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CCGS Hudson Expedition 2010-023 Northeast Newfoundland Shelf and Slope June 18-July 3, 2010

D.C. Campbell, F. Saint-Ange

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0. Acknowledgments-

On behalf of the scientific staff of Hudson 2010-023 and the Atlantic division of the Geological Survey of Canada at BIO, I would like to thank the Commanding Officer William Naugle, the deck crew led by Bosun Edward O'Quinn, the engineering department under the direction of Ian Fraser, as well as the entire ship's complement for continuous support in execution of the scientific objectives.

- Calvin Campbell, Chief Scientist, Hudson 2010-023

1.0 Objectives

CCGS Hudson expedition 2010-023 to the Northeast Newfoundland Shelf and Slope region had the following primary objectives:

1) Investigate the largest submarine slide complex ever observed on the continental shelves of Atlantic Canada (Shaw et al. 2011). The slide complex is located on the north flank of the Notre Dame glacial trough, covering an area of ~2400 km^2 and represents a displaced volume of ~300 km^3 of sediment.

2) Improve understanding of the Neogene geological history, surficial geology, seafloor properties and processes of the continental slope between Orphan Spur and Hamilton Spur, the most extensive unsampled deepwater area off Canada's east coast. The 500 km long segment of the slope has never been sampled by piston coring, and only one high resolution seismic reflection profile was collected in the area since 1984.

2.0 Participants

Name		**Affiliation**	**Role**
Owen	Brown	NRCan	Manage GP lab sample operations
Calvin	Campbell	NRCan	Senior Scientist
Beth	Cowan	NRCan co-op student	General watchkeeper, GP lab
Paul	Fraser	NRCan	Navigation, digital data archiving
Scott	Hayward	NRCan	Navigation, digital data archiving
Fred	Learning	GeoForce	Huntec
Gang	Li	NRCan	Assist in GP lab
Desmond	Manning	NRCan	Senior tech. seismic operations
Susan	Merchant	NRCan	Data curation (hardcopies), ED at Sea
Shawn	Meredyck	MUN student	General watchkeeper, GP lab
Patrick	Meslin	NRCan	Elec. tech., seismic watch keeping.
Bob	Murphy	NRCan	Senior tech. sampling operations
Amy	Pellerin	NRCan co-op student	General watchkeeper, GP lab
Ryan	Pike	GeoForce	Sampling
Albert	Rand	NRCan co-op student	General watchkeeper, GP lab
Marla	Reid	NRCan co-op student	General watchkeeper, GP lab
Katey	Roberts	MUN student	General watchkeeper, GP lab
Angus	Robertson	NRCan	Sampling, photography
Francky	St-Ange	NRCan	Planning, assist in GP lab

3.0 Summary of Activities

Hudson 2010-023 Summary of Activities				*Sampling*		*Geophysical Surveys*		
Date	*JD*	*Location*	*Purpose*	*Core*	*Camera*	*GI Gun*	*Huntec*	*3.5 kHz*
18-Jun	169	St. John's	Changeover with Hudson 2010-020 cruise.					
19-Jun	170	St. John's to Notre Dame trough failure site	24 hour transit					
20-Jun	171	Notre Dame trough failure site	Groundtruth and seismic surveys of failure site	1-4		1-6	1 (partial)	1 (partial)-6
21-Jun	172	Notre Dame trough failure site	Groundtruth and seismic surveys of failure site	5-8		7-13	7 (partial)	7 (partial)-13
22-Jun	173	Notre Dame trough failure site	Groundtruth and seismic surveys of failure site	9-13		14	14 (partial)	14 (partial)
23-Jun	174	Notre Dame trough mouth fan	Ground truth and seismic surveys of slope area	14-16	17	15	15	
24-Jun	175	Notre Dame to Hawke Saddle trough mouth fans	Ground truth and seismic surveys of slope area	18-20		16	16	
25-Jun	176	Hawke Saddle trough mouth fan	Ground truth and seismic surveys of slope area	21				17-18
26-Jun	177	Hawke Saddle trough mouth fan	Ground truth and seismic surveys of slope area	22-24	25	19	19 (partial)	
27-Jun	178	Hawke Saddle to Notre Dame trough mouth fans	Ground truth and seismic surveys of slope area	26-27		20	20	
28-Jun	179	Notre Dame trough mouth fan and south	Ground truth and seismic surveys of slope area	28-30		21-22	21-22	
29-Jun	180	South of Notre Dame trough mouth fan	Ground truth and seismic surveys of slope area	31-33				
End of cruise. Run 3.5 kHz across slope and shelf until midday June 30. Return to BIO July 3.								

