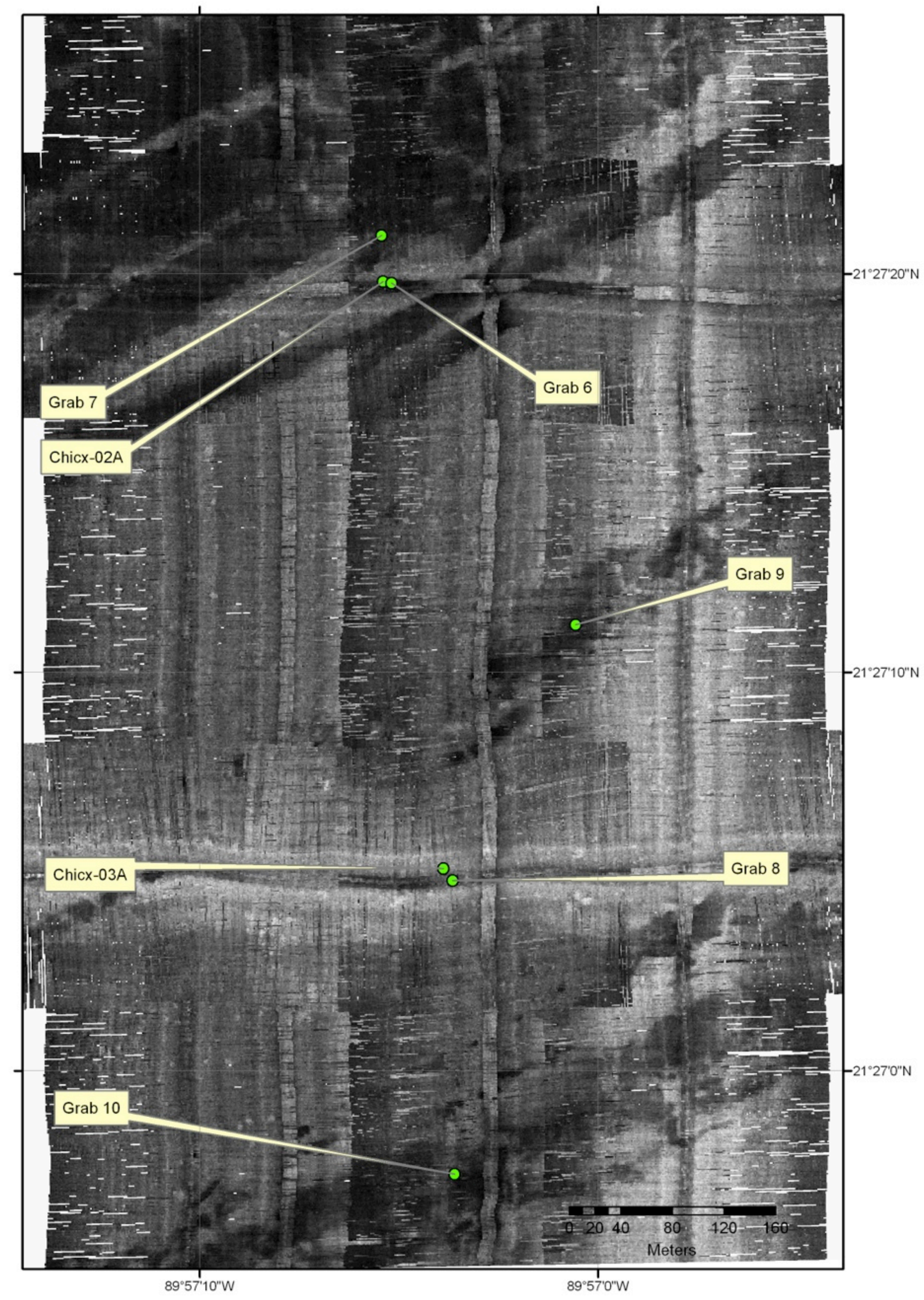


Figure 26. Location map of grab samples around site Chicx-2A and Chicx-3A on a mosaic of selected side scan sonar data.

Appendix 7 **Line Summary Sheets**

Surface Tow Boomer and Multibeam Echosounder Acquisition 17April – 18 April 2013.

Date GMT	Time-GMT	Date Local	Time-Local	Line	Boomer Hertz	Boomer Samples	Boomer file	Multi-beam File	Qinsy File	Survey Line	Direction	Comment
17-Apr	0951	17-Apr	0452	NS31	20000	10000	170413.095149.cod		4-Yucatan_0413.db	SOL NS31		
17-Apr	1048	17-Apr	0548	NS31	20000	10000	170413.103500.cod			EOL NS31		
17-Apr	1049	17-Apr	0549	NS26	20000	10000	170413.104915.cod			SOL NS26	N	
17-Apr	1055	17-Apr	0555	NS26	20000	10000						passing start of line waypoint
17-Apr	1127	17-Apr	0627	NS26	20000	10000	170413.104915.cod			EOL NS26		
17-Apr	1144	17-Apr	0644	NS30	20000	10000	170413.114400.cod			SOL NS30	S	
17-Apr	1225	17-Apr	0725	NS30	20000	10000	170413.114400.cod			EOL NS30		
17-Apr	1235	17-Apr	0735	NS25	20000	10000	170413.123523.cod			SOL NS25	N	
17-Apr	1318	17-Apr	0818	NS25	20000	10000	170413.131834.cod			EOL NS25		
17-Apr	1327	17-Apr	0827	NS29	20000	10000	170413.132746.cod			SOL NS29	S	
17-Apr	1357	17-Apr	0857	NS29	20000	10000		10				Multibeam - new file every 30 minutes. Project name: CHIXCILUB_LEG2
17-Apr	1410	17-Apr	0910	NS29	20000	10000	170413.141058.cod			EOL NS29		(two boomer files for line 29)
17-Apr	1416	17-Apr	0919	NS24	20000	10000	170413.141641.cod	11	5-Yucatan_0413.db	SOL NS24	N	(asked for shorter line run-ins/outs. So far about 800m)

Date GMT	Time-GMT	Date Local	Time-Local	Line	Boomer Hertz	Boomer Samples	Boomer file	Multi-beam File	Qinsy File	Survey Line	Direction	Comment
17-Apr	1455	17-Apr	0958	NS24	20000	10000	170413.141641.cod			EOL NS24		increased boomer filesize to 150MB
17-Apr	1458	14-Apr	0958	NS28	20000	10000	170413.145847.cod	13	6-Yucatan_0413.db	SOL NS28	S	
17-Apr	1529	17-Apr	1029	NS28	20000	10000	170413.145847.cod	14		EOL NS28		
17-Apr	1536	17-Apr	1036	NS23	20000	10000	170413.153620.cod	15	7-Yucatan_0413.db	SOL NS23	N	
17-Apr	1609	17-Apr	1109	NS23	20000	10000	170413.153620.cod	17		EOL NS23		
17-Apr	1614	17-Apr	1114	NS27	20000	10000	170413.161415.cod	18	8-Yucatan_0413.db	SOL NS27	S	increased boomer filesize to 200MB
17-Apr	1644	17-Apr	1144	NS27	20000	10000	170413.161415.cod	19		EOL NS27		shifting racetrack over to line 18
17-Apr	1654	17-Apr	1154	NS18	20000	10000	170413.165403.cod	19	9-Yucatan_0413.db	SOL NS18	N	(overshot on the boomer and POS - late start)
17-Apr	1726	17-Apr	1226	NS18	20000	10000	170413.165403.cod	20		EOL NS18		
17-Apr	1729	17-Apr	1229	NS22	20000	10000	170413.172926.cod	20	10-Yucatan_0413.db	SOL NS22	S	
17-Apr	1803	17-Apr	1303	NS22	20000	10000	170413.172926.cod	22		EOL NS22		
17-Apr	1808	17-Apr	1308	NS17	20000	10000	170413.180800.cod	22	11-Yucatan_0413.db	SOL NS17	N	
17-Apr	1843	17-Apr	1343	NS17	20000	10000	170413.180800.cod	23		EOL NS17		
17-Apr	1846	17-Apr	1346	NS21	20000	10000	170413.184650.cod	24	12-Yucatan_0413.db	SOL NS21	S	

Date GMT	Time-GMT	Date Local	Time-Local	Line	Boomer Hertz	Boomer Samples	Boomer file	Multi-beam File	Qinsy File	Survey Line	Direction	Comment
17-Apr	1919	17-Apr	1419	NS21	20000	10000	170413.184650.cod	26		EOL NS21		
17-Apr	1923	17-Apr	1423	NS16	20000	10000	170413.192357.cod	28	13-Yucatan_0413	SOL NS16	N	
17-Apr	2001	17-Apr	1501	NS16	20000	10000	170413.192357.cod	29		EOL NS16		
17-Apr	2004	17-Apr	1504	NS20	20000	10000	170413.200415.cod	29	14-Yucatan_0413	SOL NS20	S	
17-Apr	2038	17-Apr	1538	NS20	20000	10000	170413.200415.cod	32		EOL NS20		
17-Apr	2043	17-Apr	1543	NS15	20000	10000	170413.204309.cod	34	15-Yucatan_0413	SOL NS15	N	
17-Apr	2122	17-Apr	1622	NS15	20000	10000	170413.204309.cod	35		EOL NS15		
17-Apr	2127	17-Apr	1627	NS19	20000	10000	170413.212700.cod	37	16-Yucatan_0413	SOL NS19	S	
17-Apr	2203	17-Apr	1703	NS19	20000	10000	170413.212700.cod	38		EOL NS19		
17-Apr	2211	17-Apr	1711	NS10	20000	10000	170413.221102.cod	40	17-Yucatan_0413	SOL NS10	N	according to Fugawi there is a possible break in GPS?
17-Apr	2249	17-Apr	1749	NS10	20000	10000	170413.221102.cod	41		EOL MS10		
17-Apr	2255	17-Apr	1755	NS14	20000	10000	170413.225519.cod	43	18-Yucatan_0413	SOL NS14	S	
17-Apr	2329	17-Apr	1829	NS14	20000	10000	170413.225519.cod	44		EOL NS14		
17-Apr	2333	17-Apr	1833	NS9	20000	10000	170413.233314.cod	46	19-Yucatan_0413	SOL NS09	N	

Date GMT	Time-GMT	Date Local	Time-Local	Line	Boomer Hertz	Boomer Samples	Boomer file	Multi-beam File	Qinsy File	Survey Line	Direction	Comment
18-Apr	0006	17-Apr	1906	NS9	20000	10000	170413.233314.cod	47		EOL NS09		
18-Apr	0009	17-Apr	1909	NS7	20000	10000	180413.000950.cod	49	20-Yucatan_0413	SOL NS06	S	
18-Apr	0045	17-Apr	1945	NS7	20000	10000	180413.000950.cod	50		EOL NS06		
18-Apr	0054	17-Apr	1954	NS13	20000	10000	180413.005429.cod	52	21-Yucatan_0413	SOL NS13	N	
18-Apr	0135	17-Apr	2035	NS13	20000	10000	180413.013522.cod	53		EOL NS13		
18-Apr	0141	17-Apr	2041	NS5	20000	10000	180413.014100.cod	53	22-Yucatan_0413	SOL NS05	S	Qinsy did not start new file, appears to be appending?
18-Apr	0214	17-Apr	2114	NS5	20000	10000	180413.014100.cod	54		EOL NS05		
18-Apr	0220	17-Apr	2120	NS12	20000	10000	180413.022018.cod	54	23-Yucatan_0413	SOL NS11	N	Started on line 12 before switching to line 11.
18-Apr	0303	17-Apr	2203	NS12	20000	10000	180413.022018.cod	56		EOL NS11		
18-Apr	0303	17-Apr	2203	NS4	20000	10000	180413.030320.cod	56	24-Yucatan_0413	SOL NS04	S	
18-Apr	0339	17-Apr	2239	NS4	20000	10000	180413.030320.cod	57		EOL NS04		
18-Apr	0340	17-Apr	2240	NS8	20000	10000	180413.034052.cod	57	25-Yucatan_0413	SOL NS08	N	
18-Apr	0416	17-Apr	2316	NS8	20000	10000	180413.034052.cod	58		EOL NS08		
18-Apr	0422	17-Apr	2322	NS3	20000	10000	180413.042213.cod	58	26-Yucatan_0413	SOL NS03	S	

Date GMT	Time-GMT	Date Local	Time-Local	Line	Boomer Hertz	Boomer Samples	Boomer file	Multi-beam File	Qinsy File	Survey Line	Direction	Comment
18-Apr	0455	17-Apr	2355	NS3	20000	10000	180413.042213.cod	60		EOL NS03		
18-Apr	0500	17-Apr	0000	NS7	20000	10000	180413.050053.cod	60	27-Yucatan_0413	SOL NS07	N	
18-Apr	0536	18-Apr	0036	NS7	20000	10000	180413.050053.cod	61		EOL NS07		
18-Apr	0541	18-Apr	0041	NS0	20000	10000	180413.054134.cod	63	28-Yucatan_0413	SOL NS00	S	
18-Apr	0617	18-Apr	0117	NS0	20000	10000	180413.054134.cod	64		EOL NS00		
18-Apr	0623	18-Apr	0123	NS2	20000	10000	180413.062308.cod	66	29-Yucatan_0413	SOL NS02	N	0632 started Qinsy, didn't start at SOL
18-Apr	0658	18-Apr	0158	NS2	20000	10000	180413.062308.cod	67		EOL NS02		
18-Apr	0704	18-Apr	0204	NS12	20000	10000	180413.070428.cod	69	30-Yucatan_0413	SOL NS12	S	
18-Apr	0742	18-Apr	0242	NS12	20000	10000	180413.070428.cod	70		EOL NS12		
18-Apr	0751	18-Apr	0251	NS01	20000	10000	180413.075147.cod	72	31-Yucatan_0413	SOL NS01	N	
18-Apr	0830	18-Apr	0330	NS01	20000	10000	180413.075147.cod	73		EOL NS01		
18-Apr	0845	18-Apr	0345	EW12	20000	10000	180413.084525.cod	75	32-Yucatan_0413	SOL EW12	W	
18-Apr	0900	18-Apr	0400	EW12	20000	10000	180413.084525.cod	75		EOL EW12		
18-Apr	0905	18-Apr	0405	EW11	20000	10000	180413.090533.cod	77	33-Yucatan_0413	SOL EW11	E	

Date GMT	Time-GMT	Date Local	Time-Local	Line	Boomer Hertz	Boomer Samples	Boomer file	Multi-beam File	Qinsy File	Survey Line	Direction	Comment
18-Apr	0923	18-Apr	0423	EW11	20000	10000	180413.090533.cod	77		EOL EW11		
18-Apr	0943	18-Apr	0443	EW10	20000	10000	180413.094347.cod	79	34-Yucatan_0413	SOL EW10	W	
18-Apr	1001	18-Apr	0501	EW10	20000	10000	180413.094347.cod	79		EOL EW10		
18-Apr	1005	18-Apr	0505	EW09	20000	10000	180413.100552.cod	81	35-Yucatan_0413	SOL EW09	E	
18-Apr	1025	18-Apr	0525	EW09	20000	10000	180413.100552.cod	81		EOL EW09		
18-Apr	1030	18-Apr	0531	EW08	20000	10000	180413.103004.cod	83	36-Yucatan_0413	SOL EW08	W	
18-Apr	1049	18-Apr	0549	EW08	20000	10000	180413.103004.cod	83		EOL EW08		
18-Apr	1054	18-Apr	0557	EW07	20000	10000	180413.105422.cod	85	37-Yucatan_0413	SOL EW07	E	
18-Apr	1116	18-Apr	0616	EW07	20000	10000	180413.105422.cod	85		EOL EW07		
18-Apr	1121	18-Apr	0621	EW06	20000	10000	180413.112107.cod	87	38-Yucatan_0413	SOL EW06	W	
18-Apr	1139	18-Apr	0639	EW06	20000	10000	180413.112107.cod	87		EOL EW06		
18-Apr	1144	18-Apr	0644	EW05	20000	10000	180413.114445.cod	89	39-Yucatan_0413	SOL EW05	E	
18-Apr	1207	18-Apr	0707	Ew05	20000	10000	180413.114445.cod	89		EOL EW05		
18-Apr	1213	18-Apr	0713	EW04	20000	10000	180413.121314.cod	91	40-Yucatan_0413	SOL EW04	W	

Date GMT	Time-GMT	Date Local	Time-Local	Line	Boomer Hertz	Boomer Samples	Boomer file	Multi-beam File	Qinsy File	Survey Line	Direction	Comment
18-Apr	1233	18-Apr	0733	EW04	20000	10000	180413.121314.cod	91		EOL EW04		
18-Apr	1240	18-Apr	0740	EW03	20000	10000	180413.124001.cod	93	41-Yucatan_0413	SOL EW03	E	
18-Apr	1300	18-Apr	0800	EW03	20000	10000	180413.124001.cod	93		EOL EW03		
18-Apr	1305	18-Apr	0805	EW02	20000	10000	180413.130513.cod	96	42-Yucatan_0413	SOL EW02	W	
18-Apr	1322	18-Apr	0822	EW02	20000	10000	180413.130513.cod	96	43-Yucatan_0413	EOL EW02		
18-Apr	1328	18-Apr	0828	EW01	20000	10000	180413.132823.cod	97	43-Yucatan_0413	SOL EW01	E	
18-Apr	1345	18-Apr	0845	EW01	20000	10000	180413.132823.cod	97	44-Yucatan_0413	EOL EW01		End of Boomer/ Multibeam survey

Side Scan Sonar, CHIRP, Magnetometer and Multibeam Echosounder Acquisition 18 April – 20 April 2013.