4.0 Preliminary Results

4.1 Cruise statistics

4.1.1 Geophysics

885 line km of 1x210 in^3 GI Gun single channel seismic reflection data.

525 line km of Huntec DTS ultra high resolution seismic reflection data (primarily sparker mode).

510 line km of 3.5 kHz chirp data collected during Huntec DTS down time.

4.1.2 Samples

31 piston cores using the AGC Long Coring Facility, recovering 195 m of sediment.

2 drop camera stations using the 4K Camera system with VladCam bullet, recovering 58 high quality digital still images and 65 minutes of high definition video.

4.2 Key Preliminary Results

4.2.1 Notre Dame Trough failure area

At the request of Dr. John Shaw, a large submarine failure in Notre Dame Trough, NE Newfoundland Shelf (Shaw et al. 2011) was investigated during part of this expedition. The failure zone encompasses a significant portion of the NE Newfoundland Shelf, an area of possible future seabed infrastructure, and a setting not traditionally considered prone to submarine landsliding at this scale. The 2400 km^2 failure area was identified on the OLEX bathymetric compilation and confirmed by vintage seismic reflection data collected in the 1960s and 1970s. A 5 x 5 km failure block within the larger failed area was surveyed with multibeam bathymetry and 3.5 kHz chirp sonar in 2009. A number of piston coring sites during 2010-023 were preselected from these data. The Notre Dame Trough failure was given high priority for this cruise because it represents a new style of seafloor instability in eastern Canada.

The objectives for the Notre Dame Trough site during Hudson 2010023 were to collect regional high resolution seismic reflection data as well as piston cores (Figure 4.1). The seismic reflection survey plan was designed to determine the seismic stratigraphic architecture of the failure features seen on the OLEX data. Piston core locations were selected to determine the age of the failure which was attempted in several areas, as well as provide information on the lithology and geotechnical properties of the failed units.

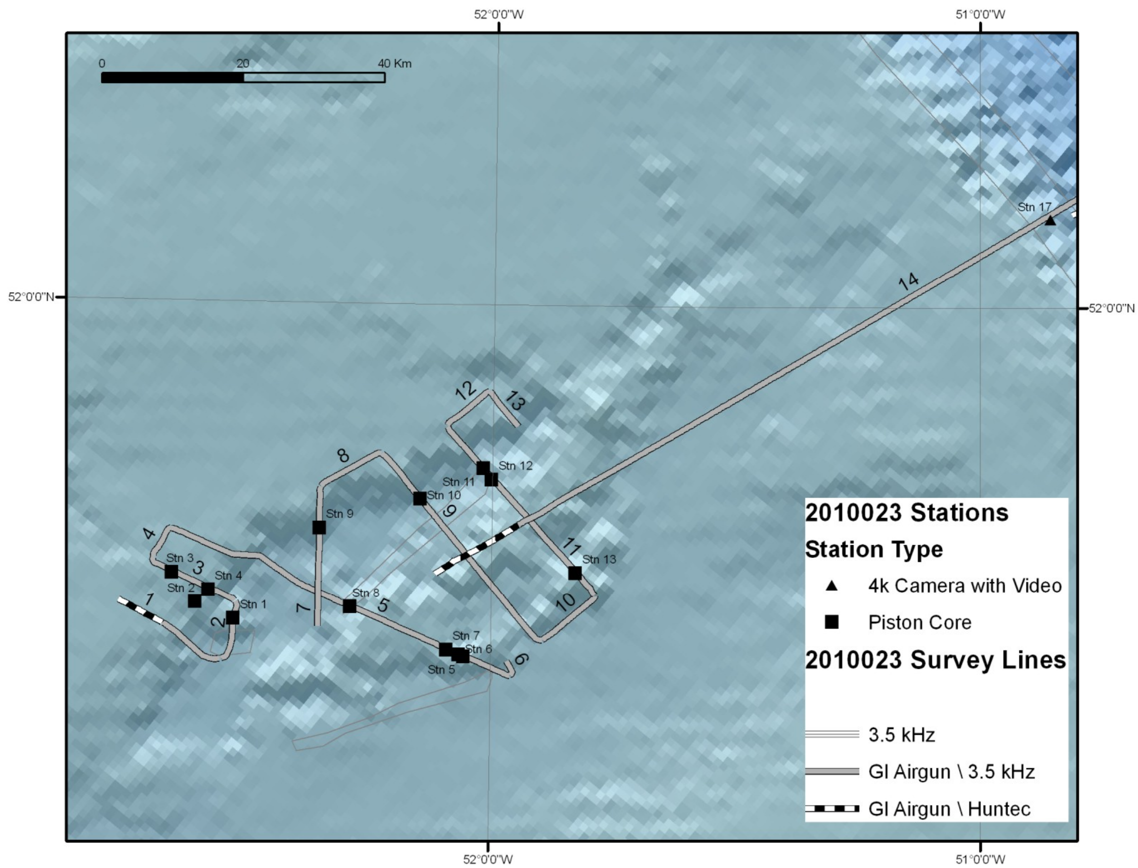


Figure 4.1- Map of seismic reflection lines and samples collected in the Notre Dame Trough failure site during Hudson 2010023.

Preliminary interpretation of data collected in the Notre Dame Trough failure area is as follows:

1. A décollement surfaces is interpreted to occur at the base of stacked acoustically transparent lenticular units interpreted to be till (Figures 4.2.and 4.3).
2. The décollement is at the same stratigraphic level as a sequence of Pliocene or early Pleistocene delta topsets which coalesce towards a fall line near the failure area. The seismic reflections form a regional, high seismic amplitude amalgamated seismic unit which is probably regionally mapable on older data (Figures 4.2.and 4.3).
3. Regionally, the failure zone consist of a pressure ridge complex which was exhumed from depth and deposited on till and has the characteristics of a frontally emergent system (Figure 4.2.).
4. Major NE trending trough/berm complex and an associated glide block failed along the same (or similar) stratigraphic level as the pressure ridge complex and slide block imaged

by the multibeam data. The slide block eroded up to 200 m into underlying till (Figure 4.2).
5. Results from piston coring will provide information on the age of the failure (attempted at several locations), as well as the physical and geotechnical properties of the failed material.

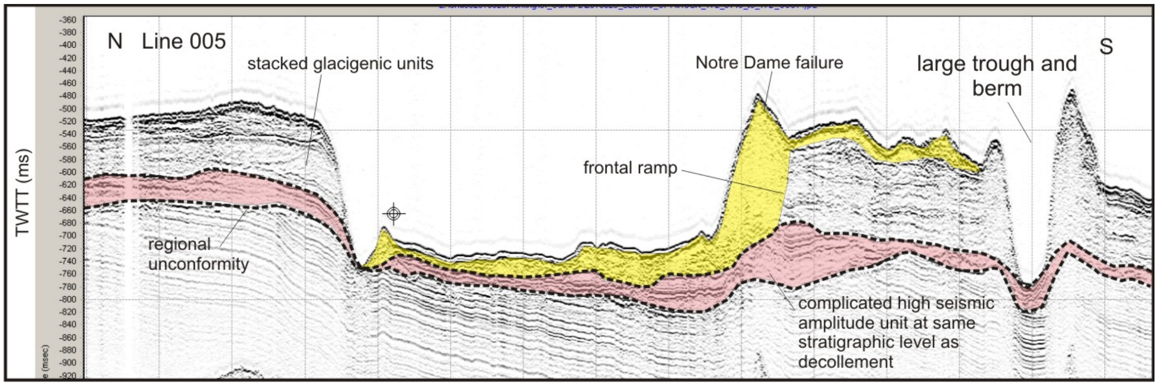


Figure 4.2- GI Gun profile (line 005) across the failure area. Note the frontal ramp and the depth of incision on the trough (right side of profile).