Date (GMT)	Time-GMT	Date Local	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magnet-ometer File	Direction	Comment
18-Apr	1540	18-Apr	1040	NS31a	ns31a	20130418153830	3	44_Yucatan_0413		N	SOL NS31a, sidescan GPS off
18-Apr	1610	18-Apr	1110	NS31a	ns31a	20130418153830	4	44_Yucatan_0413			EOL NS31a
18-Apr	1620	18-Apr	1120	NS22a	ns22a	20130418161750	5	45_Yucatan_0413		S	SOL NS22a, sidescan GPS still off

Date (GMT)	Time-GMT	Date Local	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magnet-ometer File	Direction	Comment
18-Apr	1648	18-Apr	1148	NS22a	ns22a	20130418161750					EOL NS22a; had to go off the line due to fishermen. stopped sidesscan and sonar. Socket error following remote desktop and jstar.exe, moved towpoint 4m to port of centerline.
18-Apr	2350	18-Apr	1850	NS01a	ns01a	20130418235333 and 20130419003350	22	46_Yucatan_0413	ns01,ns01a_000	N	SOL NS01a; back online with sidescan, chirp. Magnetometer working with power directly from orange box and GPGGA GPS rather than IGGGA, Qinsy file 45 recorded all day while troubleshooting
19-Apr	0044	18-Apr	1944	NS01a	ns01a	20130418235333 and 20130419003350	23	47_Yucatan_0413			EOL NS01a; Incomplete line in the beginning
19-Apr	0054	18-Apr	1954	NS16a	ns16a	20130419005413 and 20130419004454	25	48_Yucatan_0413	ns16a, ns16a_000	S	SOL NS16a; GPS lat/long not appending to .xyz file, not sure about .mag as looks like can't record and do playback at same time
19-Apr	0128	18-Apr	2028	NS16a	ns16a	20130419005413 and 20130419004454	26				EOL NS16a
19-Apr	0136	18-Apr	2036	NS02a	ns02a	20130419013602	28	49_Yucatan_0413	ns16a_001	N	SOL NS02a; enabled utm and lat/long append to mag .xyz file as test, still didn't append
19-Apr	0212	18-Apr	2112	NS02a	ns02a	20130419013602	29				EOL NS02a
19-Apr	0220	18-Apr	2120	NS17a	ns17a	20130419022032	31	50_Yucatan_0413	yucatan0413	S	SOL NS17a
19-Apr	0255	18-Apr	2155	NS17a	ns17a	20130419022032	32				EOL NS17a
19-Apr	0306	18-Apr	2206	NS03a	ns03a	20130419030634	34	51_Yucatan_0413	yucatan0413_000	N	SOL NS03a

Date (GMT)	Time-GMT	Date Local	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magnet-ometer File	Direction	Comment
19-Apr	0342	18-Apr	2242	NS03a	ns03a	20130419030634	35				EOL NS03a
19-Apr	0353	18-Apr	2253	NS18a	ns18a	20130419035309 and 20130419043325	37	52_Yucatan_0413	yucatan0413_002	S	SOL NS18a; might have started new file twice on SeaLINK at EOL NS03a; yucatan0413_001 might also have data
19-Apr	0434	18-Apr	2334	NS18a	ns18a	20130419035309 and 20130419043325	38				EOL NS18a
19-Apr	0440	19-Apr	2340	NS04a	ns04a	20130419044017	40	53_Yucatan_0413	yucatan0413_003, 004	N	SOL NS04a, mag file 003 was another test. Must click 'appending gps to Fish output' icon then set preferences
19-Apr	0518	19-Apr	0018	NS04a	ns04a	20130419044017	41		yucatan0413_005		EOL NS04a
19-Apr	0530	19-Apr	0030	NS19a	ns19a	20130419053025	43	54_Yucatan_0413	yucatan0413_005	S	SOL NS19a
19-Apr	0609	19-Apr	0109	NS19a	ns19a	20130419053025	44				EOL NS19a
19-Apr	0623	19-Apr	0123	NS05a	ns05a	20130419062054	46	55_Yucatan_0413	yucatan0413_006	N	SOL NS05a
19-Apr	0655	19-Apr	0155	NS05a	ns05a	20130419062054	47				EOL NS05a
19-Apr	0707	19-Apr	0207	NS20a	ns20a	20130419070706	49	56_Yucatan_0413	yucatan0413_007	S	SOL NS20a, started line a bit fast (6+knots), vessel slowed to survey speed by 0711)
19-Apr	0742	19-Apr	0242	NS20a	ns20a	20130419070706	50				EOL NS20a, poorer data quality on southerly heading due to vessel having to maintain enough speed to not be pushed off line is detrimental to the sidescan sonar data acquisition.
19-Apr	0753	19-Apr	0253	NS06a	ns06a	20130419075313	52	57_Yucatan_0413	yucatan0413_008	N	SOL NS06a

Date (GMT)	Time-GMT	Date Local	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magnet-ometer File	Direction	Comment
19-Apr	0826	19-Apr	0326	NS06a	ns06a	20130419075313	53				EOL NS06a
19-Apr	0836	19-Apr	0336	NS21a	ns21a	20130419083643	55	58_Yucatan_0413	yucatan0413_009	S	SOL NS21a
19-Apr	0912	19-Apr	0412	NS21a	ns21a	20130419083643	56				EOL NS21a
19-Apr	0924	19-Apr	0424	NS07a	ns07a	20130419092401	58	59_Yucatan_0413	yucatan0413_010 & 011	N	SOL NS07a
19-Apr	1000	19-Apr	0500	NS07a	ns07a	20130419092401	59				EOL NS07a
19-Apr	1016	19-Apr	0516	NS22a	ns22a	20130419101620	61	60_Yucatan_0413	yucatan0413_012	S	SOL NS22a
19-Apr	1050	19-Apr	0550	NS22a	ns22a	20130419101620	62				EOL NS22a
19-Apr	1102	19-Apr	0602	NS08a	ns08a	20130419105133 and 20130419113 10	64	61_Yucatan_0413	yucatan0413_013	N	SOL NS08a Side scan recorded the turn before to star a line
19-Apr	1140	19-Apr	0640	NS08a	ns08a	20130419105133 and 20130419113 10	65				EOL NS08a
19-Apr	1153	19-Apr	0653	NS23a	ns23a	20130419115252	67	62_Yucatan_0413	yucatan0413_014	S	SOL NS23a
19-Apr	1228	19-Apr	0728	NS23a	ns23a	20130419115252	68				EOL NS23a
19-Apr	1237	19-Apr	0737	NS09a	ns09a	20130419123746	70	62_Yucatan_0413	yucatan0413_014	N	SOL NS09a
19-Apr	1313	19-Apr	0813	NS09a	ns09a	20130419123746					EOL NS09a

Date (GMT)	Time - GMT	Date Local	Time - Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magnet-ometer File	Direction	Comment
19-Apr	1324	19-Apr	0824	NS24a	ns24a	20130419132413	73	63_Yucatan_0413	yucatan0413_015	S	SOL NS24a; at 1332 GMT, ship's navigation/multibeam system crashed--trying to backup files for reboot
19-Apr	1332	19-Apr	0832	NS24a	ns24a	20130419132413					multibeam system crashed; backed up files for reboot
19-Apr	1350	19-Apr	0850	NS24a	ns24a	20130419132413	74				multibeam system rebooted and operatioinal
19-Apr	1405	19-Apr	0905	NS24a	ns24a	20130419132413					EOL NS24a
19-Apr	1415	19-Apr	0915	NS10a	ns10a	20130419141457	75	64_Yucatan_0413	yucatan0413_016	N	SOL NS10a
19-Apr	1450	19-Apr	0950	NS10a	ns10a	20130419141457	76				EOL NS10a
19-Apr	1503	19-Apr	1003	NS25a	ns25a	20130419150347	78	65_Yucatan_0413	yucatan0413_017	S	SOL NS25a
19-Apr	1538	19-Apr	1038	NS25a	ns25a	20130419150347	79				EOL NS25a
19-Apr	1552	19-Apr	1052	NS11a	ns11a	20130419155144	81	66_Yucatan_0413	yucatan0413_018	N	SOL NS11a
19-Apr	1628	19-Apr	1128	NS11a	ns11a	20130419155144	82				EOL NS11a
19-Apr	1640	19-Apr	1140	NS26a	ns26a	20130419163934	84	67_Yucatan_0413	yucatan0413_019	S	SOL NS26a
19-Apr	1715	19-Apr	1215	NS26a	ns26a	20130419163934	85				EOL NS26a
19-Apr	1725	19-Apr	1225	NS12a	ns12a	20130419172523	87	68_Yucatan_0413	yucatan0413_020	N	SOL NS12a
19-Apr	1758	19-Apr	1258	NS12a	ns12a	20130419172523	88				EOL NS12a, stopped magnetometer logging to charge battery

Date (GMT)	Time-GMT	Date Local	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magnet-ometer File	Direction	Comment
19-Apr	1806	19-Apr	1306	NS27a	ns27a	201304191806 52	90	69_Yucatan_0413		S	SOL NS27a
19-Apr	1809	19-Apr	1309	NS27a					yucatan0413_21		Started magnetometer logging, battery charging simultaneously.
19-Apr	1841	19-Apr	1341	NS27a	ns27a	201304191806 52	91				EOL NS27a
19-Apr	1850	19-Apr	1350	NS13a	ns13a	201304191850 34	93	70_Yucatan_0413	yucatan0413_22	N	SOL NS13a
19-Apr	1910	19-Apr	1410	NS13a					yucatan0413_22&23		Magnetometer GPS dropped out, fixed and logging again at 19:30 GMT but dropped again at 19:32. No Magnetometer recording
19-Apr	1925	19-Apr	1425	NS13a	ns13a	201304191850 34	94				EOL NS13a
19-Apr	1935	19-Apr	1435	NS28a	ns28a	201304191935 31	96	71_Yucatan_0413	yucatan0413_24	S	SOL NS28a, Magnetometer GPS fixed, file started recording at 19:36.
19-Apr	2009	19-Apr	1509	NS28a	ns28a	201304191935 31	97				EOL NS28a
19-Apr	2020	19-Apr	1520	NS14a	ns14a	201304192020 39	99	72_Yucatan_0413	yucatan0413_25	N	SOL NS14a
19-Apr	2056	19-Apr	1556	NS14a	ns14a	201304192020 39	100				EOL NS14a
19-Apr	2105	19-Apr	1605	NS29a	ns29a	201304192105 11	102	73_Yucatan_0413	yucatan0413_26	S	SOL NS29a
19-Apr	2140	19-Apr	1640	NS29a	ns29a	201304192105 11	103				EOL NS29a
19-Apr	2150	19-Apr	1653	NS15a	ns15a	201304192150 29	105	74_Yucatan_0413	yucatan0413_27	N	SOL NS15a
19-Apr	2226	19-Apr	1726	NS15a	ns15a	201304192150 29	106				EOL NS15a

Date (GMT)	Time-GMT	Date Local	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magnet-ometer File	Direction	Comment
19-Apr	2235	19-Apr	1735	NS30a	ns30a	20130419223559	108	75_Yucatan_0413	yucatan0413_28	S	SOL NS30a
19-Apr	2311	19-Apr	1811	NS30a	ns30a	20130419223559	109				EOL NS30a
19-Apr	2328	19-Apr	1828	EW02	ew02	20130419232840	111	76_Yucatan_0413	yucatan0413_29	E	SOL EW02
19-Apr	2348	19-Apr	1848	EW02	ew02	20130419232840	112				EOL EW02
19-Apr	2357	19-Apr	1857	EW04	ew04	20130419235702	113	76_Yucatan_0413	yucatan0413_30	W	SOL EW04
20-Apr	0016	19-Apr	1916	EW04	ew04	20130419235702	114				EOL EW04
20-Apr	0024	19-Apr	1924	EW06	ew06	20130420002455	115	77_Yucatan_0413	yucatan0413_31	E	SOL EW06
20-Apr	0048	19-Apr	1948	EW06	ew06	20130420002455	116				EOL EW06
20-Apr	0056	19-Apr	1956	EW08	ew08	20130420005608	117	78_Yucatan_0413	yucatan0413_33	W	SOL EW08
20-Apr	0114	19-Apr	2014	EW08	ew08	20130420005608	117				EOL EW08; now stopping the multibeam file at the end of every line and starting it at the start of next line at Sean's behest
20-Apr	0127	19-Apr	2027	EW10	ew10	20130420012735	119	79_Yucatan_0413	yucatan0413_34	E	SOL EW10
20-Apr	0144	19-Apr	2044	EW10	ew10	20130420012735	119				EOL EW10
20-Apr	0156	19-Apr	2056	EW12	ew12	20130420015622	121	80_Yucatan_0413	yucatan0413_35	W	SOL EW12
20-Apr	0214	19-Apr	2114	EW12	ew12	20130420015622	121				EOL EW12

Date (GMT)	Time-GMT	Date Local	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magnet-ometer File	Direction	Comment
20-Apr	0225	19-Apr	2125	EW11	ew11	20130420022528	123	81_Yucatan_0413	yucatan0413_36	E	SOL EW11
20-Apr	0248	19-Apr	2148	EW11	ew11	20130420022528	123				EOL EW11
20-Apr	0256	19-Apr	2156	EW09	ew09	20130420025609	125	82_Yucatan_0413	yucatan0413_37	W	SOL EW09
20-Apr	0317	19-Apr	2217	EW09	ew09	20130420025609	125				EOL EW09
20-Apr	0327	19-Apr	2227	EW07	ew07	20130420032744	127	83_Yucatan_0413	yucatan0413_38	E	SOL EW07
20-Apr	0345	19-Apr	2245	EW07	ew07	20130420032744	127				EOL EW07
20-Apr	0357	19-Apr	2257	EW05	ew05	20130420035708	129	84_Yucatan_0413	yucatan0413_39	W	SOL EW05
20-Apr	0413	19-Apr	2313	EW05	ew05	20130420035708	129				EOL EW05
20-Apr	0421	19-Apr	2321	EW03	ew03	20130420042121	131	85_Yucatan_0413	yucatan0413_40	E	SOL EW03
20-Apr	0441	19-Apr	2341	EW03	ew03	20130420042121	131				EOL EW03
20-Apr	0451	19-Apr	2351	EW01	ew01	20130420045114	133	86_Yucatan_0413	yucatan0413_41	W	SOL EW01
20-Apr	0511	20-Apr	0011	EW01	ew01	20130420045114	133				EOL EW01
20-Apr	0529	20-Apr	0029	NS24b	ns24b	20130420052902	135	87_Yucatan_0413	yucatan0413_42	N	SOL NS24b, filling in a gap in the dataset.
20-Apr	0607	20-Apr	0107	NS24b	ns24b	20130420052902	136				EOL NS24b

Date (GMT)	Time-GMT	Date Local	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magnet-ometer File	Direction	Comment
20-Apr	0617	20-Apr	0117	NS11b	ns11b	20130420061719	139	88_Yucatan_0413	yucatan0413_43	S	SOL NS11b
20-Apr	0652	20-Apr	0152	NS11b	ns11b	20130420061719	140				EOL NS11b
20-Apr	0702	20-Apr	0202	NS13b	ns13b	20130420070241	142	89_Yucatan_0413	yucatan0413_44	N	SOL NS13b
20-Apr	0735	20-Apr	0235	NS13b	ns13b	20130420070241	143				EOL NS13b
20-Apr	0746	20-Apr	0246	NS31b	ns31b	20130420074615	145	90_Yucatan_0413	yucatan0413_45	S	SOL NS31b
20-Apr	0822	20-Apr	0322	NS31b	ns31b	20130420074615	146				EOL NS31b
20-Apr	0830	20-Apr	0330	NS32	ns32	20130420083010	148	91_Yucatan_0413	yucatan0413_46	N	SOL NS32
20-Apr	0910	20-Apr	0410	NS32	ns32	20130420083010	149				EOL NS32
20-Apr	0912	20-Apr	0413	NS39	ns39	20130420091220	151	92_Yucatan_0413	yucatan0413_47	S	SOL NS39
20-Apr		20-Apr	0430	NS39	ns39	20130420091220	152				EOL NS39
20-Apr	0934	20-Apr	0434	NS33	ns33	20130420093401	153	93_Yucatan_0413	yucatan0413_48	N	SOL NS33
20-Apr	0940	20-Apr	0440	NS33	ns33	20130420093401	154				EOL NS33
20-Apr	0958	20-Apr	0458	NS40	ns40	20130420095836	155	94_Yucatan_0413	yucatan0413_49	S	SOL NS40
20-Apr	1015	20-Apr	0515	NS40	ns40	20130420095836	156				EOL NS40

Date (GMT)	Time-GMT	Date Local	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magnet-ometer File	Direction	Comment
20-Apr	1018	20-Apr	0518	NS34	ns34	20130420101820	157	95_Yucatan_0413	yucatan0413_50	N	SOL NS34
20-Apr	1037	20-Apr	0537	NS34	ns34	20130420101820	158				EOL NS34
20-Apr	1040	20-Apr	0540	NS41	ns41	20130420104059	159	96_Yucatan_0413	yucatan0413_51	S	SOL NS41
20-Apr	1049	20-Apr	0549	NS41	ns41	20130420104059	160				EOL NS41
20-Apr	1102	20-Apr	0602	NS35	ns35	20130420110229	161	97_Yucatan_0413	yucatan0413_52	N	SOL NS35
20-Apr	1121	20-Apr	0621	NS35	ns35	20130420110229	162				EOL NS35
20-Apr	1124	20-Apr	0624	NS42	ns42	20130420112446	163	98_Yucatan_0413	yucatan0413_53	S	SOL NS42
20-Apr	1141	20-Apr	0641	NS42	ns42	20130420112446	164				EOL NS42
20-Apr	1146	20-Apr	0646	NS36	ns36	20130420114601	165	99_Yucatan_0413	yucatan0413_54	N	SOL NS36
20-Apr	1205	20-Apr	0707	NS36	ns36	20130420114601	166				EOL NS36
20-Apr	1211	20-Apr	0711	NS43	ns43	20130420121100	167	100_Yucatan_0413	yucatan0413_55	S	SOL NS43
20-Apr	1230	20-Apr	0730	NS43	ns43	20130420121100	168				EOL NS43; lost maggie data for ~30 minutes
20-Apr	1233	20-Apr	0733	NS37	ns37	20130420123359	169	101_Yucatan_0413	yucatan0413_56	N	SOL NS37
20-Apr	1251	20-Apr	0751	NS37	ns37	20130420123359	170				EOL NS37

Date (GMT)	Time-GMT	Date Local	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magnet-ometer File	Direction	Comment
20-Apr	1255	20-Apr	0755	NS44	ns44	201304201255 26	171	102_Yucatan_0413	yucatan0413_57	S	SOL NS44
20-Apr	1313	20-Apr	0813	NS44	ns44	201304201255 26	172				EOL NS44
20-Apr	1324	20-Apr	0824	NS38	ns38	201304201324 11	173	103_Yucatan_0413	yucatan0413_58	N	SOL NS38; maggie file started at start of line, not start of turn
20-Apr	1341	20-Apr	0841	NS38	ns38	201304201324 11	174				EOL NS38
20-Apr	1344	20-Apr	0844	EW23	ew23	201304201344 43	175	104_Yucatan_0413	yucatan0413_59	E	SOL EW23
20-Apr	1400	20-Apr	0900								Lost heading for ~2 minutes
20-Apr	1403	20-Apr	0903	EW23	ew23	201304201344 43	176				EOL EW23
20-Apr	1412	20-Apr	0912	EW17	ew17	201304201412 54	177	105_Yucatan_0413	yucatan0413_060	W	SOL EW17
20-Apr	1430	20-Apr	0930	EW17	ew17	201304201412 54	178				EOL EW17
20-Apr	1442	20-Apr	0941	EW22	ew22	201304201441 40	179	106_Yucatan_0413	yucatan0413_061	E	SOL EW22
20-Apr	1501	20-Apr	1001	EW22	ew22	201304201441 40	180				EOL EW22
20-Apr	1511	20-Apr	1011	EW16	ew16	201304201510 52	181	107_Yucatan_0413	yucatan0413_062	W	SOL EW16
20-Apr	1528	20-Apr	1028	EW16	ew16	201304201510 52	182				EOL EW16
20-Apr	1538	20-Apr	1038	EW21	ew21	201304201538 12	183	108_Yucatan_0413	yucatan0413_063	E	SOL EW21

Date (GMT)	Time-GMT	Date Local	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magnet-ometer File	Direction	Comment
20-Apr	1550	20-Apr	1050	EW21	ew21	20130420153812	184				EOL EW21
20-Apr	1604	20-Apr	1104	EW15	ew15	20130420160443	185	109_Yucatan_0413	yucatan0413_064	W	SOL EW15
20-Apr	1622	20-Apr	1122	EW15	ew15	20130420160443	186				EOL EW15
20-Apr	1631	20-Apr	1131	EW20	ew20	20130420163147	187	110_Yucatan_0413	yucatan0413_065	E	SOL EW20
20-Apr	1648	20-Apr	1148	EW20	ew20	20130420163147	188				EOL EW20
20-Apr	1656	20-Apr	1156	EW14	ew14	20130420165659	189	111_Yucatan_0413	yucatan0413_066	W	SOL EW14
20-Apr	1715	20-Apr	1215	EW14	ew14	20130420165659	190				EOL EW14
20-Apr	1721	20-Apr	1221	EW19	ew19	20130420172135	191	112_Yucatan_0413	yucatan0413_067	E	SOL EW19
20-Apr	1740	20-Apr	1240	EW19	ew19	20130420172135	192				EOL EW19
20-Apr	1746	20-Apr	1246	EW13	ew13	20130420174619	193	113_Yucatan_0413	yucatan0413_068	W	SOL EW13
20-Apr	1804	20-Apr	1304	EW13	ew13	20130420174619	194				EOL EW13
20-Apr	1810	20-Apr	1310	EW18	ew18	20130420181029	194	114_Yucatan_0413	yucatan0413_069	E	SOL EW18
20-Apr	1828	20-Apr	1328	EW18	ew18	20130420181029					EOL EW18
20-Apr	1836	20-Apr	1336	NS45	ns45	19800106094640	194	115_Yucatan_0413	yucatan0413_070	S	SOL NS45

Date (GMT)	Time-GMT	Date Local	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magnet-ometer File	Direction	Comment
20-Apr	1845	20-Apr	1345	NS45	ns45	19800106094640		Qinsy file stopped			Problem discovered with UTIG primary Pos MV GPS (antenna 1) giving GPS feed to SSS, CHIRP, Qinsy.
20-Apr	1850	20-Apr	1350	NS45	ns45	19800106094640					Switched GPS for the SSS and CHIRP to the UTIG antenna 4 - same antenna as magnetometer. All acquisition systems now showing correct GPS. No Qinsy.
20-Apr	1905	20-Apr	1405	NS45	ns45	19800106094640					EOL NS45
20-Apr	1910	20-Apr	1410	NS46	ns46	20130420191038	195	No Quinsy.	yucatan0413_071		SOL NS46
20-Apr	1946	20-Apr	1446	NS46	ns46	20130420191038	197				EOL NS46

Side Scan Sonar, CHIRP and Multibeam Echosounder Acquisition 21 April – 22 April 2013.

Date (GMT)	Time-GMT	Date (Local)	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magneto-meter File	Direction	Comment
22-Apr	0152	21-Apr	2052	NS19b	ns19b	20130422015228	2	116_Yucatan_0413	N/A	N	SOL NS19b
22-Apr	0228	21-Apr	2128	NS19b	ns19b	20130422015228	3				EOL NS19b
							4				either 4 is turn between EOL NS19b and SOL NS22b or 6 is turn between EOL NS22b and SOL NS20b
22-Apr	0237	21-Apr	2137	NS22b	ns22b	20130422023730	5	117_Yucatan_0413	N/A	S	SOL NS22b
22-Apr	0308	21-Apr	2208	NS22b	ns22b	20130422023730	6				EOL NS22b

Date (GMT)	Time-GMT	Date (Local)	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magneto-meter File	Direction	Comment
22-Apr	0321	21-Apr	2221	NS20b	ns20b	20130422032108	7	118_Yucatan_0413	N/A	N	SOL NS20b
22-Apr	0353	21-Apr	2253	NS20b	ns20b	20130422032108	8				EOL NS20b
22-Apr	0400	21-Apr	2300	NS21b	ns21b	20130422040048	10	119_Yucatan_0413	N/A	S	SOL NS21b
22-Apr	0438	21-Apr	2338	NS21b	ns21b	20130422040048	11				EOL NS21b
22-Apr	0450	21-Apr	2350	EW02b	ew02b	20130422045053	13	120_Yucatan_0413	N/A	E	SOL EW02b
22-Apr	0506	22-Apr	0006	EW02b	ew02b	20130422045053					EOL EW02b
22-Apr	0514	22-Apr	0014	EW31	ew31	20130422051417	15	121_Yucatan_0413	N/A	W	SOL EW31
22-Apr	0532	22-Apr	0032	EW31	ew31	20130422051417					EOL EW31
22-Apr	0538	22-Apr	0038	EW24	ew24	20130422053844	17	122_Yucatan_0413	N/A	E	SOL EW24
22-Apr	0557	22-Apr	0057	EW24	ew24	20130422053844					EOL EW24
22-Apr	0604	22-Apr	0104	EW32	ew32	20130406060432	19	123_Yucatan_0413	N/A	W	SOL EW32
22-Apr	0623	22-Apr	0123	EW32	ew32	20130406060432					EOL EW32
22-Apr	0628	22-Apr	0128	EW25	ew25	20130406062852	21	124_Yucatan_0413	N/A	E	SOL EW25
22-Apr	0647	22-Apr	0147	EW25	ew25	20130406062852					EOL EW25

Date (GMT)	Time-GMT	Date (Local)	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magneto-meter File	Direction	Comment
22-Apr	0654	22-Apr	0154	EW33	ew33	20130406065418	23	125_Yucatan_0413	N/A	W	SOL EW33
22-Apr	0713	22-Apr	0213	EW33	ew33	20130406065418					EOL EW33
22-Apr	0718	22-Apr	0218	EW26	ew26	20130406071856	25	126_Yucatan_0413	N/A	E	SOL EW26
22-Apr	0736	22-Apr	0236	EW26	ew26	20130406071856					EOL EW26
22-Apr	0743	22-Apr	0243	EW04b	ew04b	20130406074319	27	127_Yucatan_0413	N/A	W	SOL EW04b
22-Apr	0801	22-Apr	0301	EW04b	ew04b	20130406074319					EOL EW04b
22-Apr	0809	22-Apr	0309	EW27	ew27	20130406080913	29	128_Yucatan_0413	N/A	E	SOL EW27
22-Apr	0826	22-Apr	0326	EW27	ew27	20130406080913					EOL EW27
22-Apr	0833	22-Apr	0333	EW34	ew34	20130406083344	31	129_Yucatan_0413	N/A	W	SOL EW34
22-Apr	0852	22-Apr	0352	EW34	ew34	20130406083344					EOL EW34
22-Apr	0858	22-Apr	0358	EW03b	ew03b	20130406085846	33	130_Yucatan_0413	N/A	E	SOL EW03b
22-Apr		22-Apr		EW03b	ew03b	20130406085846					EOL EW03b
22-Apr	0925	22-Apr	0425	EW35	ew35	20130406092549	35	131_Yucatan_0413	N/A	W	SOL EW35
22-Apr	0945	22-Apr	445	EW35	ew35	20130406092549					EOL EW35
22-Apr	0951	22-Apr	0451	EW28	ew28	20130406095140	37	132_Yucatan_0413	N/A	E	SOL EW28

Date (GMT)	Time-GMT	Date (Local)	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magneto-meter File	Direction	Comment
22-Apr	1011	22-Apr	0511	EW28	ew28	20130406095140					EOL EW28
22-Apr	1018	22-Apr	0518	EW36	ew36	20130406101821	39	133_Yucatan_0413	N/A	W	SOL EW36
22-Apr	1035	22-Apr	0535	EW36	ew36	20130406101821					EOL EW36
22-Apr	1041	22-Apr	0541	EW29	ew29	20130406104128	41	134_Yucatan_0413	N/A	E	SOL EW29
22-Apr	1059	22-Apr	0559	EW29	ew29	20130406104128					EOL EW29
22-Apr	1105	22-Apr	0605	EW37	ew37	20130406110544	43	135_Yucatan_0413	N/A	W	SOL EW37
22-Apr	1123	22-Apr	0623	EW37	ew37	20130406110544					EOL EW37
22-Apr	1129	22-Apr	0629	EW30	ew30	20130406112910	45	136_Yucatan_0413	N/A	E	SOL EW30
22-Apr	1148	22-Apr	0648	EW30	ew30	20130406112910					EOL EW30
22-Apr	1156	22-Apr	0656	EW38	ew38	20130406115633	47	137_Yucatan_0413	N/A	W	SOL EW38
22-Apr	1215	22-Apr	0715	EW38	ew38	20130406115633					EOL EW38
22-Apr	1235	22-Apr	0735	EW11b	ew11b	20130406123520	49	138_Yucatan_0413	N/A	E	SOL EW11b
22-Apr	1254	22-Apr	0754	EW11b	ew11b	20130406123520					EOL EW11b
22-Apr	1259	22-Apr	0759	EW43	ew43	20130406125959	51	139_Yucatan_0413	N/A	W	SOL EW43