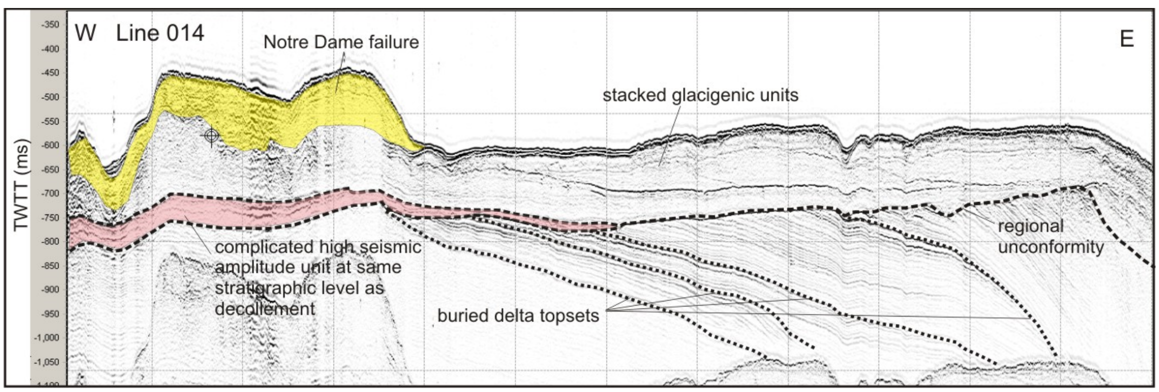


Figure 4.3- GI Gun profile along the axis of Notre Dame Trough (line 014)

4.2.2 Northeast Newfoundland Slope

Seismic reflection profiles (GI Gun and Huntec) were obtained during the cruise, covering the continental slope seaward of Notre Dame Trough to Hawke Saddle, between Orphan and Hamilton spurs. The survey was concentrated on the two trough mouth fans and adjacent valley systems. This is a brief review of the main results obtained from a preliminary examination of the GI Gun data.

Morphology and architecture of the trough mouth fans

Notre Dame Trough and Hawke Saddle fed two trough mouth fans during the Pleistocene. The fans developed from the upper slope near -500 m water depth to the upper continental rise. Preliminary estimates provide a maximum thickness of around 500 - 700 ms (~375-525 m) for the Notre Dame fan and 300 – 400 ms (~225-300 m) for the Hawke fan. The thickness decreases down slope and the fan layers pinches out at the base of the continental slope (Figures 4.4 and 4.5).

The internal stratigraphy of Notre Dame fan is a succession of stack chaotic bodies characteristic of glaciogenic debris-flow deposits as well as several thick transparent units interpreted as Mass Transport Deposits (MTDs) (Figures 4.5 and 4.6). The overall morphology is pseudo-lobate, characterized by a chaotic surface linked to the presence of U-shaped valleys, canyons and channels (Figures 4.5 and 4.6). Between 1800 and 2500 m of water depth, several MTD are observed. Laterally the fan ends abruptly with two steep escarpments 150 – 200 m high (Figures 4.5 and 4.6).

The Hawke fan shows the same internal stratigraphy, with a succession of stacked glaciogenic debris-flow deposits and few MTDs. Its morphology appears to be slightly different from the Notre Dame fan, with a lobate morphology characteristic of trough mouth fans (Figure 4.5). A few small MTDs are observed on the top of the fan but does not constitute the main characteristic of this area (Figure 4.4). Laterally it ends in a progressive way with layers pinching out toward the valley system. On the upper area the seismic profile shows a 160 m high scar, which cut a thick stratified unit overlain by the fan.

The two fans are divided by a 60 km wide valley system characterized by a set of u-shape valleys and a few canyons, which appear to coalesce from the upper to the lower slope (Figure 4.5). In the lower part of the slope covered by the survey, the valley system is composed of a set of wide unconfined channels and few small canyons, ranging from 20 to 100 m deep. The valleys system developed on a flat area showing stratified echo-facies on the upper slopes and chaotic to transparent echo-facies to the lower slopes. The base of the system shows a high amplitude reflector that is also observed in the two fans and seems to be the base of the Hawke fan.