Date (GMT)	Time-GMT	Date (Local)	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magneto-meter File	Direction	Comment
22-Apr	1318	22-Apr	0813	EW43	ew43	20130406125959					EOL EW43
22-Apr	1326	22-Apr	0826	EW47	ew47	20130406132643	53	140_Yucatan_0413	N/A	E	SOL EW47; forgot to change CHIRP file; will be a ew43 with a suffix appended
22-Apr	1346	22-Apr	0846	EW47	ew47	20130406132643					EOL EW47
22-Apr	1351	22-Apr	0851	EW42	ew42	20130406135158	55	141_Yucatan_0413	N/A	W	SOL EW42; Qinsy stopped and started at SOL EW42
22-Apr	1411	22-Apr	0911	EW42	ew42	20130406135158					EOL EW42
22-Apr	1417	22-Apr	0917	EW46	ew46	20130406141714	57	143_Yucatan_0413	N/A	E	SOL EW46; note that Qinsy file 142 is not start of line
22-Apr	1436	22-Apr	0936	EW46	ew46	20130406141714					EOL EW46
22-Apr	1442	22-Apr	0942	EW41	ew41	20130406144246	59	144_Yucatan_0413	N/A	W	SOL EW41
22-Apr	1501	22-Apr	1001	EW41	ew41	20130406144246					EOL EW41
22-Apr	1506	22-Apr	1006	EW45	ew45	20130406150621	60	145_Yucatan_0413	N/A	E	SOL EW45; at some point we may have forgotten to stop the multibeam files at the turn--we think 60 is the SOL EW45, but it may be 61--the following lines would change accordingly
22-Apr	1524	22-Apr	1024	EW45	ew45	20130406150621					EOL EW45
22-Apr	1530	22-Apr	1030	EW40	ew40	20130406153047	62	146_Yucatan_0413	N/A	W	SOL EW40
22-Apr	1548	22-Apr	1048	EW40	ew40	20130406153047					EOL EW40

Date (GMT)	Time-GMT	Date (Local)	Time-Local	Line	CHIRP line	Side Scan File	Multi-beam File	Qinsy File	Magneto-meter File	Direction	Comment
22-Apr	1553	22-Apr	1053	EW44	ew44	20130406155336	64	147_Yucatan_0413	N/A	E	SOL EW44
22-Apr	1612	22-Apr	1112	EW44	ew44	20130406155336					EOL EW44
22-Apr	1618	22-Apr	1118	EW39	ew39	20130406161839	66	148_Yucatan_0413	N/A	W	SOL EW39
22-Apr	1635	22-Apr	1135	EW39	ew39	20130406161839					EOL EW39
22-Apr	1642	22-Apr	1142	EW10b	ew10b	20130406164206	68	149_Yucatan_0413	N/A	E	SOL EW10b
22-Apr	1701	22-Apr	1201	EW10b	ew10b	20130406164206					EOL EW10b
22-Apr	1706	22-Apr	1206	EW9b	ew09b	20130406170651	70	150_Yucatan_0413	N/A	W	SOL EW09b
22-Apr	1723	22-Apr	1223	EW9b	ew09b	20130406170651					EOL EW09b
22-Apr	1736	22-Apr	1236	EW05b	ew05b	20130406173614	72	151_Yucatan_0413	N/A	E	SOL EW05b
22-Apr	1752	22-Apr	1252	EW05b	ew05b	20130406173614					EOL EW05b

Appendix 8 Multibeam Echosounder Images

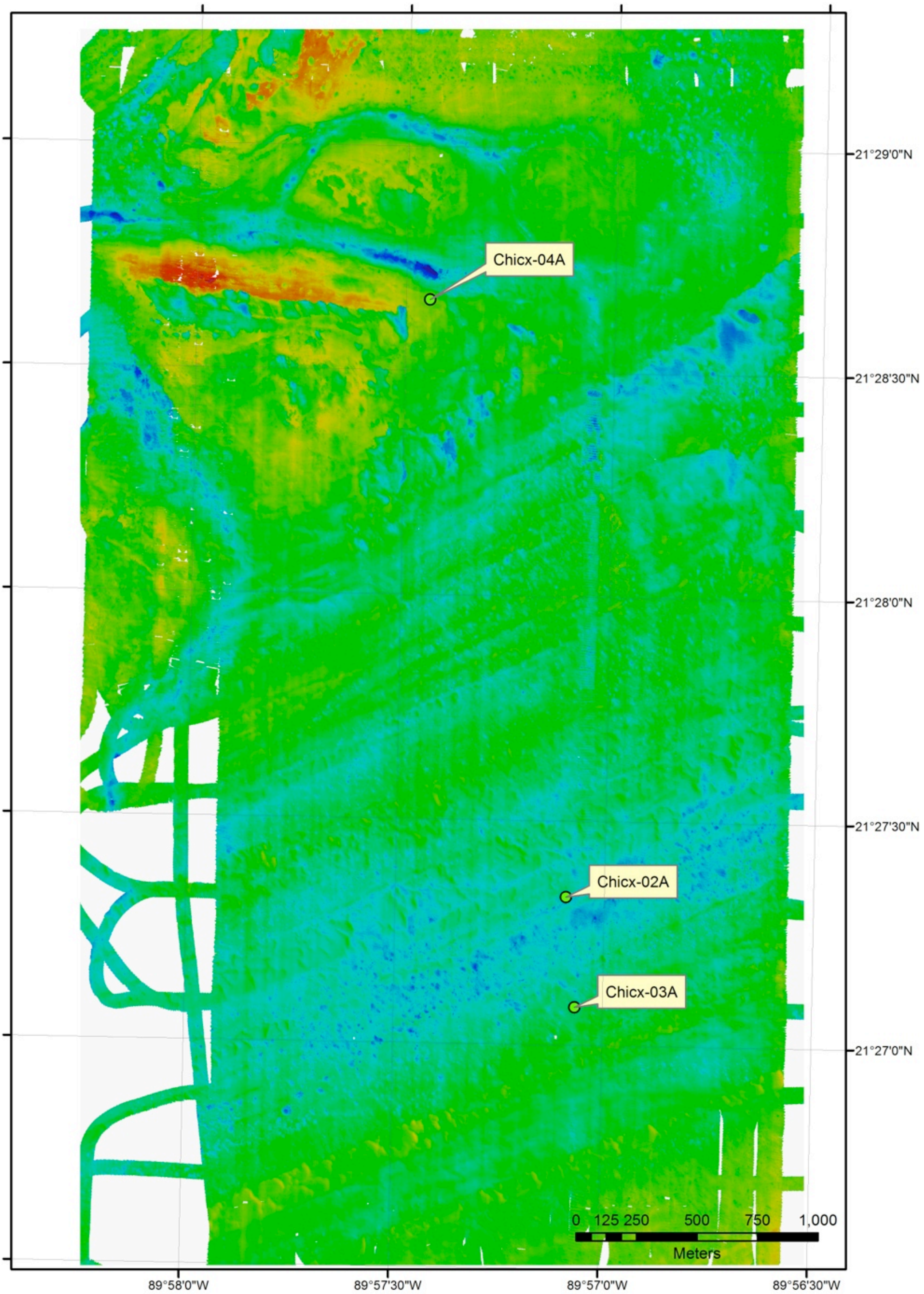


Figure 27. Overview image of partially processed multibeam bathymetry data acquired during the course of this cruise. Uncorrected water depths range from -15.78m to -19.43m. Proposed drill sites are labelled.

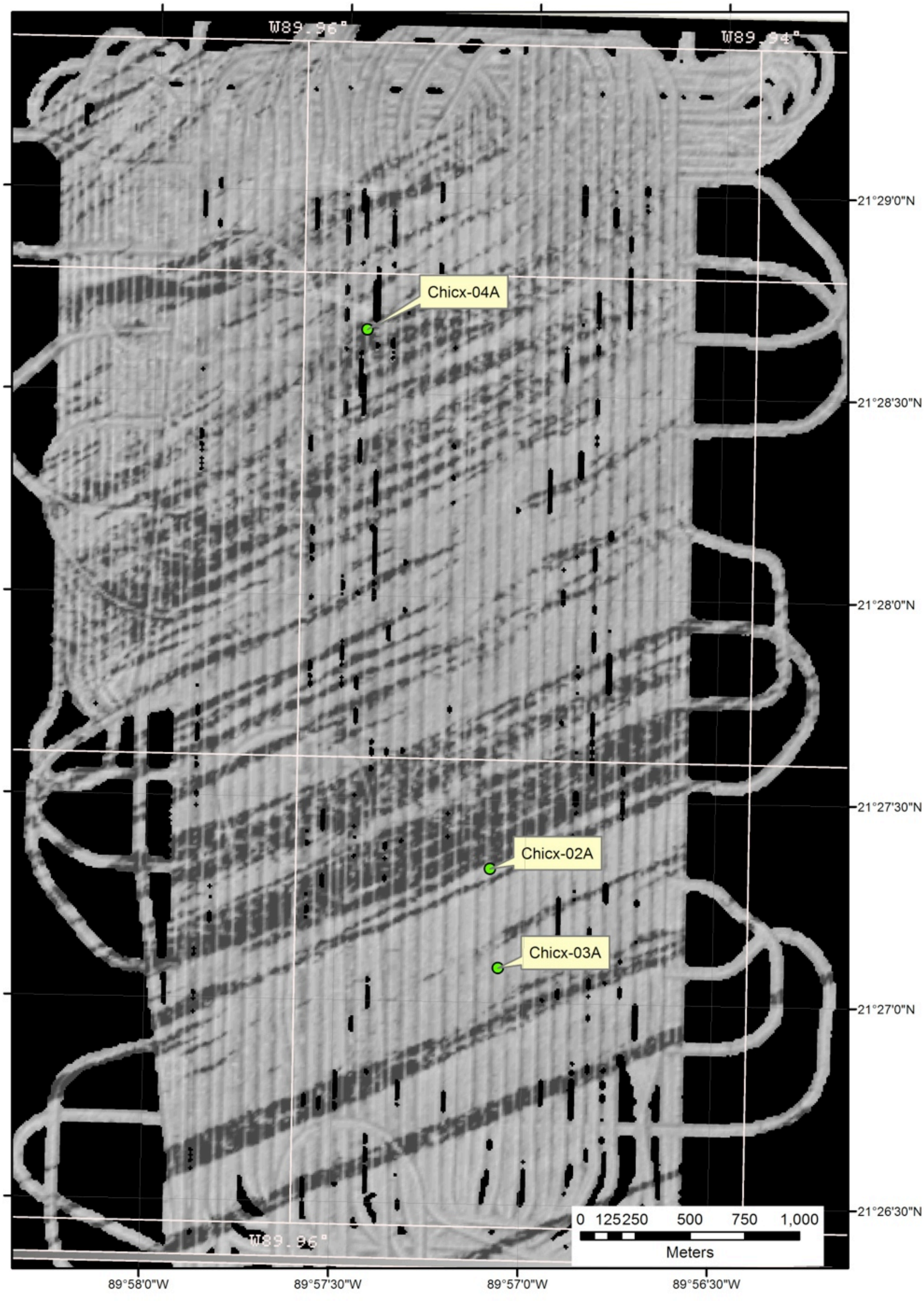


Figure 28. Georeferenced image from Kongsberg SIS of unprocessed multibeam backscatter data acquired during the course of this cruise. Proposed drill sites are labelled.

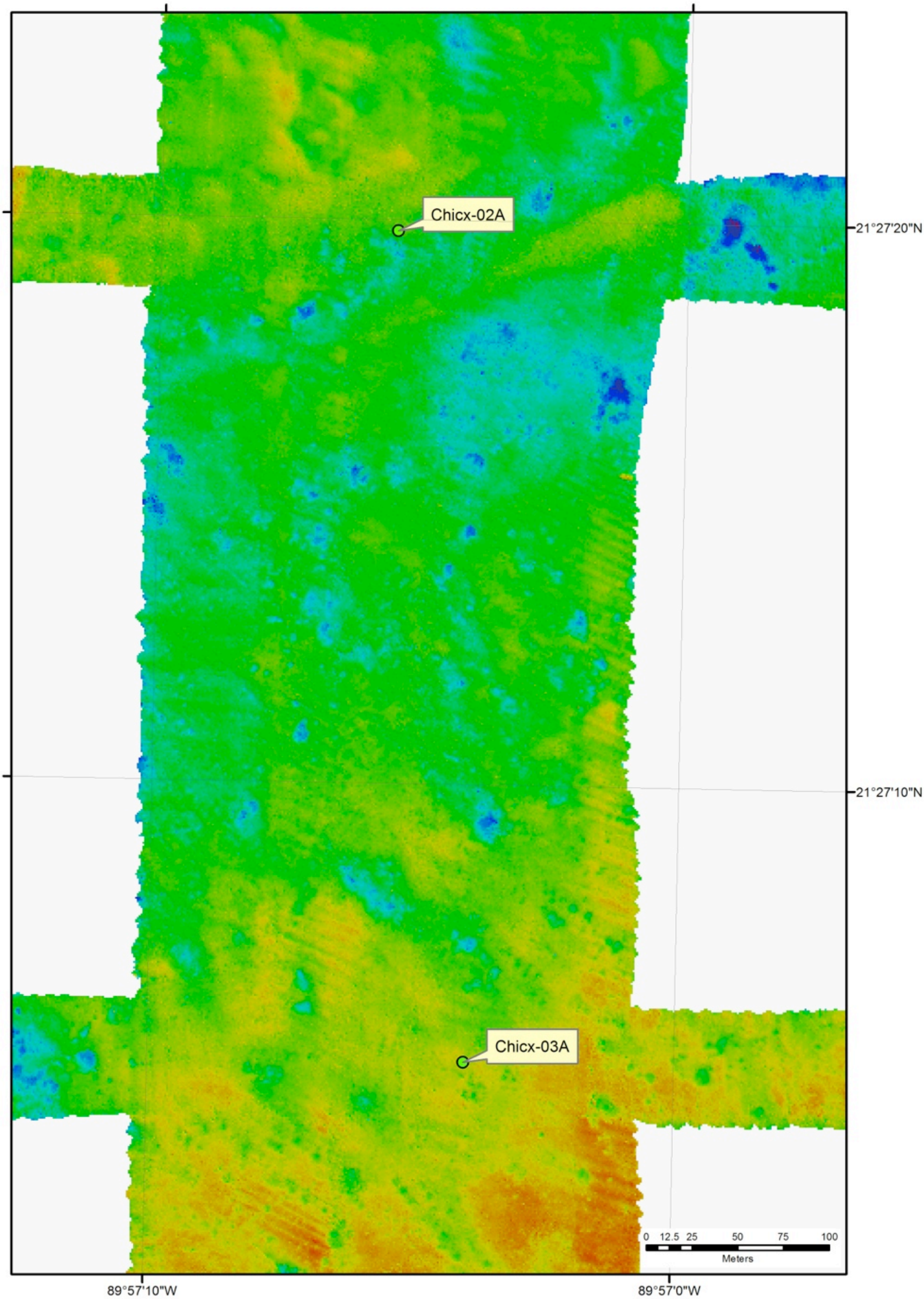


Figure 29. Close up image of partially processed multibeam bathymetry data around proposed drill sites Chicx-2A and 3A. Uncorrected water depths range from -17.36m to -18.93m.

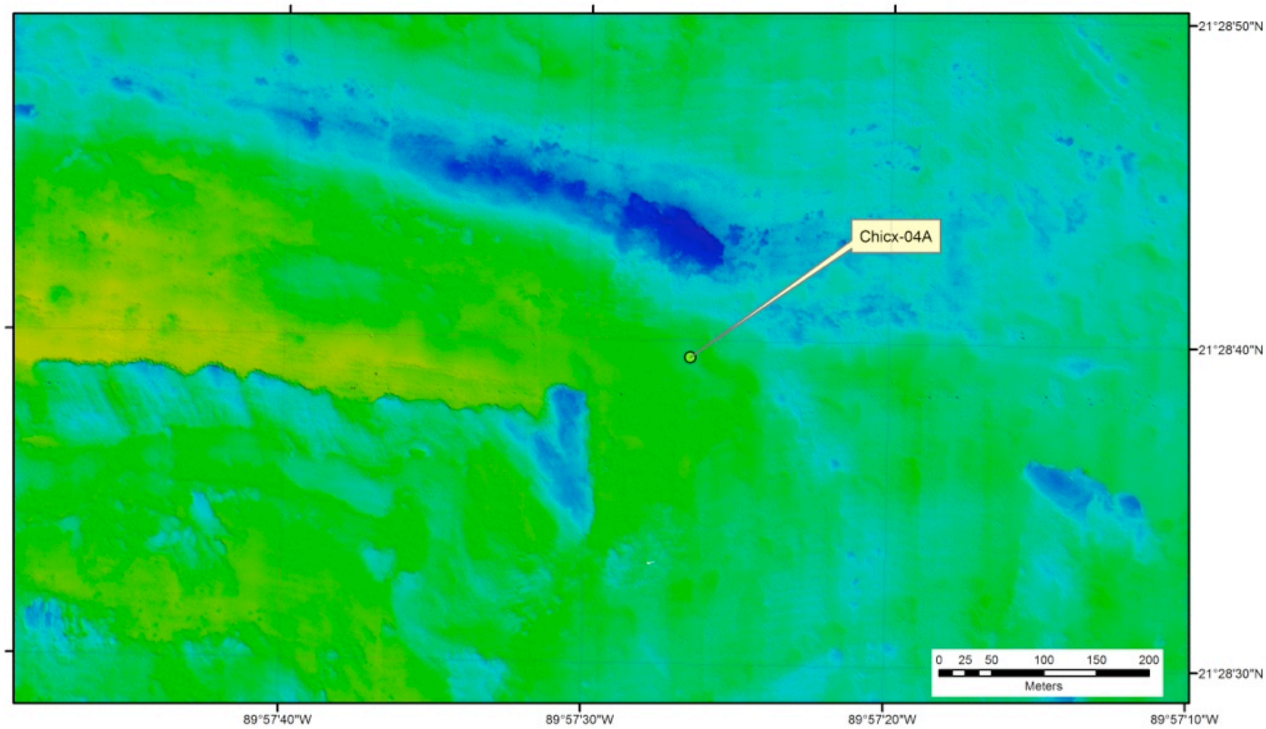


Figure 30. Close up image of partially processed multibeam bathymetry data around proposed drill site Chicx-4A. Uncorrected water depths range from -14.71m to -19.68m.

Appendix 9 Time Utilisation Diagrams

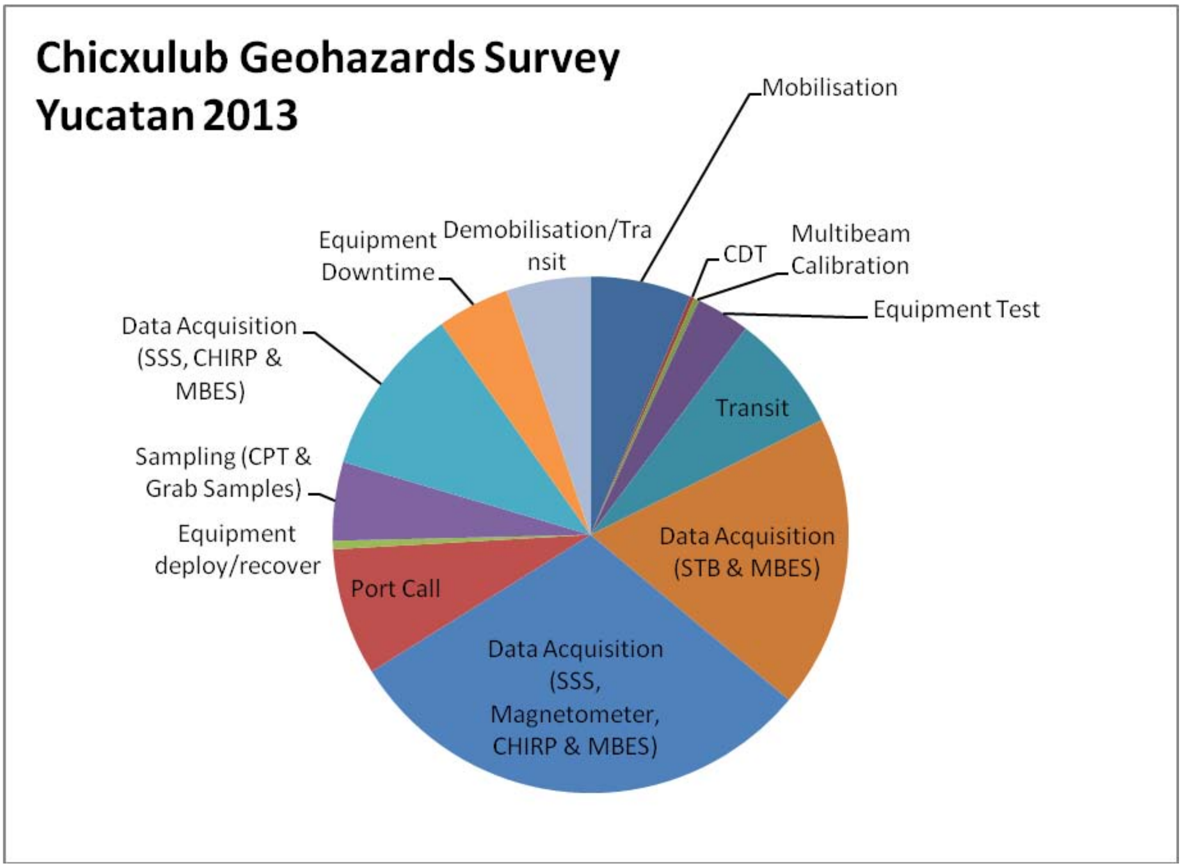


Figure 31. Pie chart showing the proportion of time spent on each activity for the Yucatan 2013 cruise.

Activity	Hours
Mobilisation	9.5
CDT	0.383333
Multibeam Calibration	0.516667
Equipment Test	5.066667
Transit	11.13333
Data Acquisition (STB & MBES)	27.63333
Data Acquisition (SSS, Magnetometer, CHIRP & MBES)	45.26667
Port Call	12
Equipment deploy/recover	0.8
Sampling (CPT & Grab Samples)	7.416667
Data Acquisition (SSS, CHIRP & MBES)	15.98333
Equipment Downtime	6.833333
Demobilisation/Transit	7.933333

Table 5. Breakdown of time per activity for the Yucatan 2013 cruise.

Appendix 10 Vessel Mobilisation Report

YUCATAN 2013 MOBILISATION REPORT

Survey Constants

Horizontal Datum

WGS84

Vertical Datum

Mean lower low (MLLW) is set as 0 m, Tide gauge at Telchac run by UNAM used for corrections post-cruise, details on the vertical datum used will be supplied at a later time.

Units

All units recorded will be metric.

Survey Area

The hazard assessment survey will survey the area surrounding the following targeted drill sites:

Site Name	Latitude	Longitude	Water Depth (m)
Chicx-04A	21 28.6578	89 57.4404	17 m
Chicx-03A	21 27.0846	89 57.0648	17 m
Chicx-02A	21 27.33	89 57.09	17 m

These locations are shown in Figure 32, along with the required 1.5-km survey regions centered on the drill sites. The regions are sufficiently proximal that we have elected to combine them into one single survey ~2.2 km E-W by ~4.6 km N-S, which will greatly increase efficiency owing to longer lines and fewer turns. Geophysical surveying will be conducted in two phases: (1) boomer seismic, and (2) sidescan (410 kHz)/CHIRP/magnetometer. Hull-mounted 300 kHz multibeam (bathymetry and sidescan) will be collected concurrently during both phases. The boomer track lines are shown in Figure 33. The 31 north-south lines are spaced ~72 m apart. Two of these lines pass through Chicx-03A and Chicx 04A. A 32nd N-S line is planned to pass through Chicx-02A, which otherwise falls between the track lines. We also plan for 12 east-west cross lines, which pass through the three locations and are otherwise spaced ~400 m apart, per the specifications of the request for proposal. Because the hull-mounted multibeam on the *R/V Justo Sierra* is a single head system, limited to a 128 degree swath, the 72-m track spacing will not be sufficient to obtain 100% multibeam coverage. The N-S lines during second phase of the survey will therefore be run in-between the boomer lines, which will provide a >50% overlap with the multibeam, and also allow the planned drill sites to be illuminated adequately by the sidescan, rather than be in the nadir region. Sidescan data coverage will be collected out to 100 m slant range both port and starboard, or roughly 90 m cross range, providing >200% sidescan coverage and the ability to produce 100% coverage maps both for east-looking and west-looking illumination. Initial at-sea tests confirm excellent data quality to 100 m slant range.

Our cruise plan calls for 7 days of survey time. Geophysical surveying will be conducted first; we have budgeted for 3 days of survey and 1 day of weather/contingency. Once the geophysical survey is completed, we will return to Progreso to load personnel and gear for the CPT measurements. A half day is budgeted for the short transit and turn-around. 2 days are budgeted for the CPT work, with one half day for weather/contingency.

At the conclusion of the CPT work, we will utilize any remaining time to survey along longer transects within the larger region of interest (Figure 32) before returning to Progreso. These lower-priority data will be used to help establish greater geologic context for the survey site.

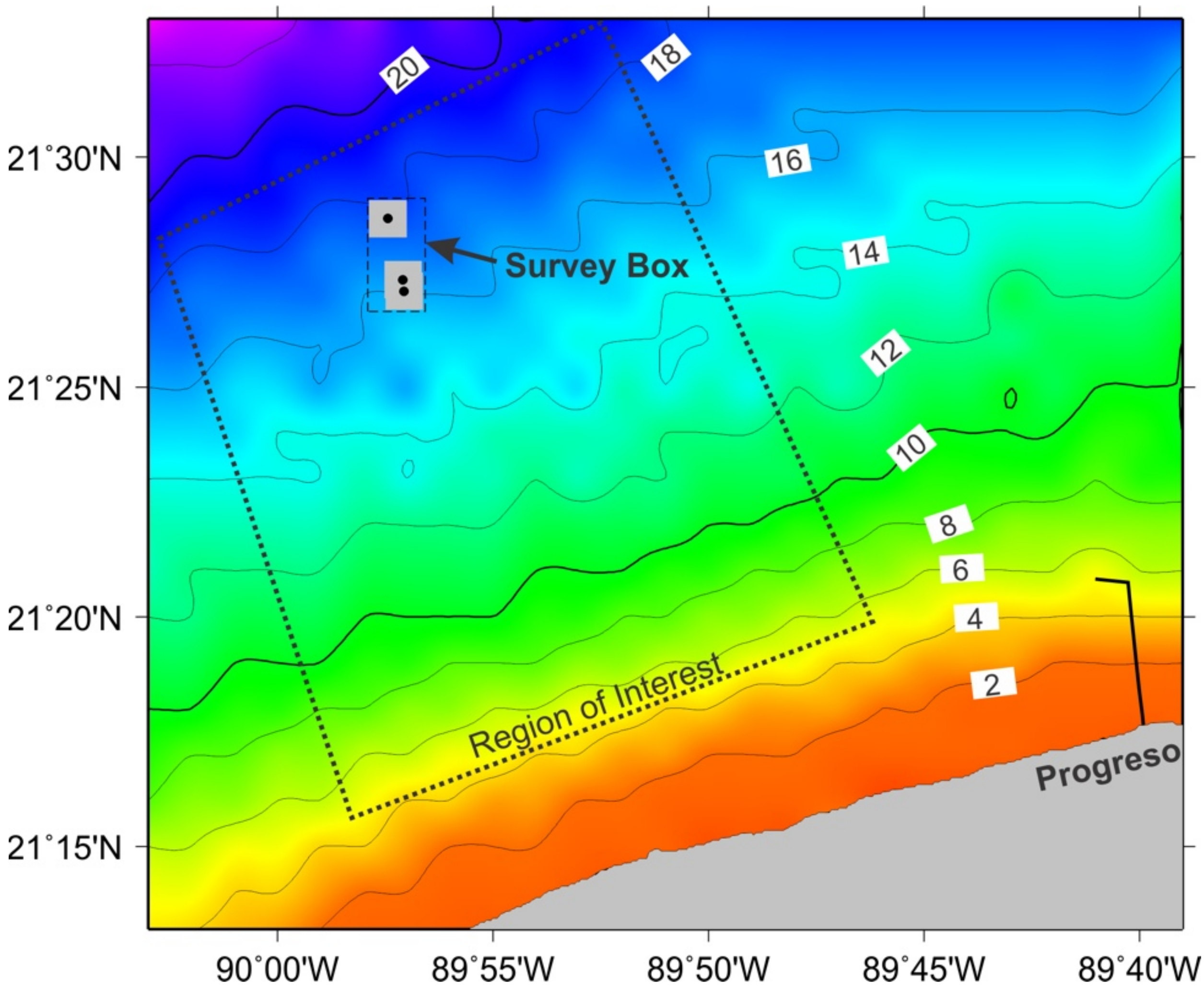


Figure 32. Location of targeted drill sites (black dots) with 1.5-km square required survey regions about each location (gray). Our plan will be to fully survey a single region which encompasses these regions (dashed box). Time permitting, we will also survey along transects within the larger region of interest indicated by dotted box, in order to provide regional geologic context to the hazard survey. The dock at Progreso, Mexico, is indicated by heavy line in the lower right of the image; it is ~20 nm from the survey box. Depth contours, from ETOPO5, are in meters.