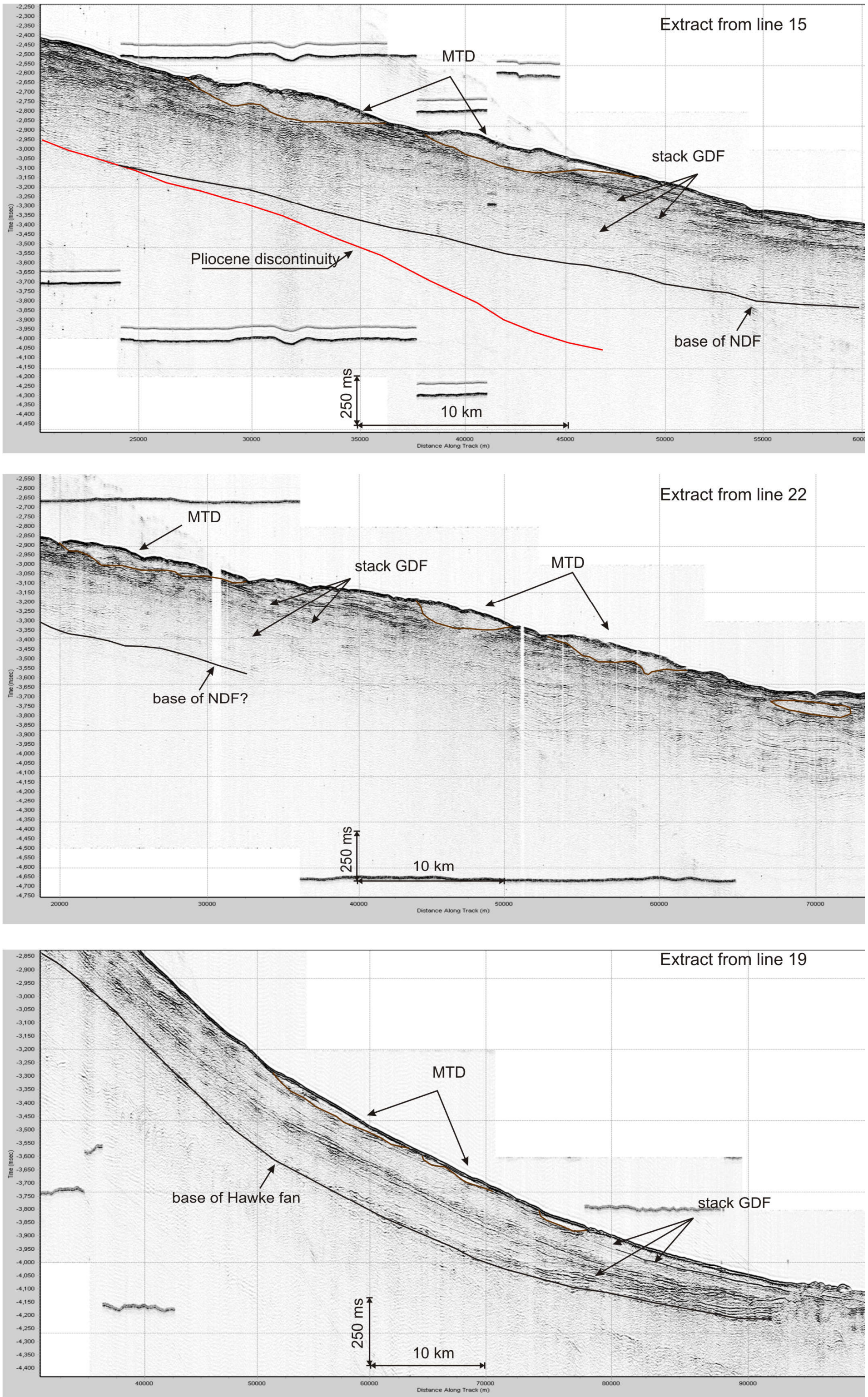


Figure 4.4**:** Extract from seismic line 15, 22 and 19 showing stack Glaciogenic Debris Flows deposits and Mass Transport Deposits in the Notre Dame Fan and Hawke Fan.