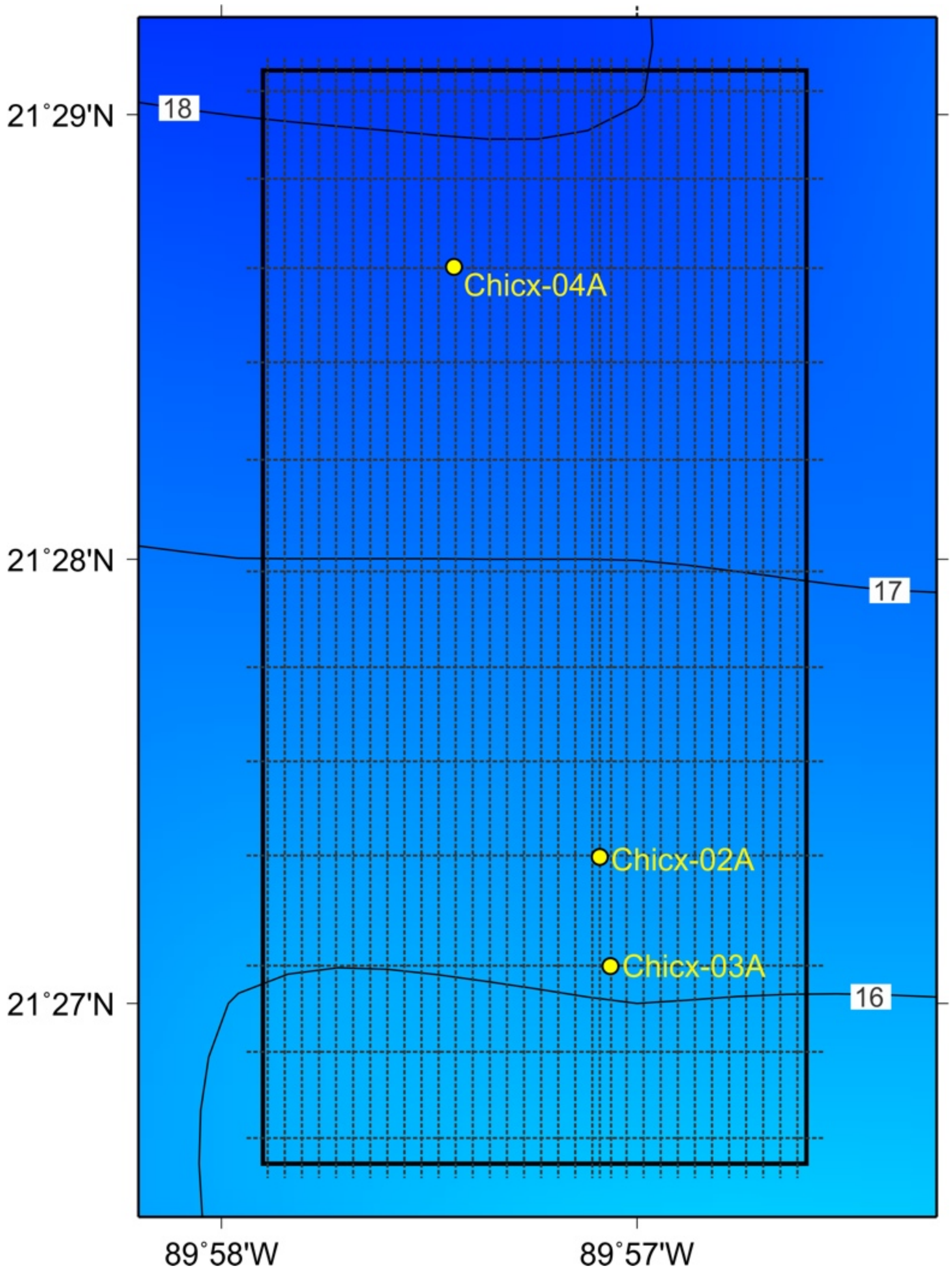


Figure 33. Detailed survey plan: box indicates targeted survey area, and dashed lines are planned track lines. Depth contours, from ETOPO5, are in meters.

Vessel Offsets

A copy of the most recent vessel survey report will be supplied. Information on the convention for offsets should also be supplied e.g.:

- Y is the across ship dimension with a negative distance to port of the CRP and positive to starboard.
- X is the fore and aft dimension with negative distance aft of the CRP and positive is forward.
- Z is the vertical dimension with positive distances below the CRP and negative above (up).

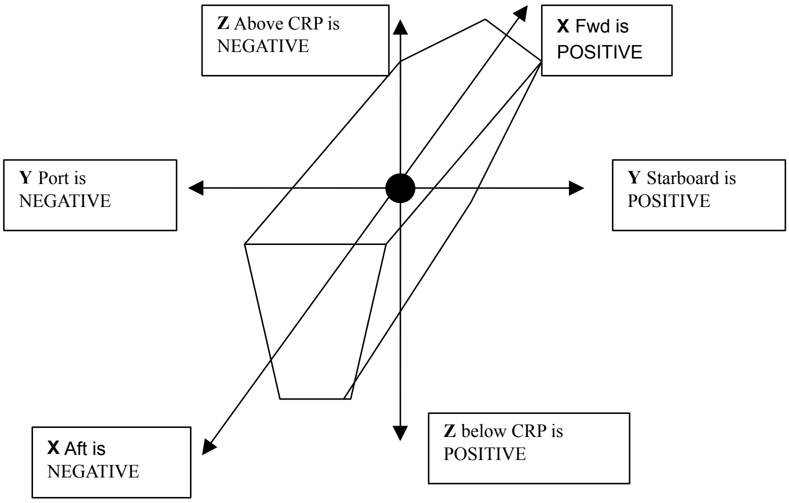


Figure 34. Vessel offset convention.

For this Yucatan2013 Survey we had two redundant POS/MV-IMU deployments and a base station set up in Progreso, Mexico to do post-processing navigation corrections. The multibeam bathymetry EM3002 system used the *R/V Justo Sierra's* POS/MV and IMU for which the measurements are provided below; these data are corrected in real time using secondary DGPS. The boomer, CHIRP, sidescan, and magnetometer data are fed GPS coordinates from UTIG's POS/MV-IMU which are also provided below. Post-cruise the UTIG navigation will be corrected with the Progreso GPS base station data using a carrier phase based geometric correction.

UNAM IMU Position: X = 35.016, Y = 0.000, Z = -2.899

UNAM GPS Antenna 1: X = 33.539, Y = 0.065, Z = -24.821

UNAM GPS Antenna 2: X = 36.055, Y = -0.053, Z = -24.802

UNAM MB Head: X = 31.955, Y = -1.014, Z = -0.061

UTIG IMU Position: X = 21.35, Y = -0.95, Z = -7.323

UTIG GPS Antenna 1: X = 20.278, Y = -1.92, Z = -10.081 (Primary to POS/MV)

UTIG GPS Antenna 2: X = 20.19, Y = 2.095, Z = -10.083 (Secondary to POS/MV)

UTIG GPS Antenna 3: X = 12.24, Y = -2.56, Z = -14.013 (For base station reference)

UTIG GPS Antenna 4: X = 21.228, Y = -3.39, Z = -9.703 (For magnetometer)

Maggie Towpoint X = 0, Y = +2.54, Z = -8.313

SS/CHIRP Towpoint X = 0, Y = -1.92, Z = -8.313

Boomer midpoints along center line of ship 18 m from stern

Mobilisation

Mobilisation Summary of Tests

System	Harbour Tests	Sea Tests
Kongsberg EM3002 Multibeam	X	X
Edgetech DSS2000 Side scan Sonar & CHIRP	X	X
Applied Acoustics Surface-Towed Boomer	All but firing	X
Marine Magnetics Explorer Magnetometer	N/A	X
Vessel positioning/ navigation suite	X	X
UTIG positioning/ navigation suite	X	X
CPT equipment (SGL)	X	X
CTD for SVP	X	X
All recording systems (and processing systems if any processing being done offshore) e.g. CODA, CARIS, Fledermaus	X	X
Data Backup	X	X

Multibeam Echosounder (MBES)

In Harbour Tests

The following tests and checks were carried out to confirm the correct operation of the systems in port and at sea when underway.

- Built in system test.
- The correct draft settings are applied.
- The correct offsets are applied.
- The system is receiving the correct heave and navigation inputs.
- That the system is logging correctly.
- That the correct data backup procedures are in place and operating correctly.

Equipment	Type	check
Transceiver Unit	Kongsberg EM3002	X
Operator Station	Kongsberg EM3002	X
Attitude Sensor	Kongsberg EM3002	X
Navigation System	Kongsberg SEAPATH 200	X
CTD	SBE 9PLUS	X
Software version	SIS	X

Transducer Draft Settings		
Draft Calibration	Pre Survey	check
Draft at the transducer	-4.80	X
Value entered into the system	-4.80	X

Offshore and draft tests

<u>At Sea Tests</u>

Calibration Settings	
Time delay	Seconds (with 1PPS timestamping this should be zero)
Pitch test	Not possible due to flat shelf
Roll test	X
Yaw test	Not possible due to flat shelf

Sound Velocity Equipment

<u>In Harbour Tests</u>

For this cruise, sound velocity profiles were acquired using a CTD. The CTD was checked out in the harbour to ensure it was communicating with the acquisition computer.

<u>At Sea Tests</u>

None required.

Seatex Seapath 200 System

The Seapath 200 provides highly accurate, real-time heading, attitude and position information by blending the best characteristics of sensor-based inertial navigation and GPS continuous position update technologies. High-rate motion data obtained from the system's IMU (Inertial Measurements Unit) and precise position data from two, fixed baseline GPS carrier-phase receivers are integrated in a Kalman Filter within the Seapath Processing Unit. Based on analysis and extensive field testing, the Kalman Filter algorithms have been refined to insure maximum measurement fidelity and reliability.

The Seapath 200 IMU contains highly accurate linear accelerometers and Bosch Coriolis force angular rate gyros (CFG). Real-world precision accuracy is guarantee by utilising the most accurate calibration methods and sophisticated production equipment available. Roll and pitch accuracy together with the linear acceleration performance are documented for each delivered IMU on a Calibration

The two, fixed baseline GPS antennas and their receivers that determine precise heading are also used as redundant GPS position and velocity sources. In case of missing data from one GPS receiver, then the other (remaining) receiver provides position and velocity. The Seapath 200 is robust against GPS dropouts by using the IMU to provide position, velocity and heading measurements when GPS is not available.

On board the *R/V Justo Sierra*, the Seapath 200 system employs EGNOS/WAAS (SBAS) correction signals to improve position accuracy, without loss of resolution compared to differential GPS (not available at the survey location). Consistency checking within measurements from the different sensors is performed internally to ensure reliability. Noisy data are automatically rejected or reported as inaccurate.

The Seapath provides accurate roll and pitch under all conditions by tightly integrating the GPS and IMU data. With this feature, horizontal accelerations are observable, making the run-ins needed to stabilise conventional vertical reference systems unnecessary.

Heading accuracy	0.05° RMS (4 m baseline)
	0.075° RMS (2.5 m baseline)
Roll and pitch accuracy	0.02° RMS for ±5° amplitude
Scale factor error in roll, pitch and heading	0.15% RMS
Heave accuracy	5 cm or 5% whichever is highest
Heave motion periods	1 to 25 seconds
Position accuracy with SBAS	0.7 m RMS or 1.5 m (95% CEP)
Position accuracy with DGPS	0.7 m RMS or 1.5 m (95% CEP)
Velocity accuracy	0.03 m/s RMS or 0.07 m/s (95% CEP) with DGPS

In Harbour Tests

Confirm the system setup. Check all offsets and data outputs.

At Sea Tests

Monitor system results application to MBES data.

Navigation Software

In Harbour Tests

Equipment	Type
Seapath 200	SBAS GPS positioning system
Applanix POS/MV	GPS and Orientation system

Operational and Consumables checks	

System Checks	X
Network connections to all client systems	X

Seapath 200 system is described above. A GPS base station set up in Progreso to correct UTIG's Applanix system post-cruise since differential GPS not available in this region.

At Sea Tests

See above for corrections for UNAM system. For UTIG system the navigation data will be post-processed.

Edgetech DSS2000 Sidescan Sonar and CHIRP Sonar

In Harbour Tests

For sidescan, rub test of port and starboard channels were conducted to ensure channels are not transposed for high and low frequency. For CHIRP and sidescan, the sound source was fired on deck at 10% to confirm operation of the equipment and that data and GPS readings were being received by the system and recorded the data files.

At Sea Tests

Deploy sidescan sonar and CHIRP and checked data quality.

Data Acquisition and Processing Systems

All recording systems were tested and GPS positions coming into each system. Problems occurred getting a single navigation feed to be read on both CHIRP and SSS. Solution was to add a splitter to provide navigation separately to each system from the UTIG POS/MV. Problems also occurred routing the magnetometer data through the CHIRP/SSS unit. To work around this a separate Maggie cable was run and data were recorded on a separate laptop. GPS to the magnetometer software required raw NMEA string, not calibrated, and therefore had to run a separate GPS antenna to this laptop.

Layback for the CHIRP/SSS were computed based on distance from GPS antenna to stern, cable out and fish depth. This was computed to be 39 m. Layback to the magnetometer was computed to be 61 m (41 m behind stern of ship).

Equipment	**Type**
CHIRP/SSS acquisition system	Edgetech 2000
CHIRP and Boomer processing system	Paradigm FOCUS on CentOS latop
Boomer acquisition system	Coda
Multibeam and SS processing system	CARIS HIPS and SIPS

Applied Acoustics Surface-Towed Boomer

In Harbour Tests

Surface tow boomer streamer and source hooked up and tap tested. Boomer catamaran assembled.

At Sea Tests

System tested at 100J and 200J for best imaging. Shelf proved to be largely hard rock at sea bed and so only minimal penetration occurred, although we did often see a consistent reflector ~0-3 m below the seafloor. Initially we thought this might be a sediment/basement contact, but this turned out not to be the case after viewing sidescan and CHIRP data.

Layback for boomer was computed to be 38 m behind GPS antenna (18 m behind stern).

Marine Magnetics Explorer Mini-Magnetometer

At Sea Tests

In order to calibrate for the effect of the ship we drove one profile twice in opposite directions and will compute an average to correct the magnetometer total field data. To create an anomaly map we will subtract the Total Field background value. The table below from the US National Geophysical Data Center (NOAA) shows the estimated Total Field for these dates and this location based on IGRF2011.

Latitude	21° N						
Longitude	89° W						
Elevation	0.0 K						
Date	**Declination (+ E | - W)**	**Inclination (+ D | - U)**	**Horizontal Intensity**	**North Comp (+ N | - S)**	**East Comp (+ E | - W)**	**Vertical Comp (+ D | - U)**	**Total Field**
2013-04-18	-0.03°	50.45°	26,699.6 nT	26,699.6 nT	-12.6 nT	32,329.0 nT	41,929.0 nT
Change/ year	-0.13°	-0.07°	-34.4 nT	-34.5 nT	-61.5 nT	-121.5 nT	-115.5 nT

Seafloor Geotech CPT

In Harbour Tests

A load test was performed on the CPT using the *R/V Justo Sierra*'s "geologic winch" with its Kevlar line. The CPT also normally uses 240 V, 50 amp, single phase power, however the *R/V Justo Sierra* provides 220V, 50 amp, single phase power. A voltage / load test was done on the system with this power and only observed a draw of ~4 amps at the motor so contractors are fine with proceeding with this power arrangement.

FACILITY SERVICES

SURVEY REPORT

For the Installation of the

Sonar Systems

On Board

R/V JUSTO SIERRA

Mike Lanigan , PTech
Fernand Richard

Project #44135003
Feb. 2007

FLEETWAY

FACILITY SERVICES

Saint John New Brunswick

Canada

(506) 648-2226

R/V Justo Sierra
Survey Report

Fleetway Facility Services Survey Group was tasked with providing survey services on board the R/V Justo Sierra by the Kongsberg project team. This included surveys for the installation of the Kongsberg supplied sonar systems components including gondola, transducer mounting structure, MRU and establishing reference points for other related equipment.

The ship rests in on keel blocks in a floating dock at the Mexico Naval Shipyard #1 facility in Tampico, Tamaulipas, Mexico.

Scope of Survey Tasks:

1. **Establish ships reference planes and a Cartesian coordinate system.**
2. **Alignment and location of the support framework for the transducers.**
3. **Hull penetrations and existing draught marks**
4. **Mast GPS antenna foundation coordinates and alignment conditions.**
5. **MRU (motion sensor) location and alignment conditions.**
6. **Towed array and shelter deck reference points.**

1. Ships reference planes and coordinate system.

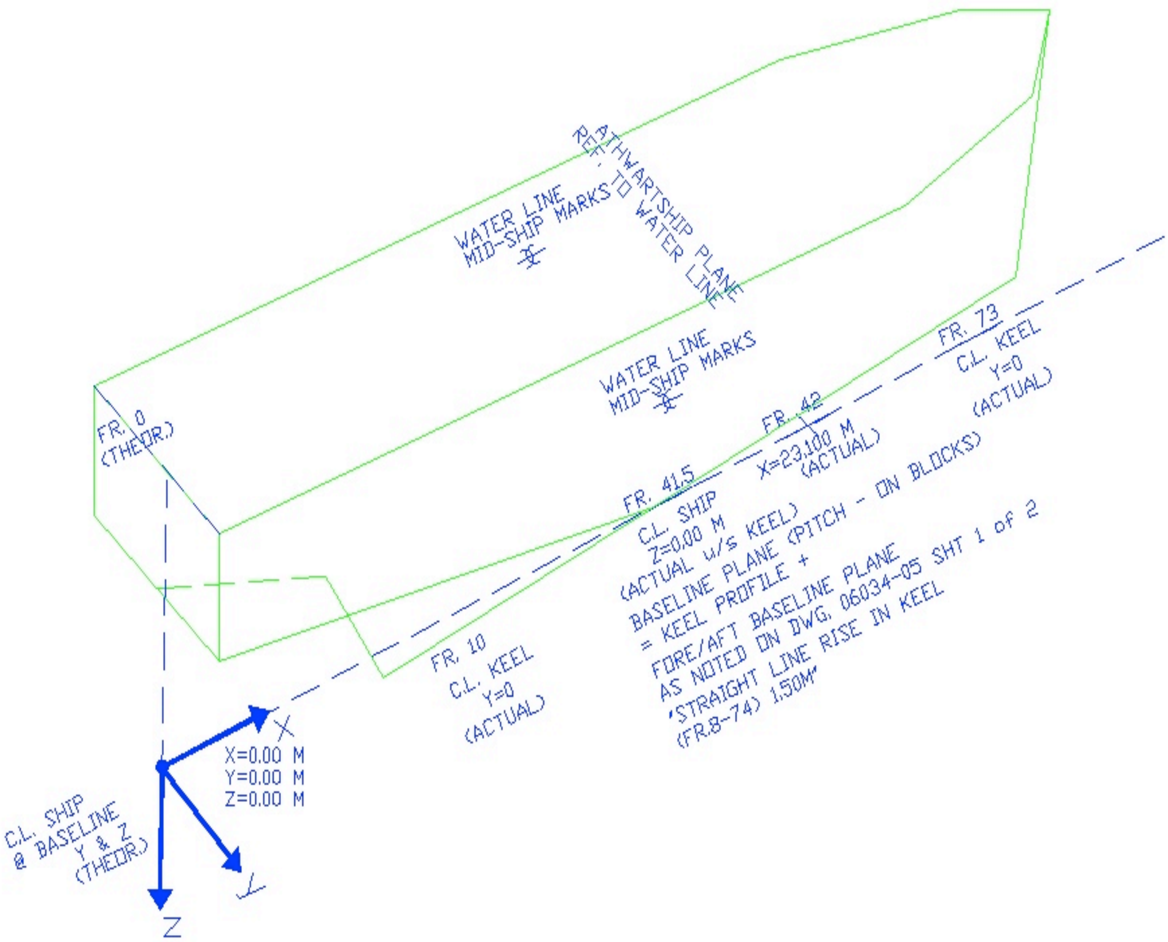
The ships for/aft (pitch) reference plane was established from a keel profile recorded at intervals of 10 frames (6500 mm) where accessible and the design keel rake (ref. dwg. 06034-05).

The athwart ship plane (roll) was established from the water line marks at mid-ship frame #41.5

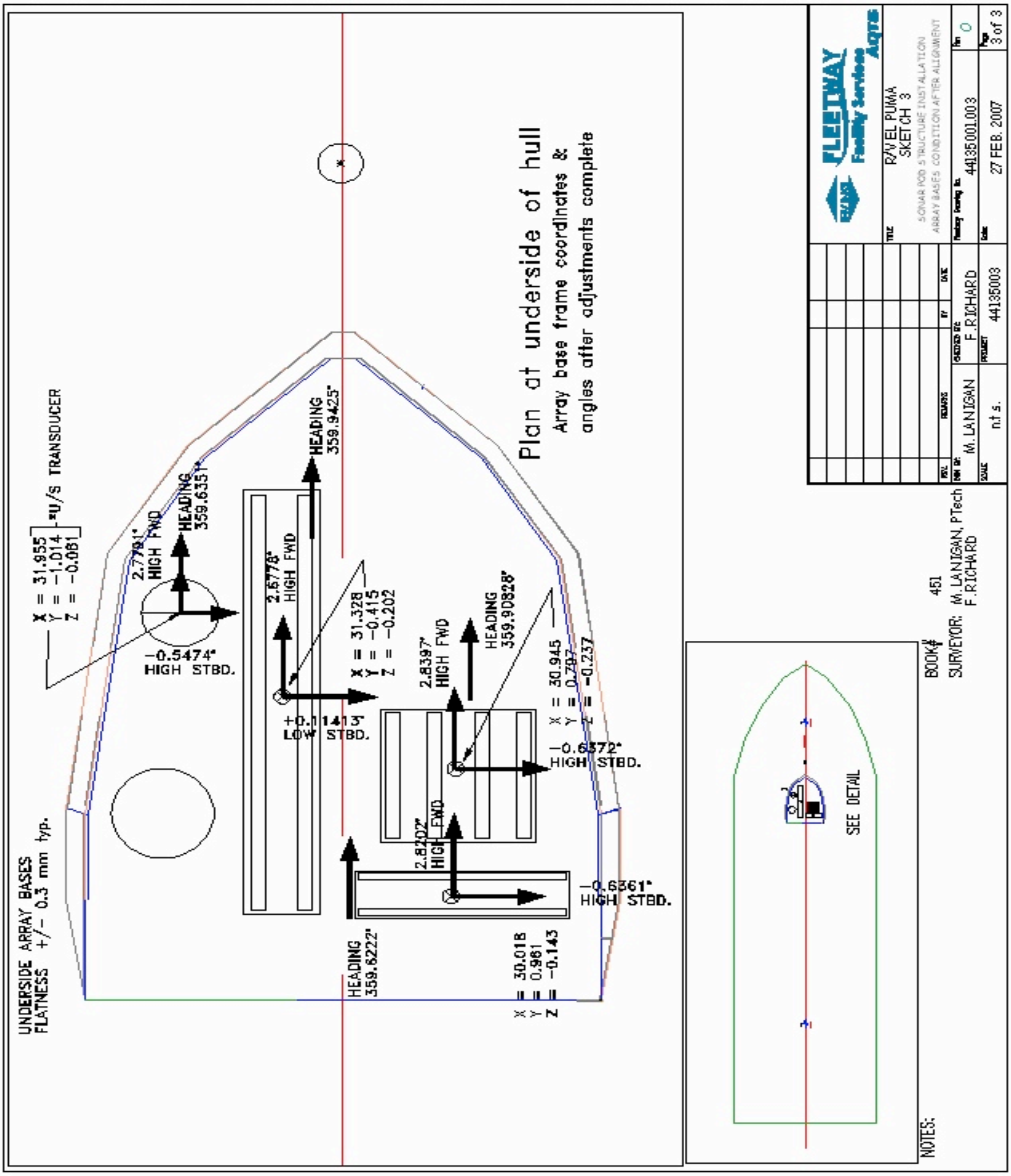
The ship's centerline (y coordinate value, with the centerline of keel as the origin and the positive values going to starboard) was established from the keel at frames #10 and #50.

The ship's fore/aft location (x coordinate value, with frame 0 as the origin and the positive values going forward) was established from frame #42.

The ship's elevation or baseline (z coordinated value, with the under side of the keel as origin at frame 41.5 and the positive values going downward) was established with consideration of the keel rake as noted on drawing 06034-05 sht.1.



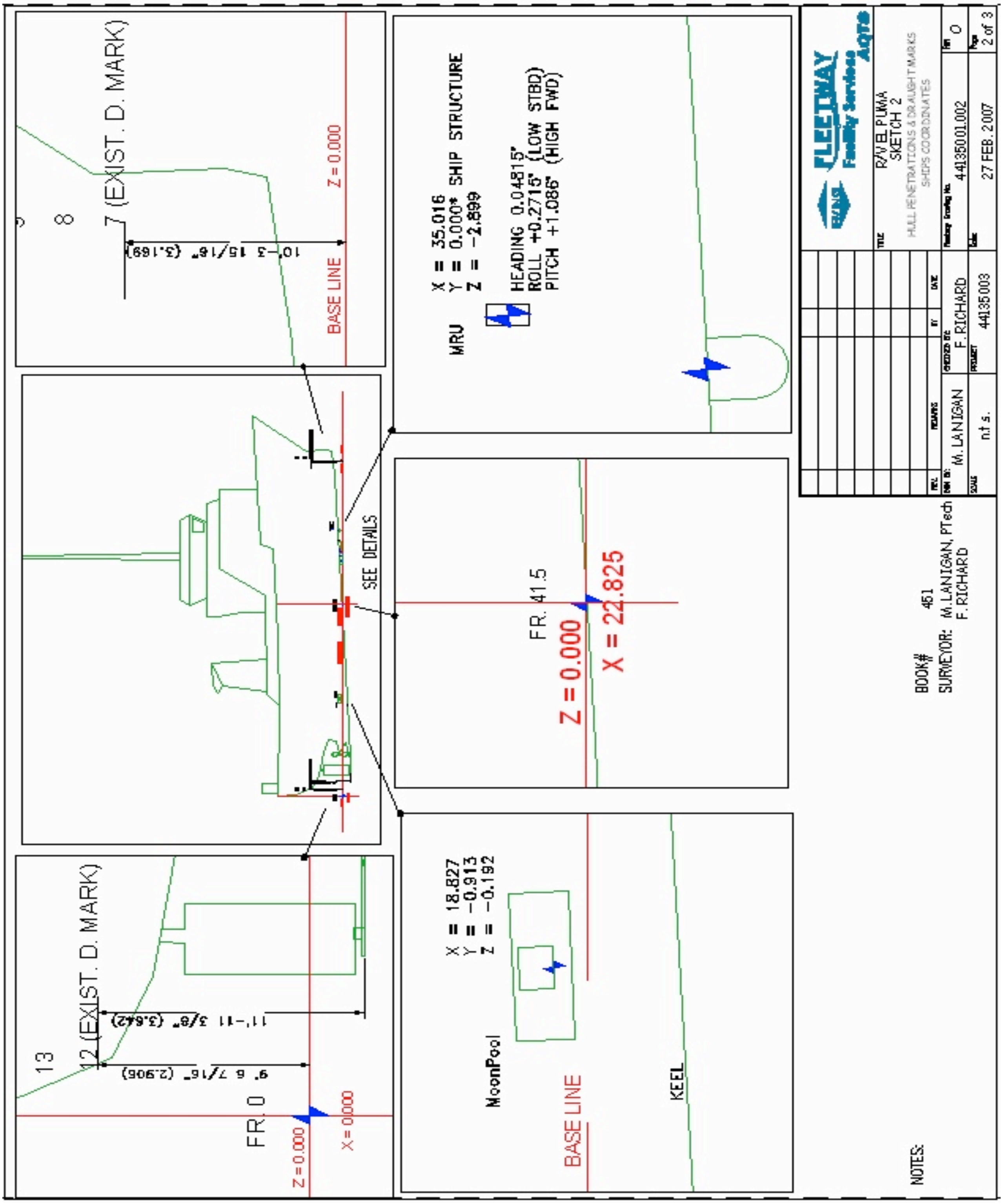
2. Sonar Gondola alignment after attachment to the ship's hull.



Sketch 3

Transducer support frames and sonar

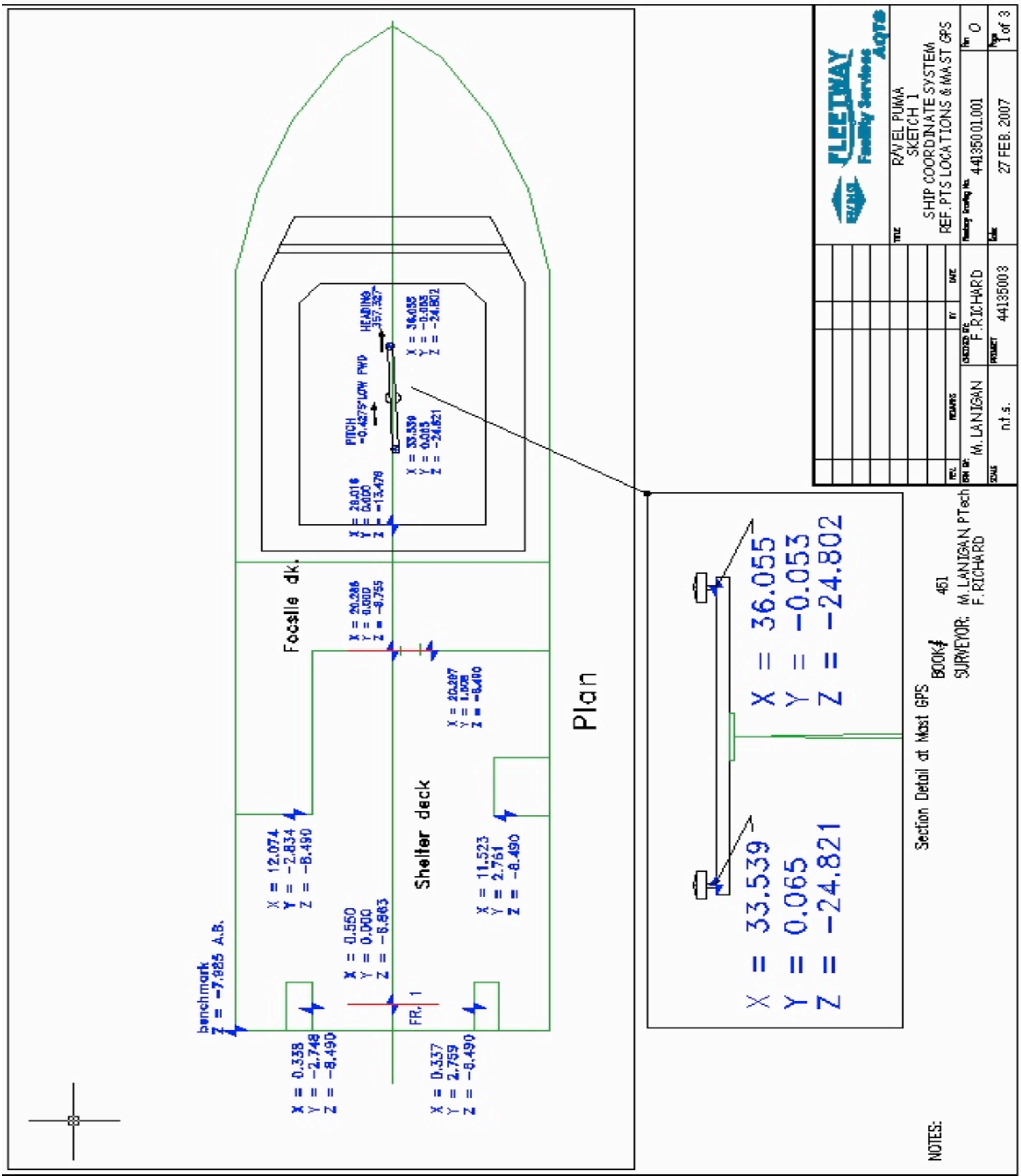
3. Alignment and location existing hull penetrations, MRU, and draught marks.



Sketch 2

Hull penetrations and draught marks

4.Towed array reference points and mast antenna data..