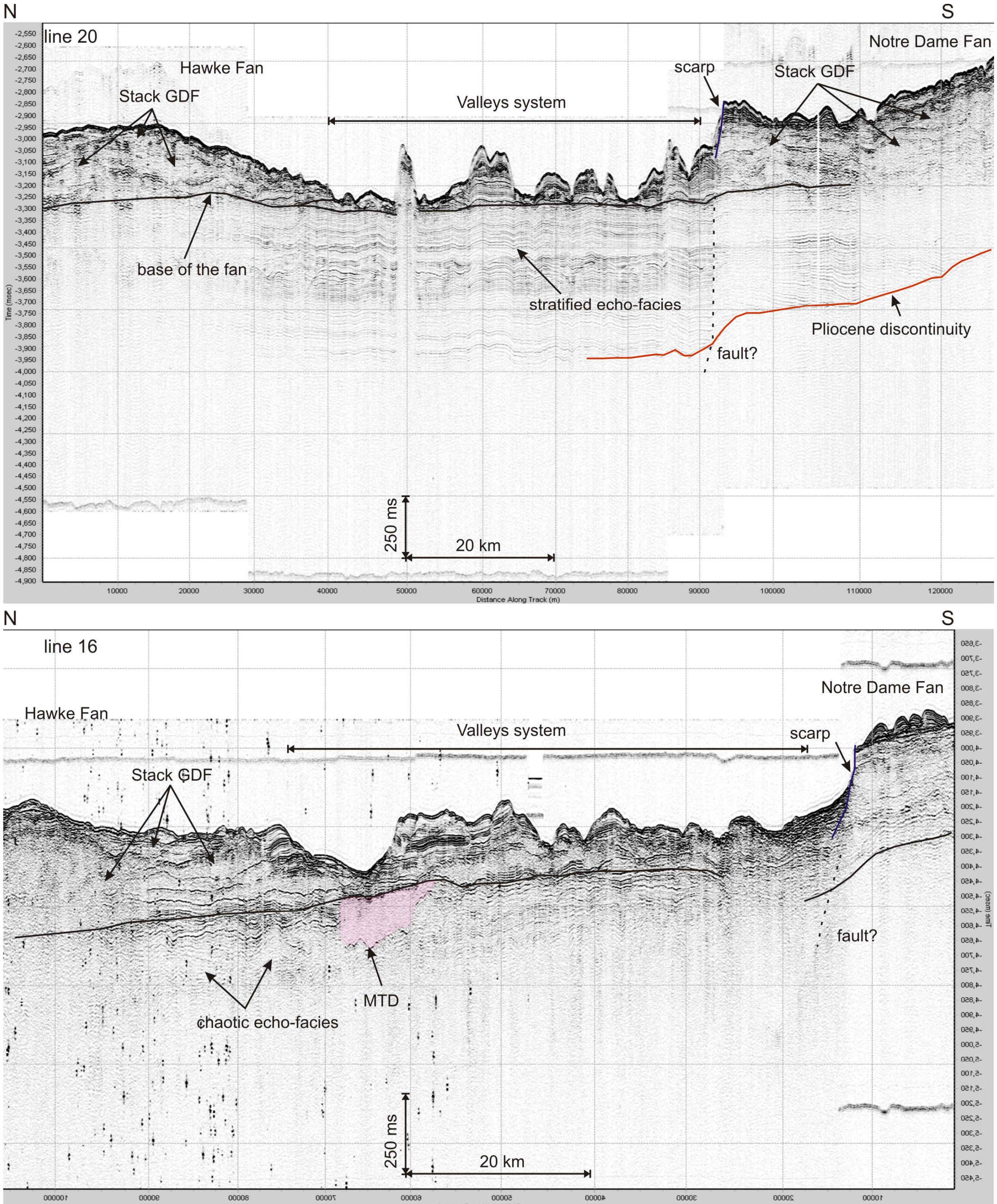


Figure 4.5: Airgun profile along the continental slope from Notre Dame Fan to Hawke Fan. GDF: Glaciogenic Debris Flows; MTD: Mass Transport Deposits.

Remarkable features

The morphology of the edge of the Notre Dame fan represent one of the most remarkable features of this area. As described above, the fan is delimited by two escarpments 150 – 200 m high (Figures 4.5-4.6). The northern escarpment developed perpendicular to the slope and can be followed for 45 km between 2000 and 3000 m of water depth. Southward, the escarpment forms the northern wall of a 20 km wide u-shape valley (Figure 4.6). This valley has a flat floor, in the middle of which a canyon-levee system developed. These escarpments show steep slopes and constitute a sharp termination of the different units of the fan. This sharp morphology coincides with the presence of a fault system that cuts the inferred Pliocene unit at the base of the seismic profile to the surface. This fault system affects all the southern part of the fan, where sediment units seem to have been slightly tilted.