Sketch 1

Reference points and mast antenna

5.Shelter deck reference points

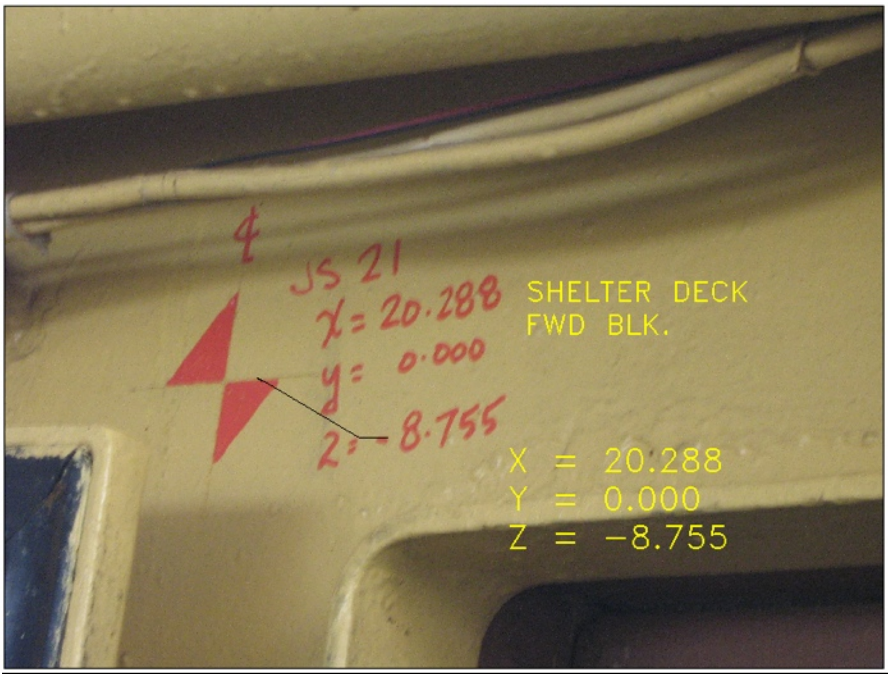


Photo 5 (a)

Looking forward at bulkhead at entrance door.

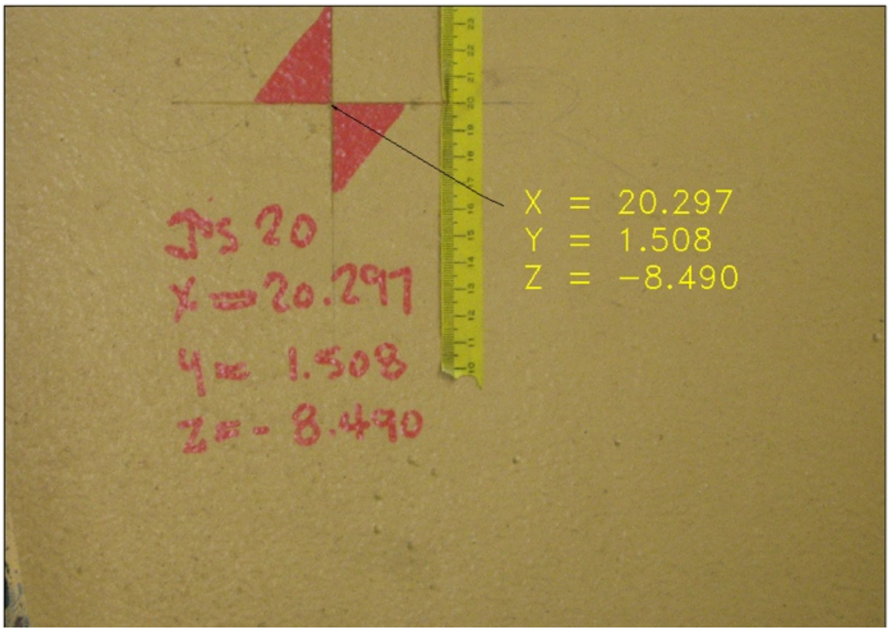


Photo 5 (b)

Bulkhead at stairway

Shelter deck reference points (cont).

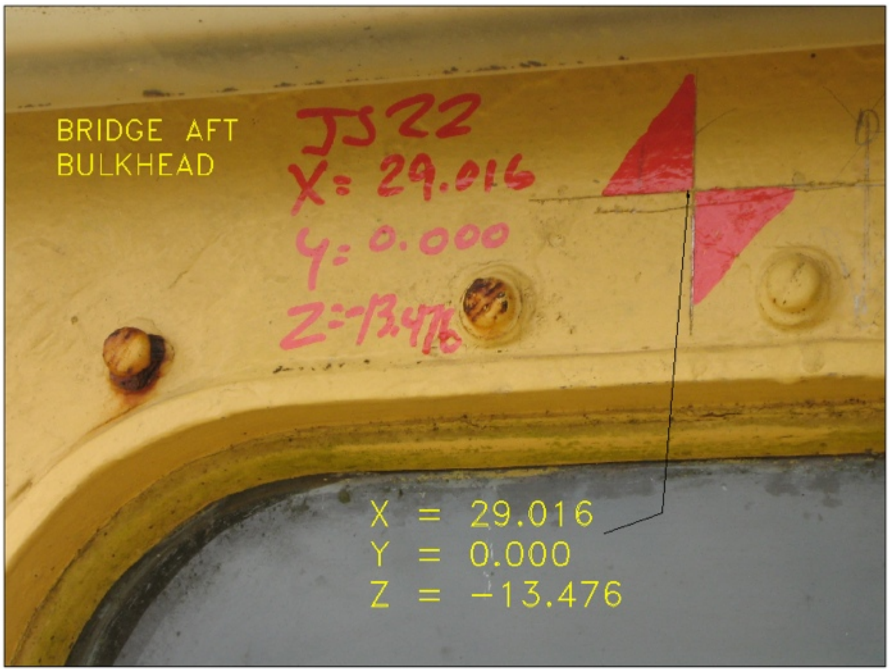


Photo 5 (c)

Bridge aft bulkhead over window.

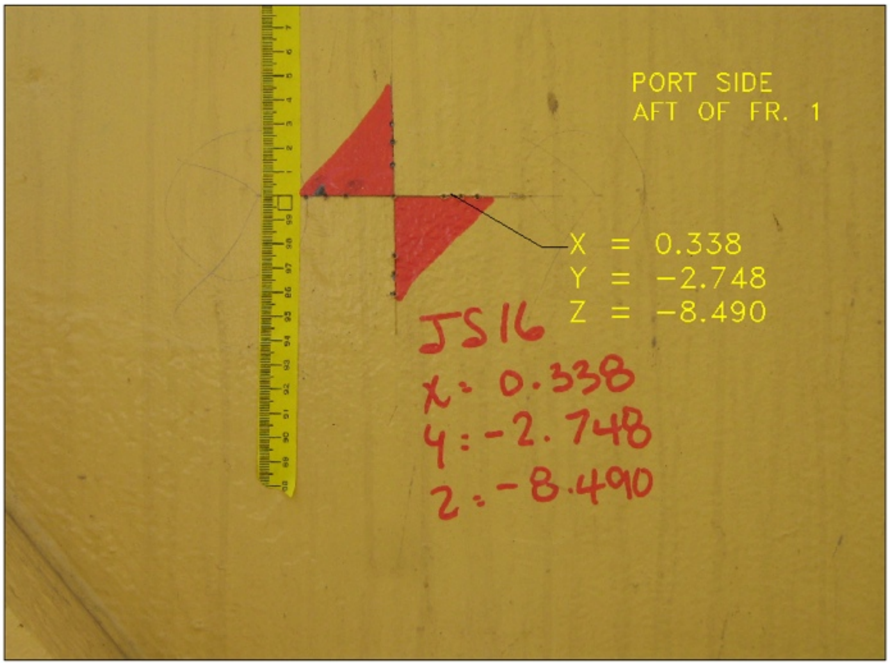


Photo 5(d)

Port side support aft of frame 1.

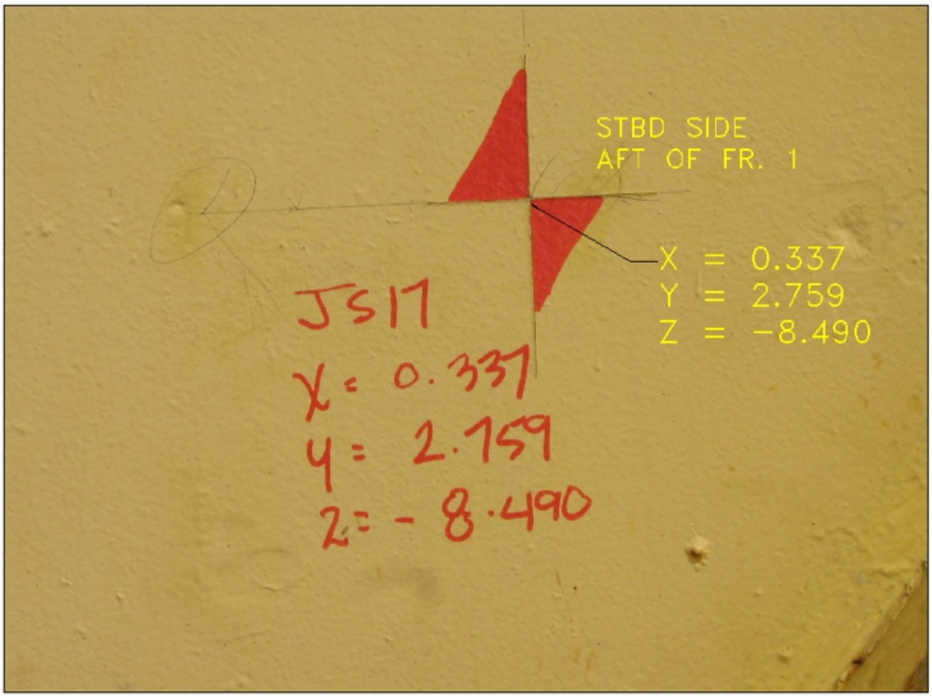


Photo 5(e)

Stbd. Support aft of frame 1.

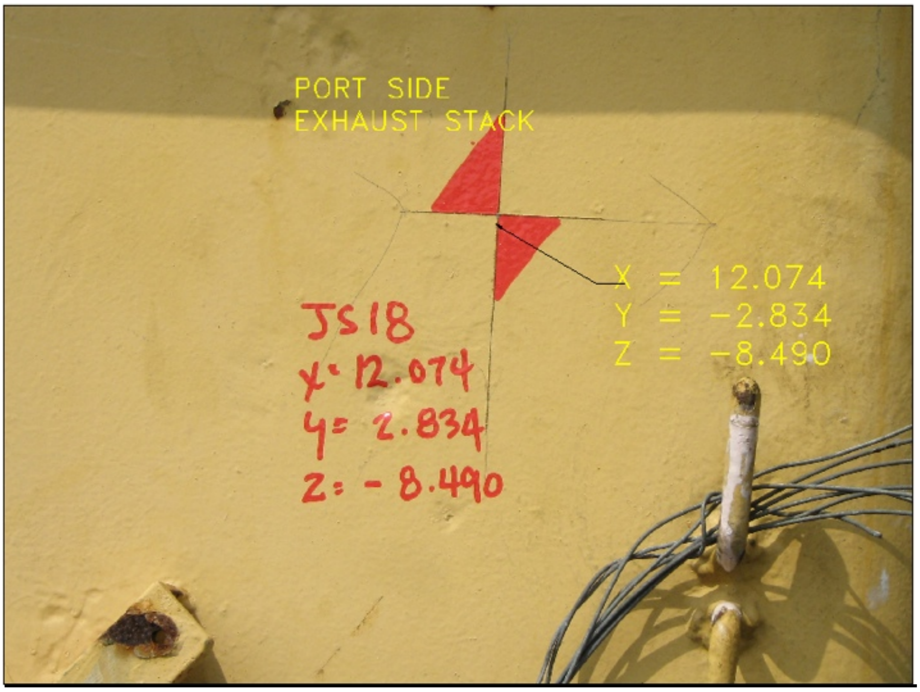


Photo 5(f)

Port side exhaust stack.

-

<u>Shelter deck reference points (cont).</u>

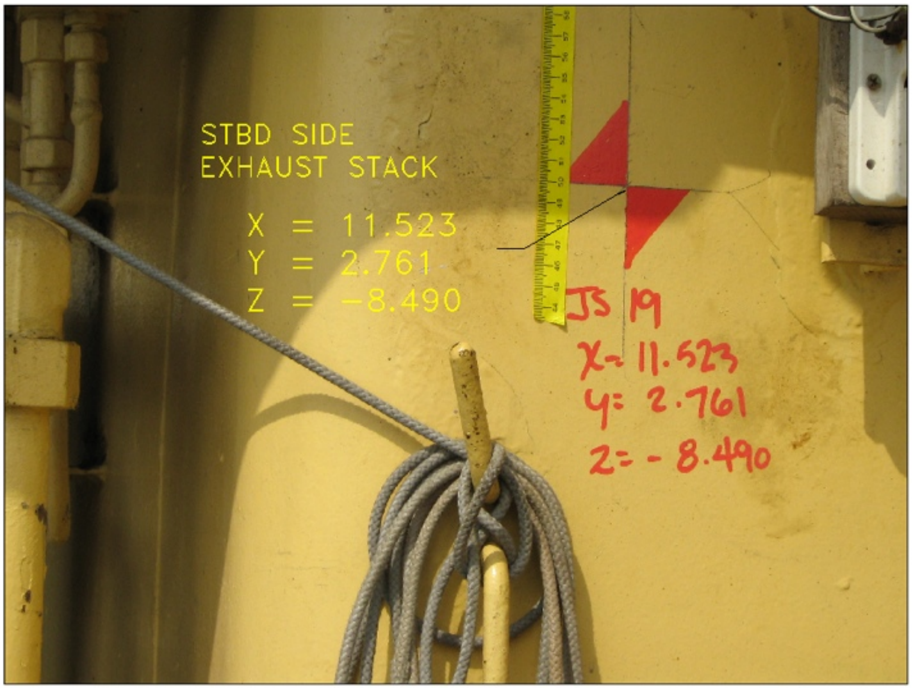


Photo 5(g)

Stbd. Side exhaust stack.

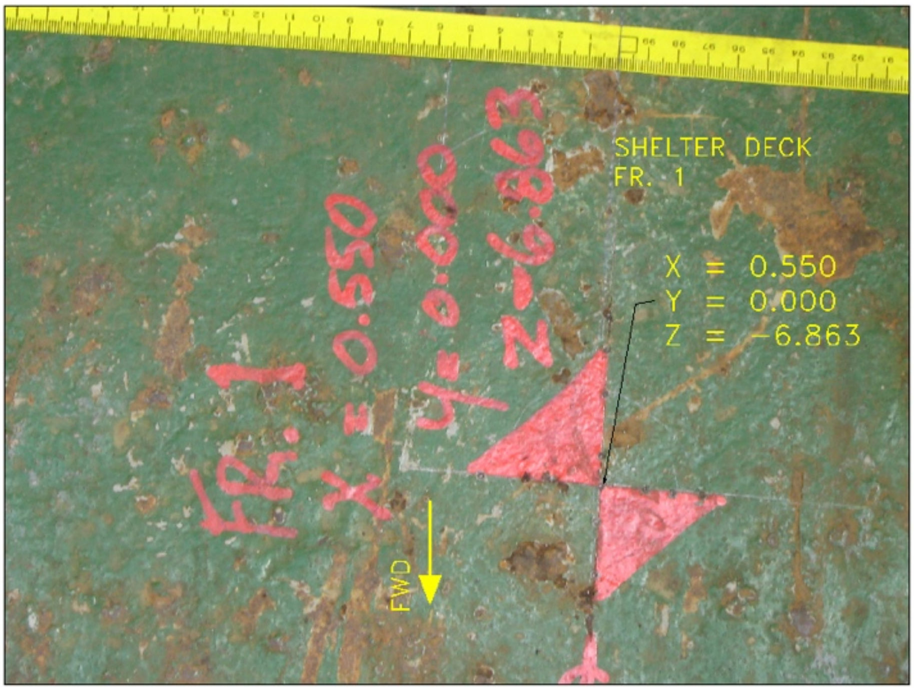


Photo 5(h)

Shelter deck at frame 1 and centerline ship.

Glossary

ECORD European Consortium for Ocean Research Drilling.