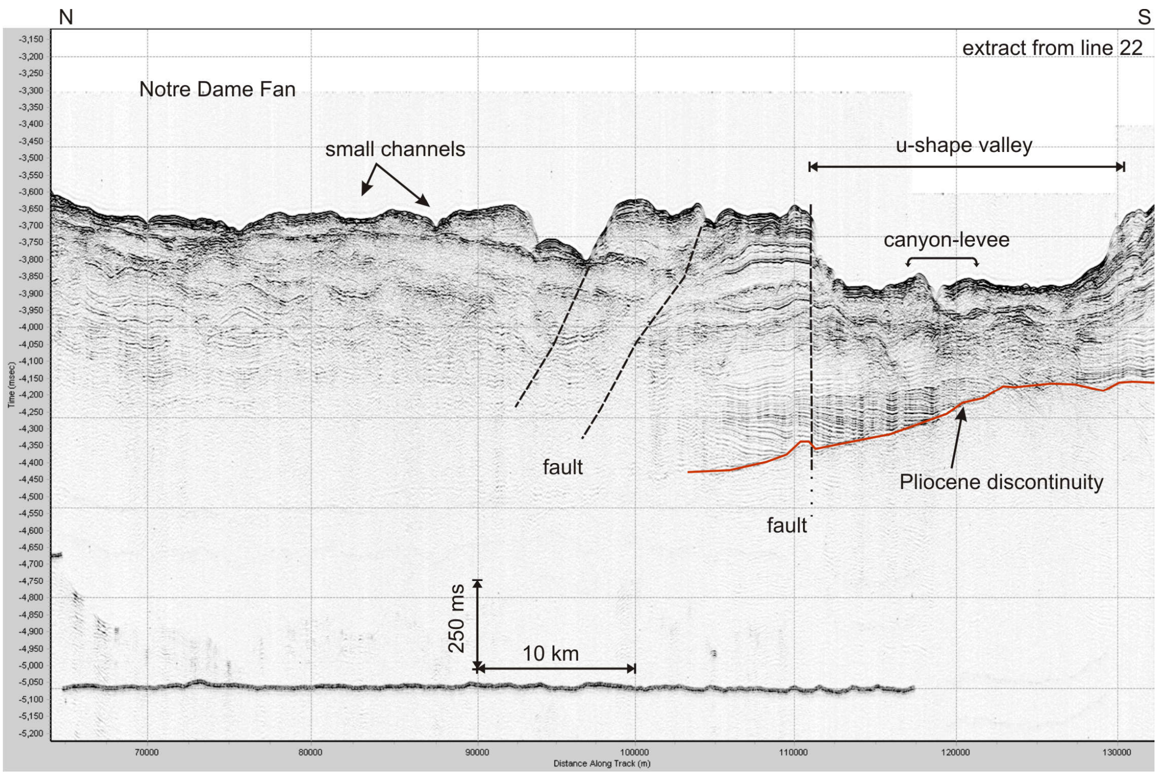


Figure 4.6: Extract from line 22 showing a faults system and a u-shape valley related to a slope failure probably controlled by the reactivation of a fault.

First assessment

The Notre Dame and Hawke fans developed in a complex area with the southern part seemingly controlled in part by shallow faulting. The morphology of the edges of the Notre Dame fan is interpreted to be the result of large scale slopes failure, and mass transport deposit evidences suggest that this area experiences recurrent slopes failure. For the southern part, the data clearly suggest that the 20 km u-shape valley is a result of a large scale failure that takes place along a major fault. The comparison with data set from

2005033B cruise shows that this failure did not affect the upper slope and the headscarp is probably located in the middle slope between 1800 and 2500 m of water depth. The data set from the 66014 cruise at the base of the continental slopes shows evidence of sediment creeping with thrust features, suggesting the existence of large slumps on the lower slope. The lack of a direct tie with our data did not allow us to establish the precise relationship between our observations and those deposits.

The morphology of the northern part of the Notre Dame fan is also the result of one or several slope failures. The failures affected the entire slope from Notre Dame toward Cartwright spur. The Hawke fan and the valley systems seem to develop inside this large landslide scar. Evolution from a stratify facies in the upper slope to mass transport deposit facies in the lower slopes suggest that the landslide scar is located in the middle slope. Based on our data coverage the preliminary results show that Hawke fan is not affected by large scale failures. Nevertheless, the evidence of small MTDs at the top of the fan suggests that small scale failures are common and probably occurred during the last deglaciation. The cores taken in this area will help determine the age of those deposits.

Outlook

The coverage obtained during the cruise reveals a complex area in which significant recurrent slopes failure occurred. Based on our first interpretation, tectonic seems to play a significant part in the instability of the margin. The fault system discovered on the southern part of the Notre Dame fan might be link with the Charlie Gibbs fracture zone in the basin. But the coverage it's too sparse to clearly identify the relationship between both areas. The data shows that the fault has been reactivated during the Quaternary, probably as a result of glacio-isostatic rebound related to the thick ice sheet coverage during the glacial cycle. Whether or not the fault system was still active during the Holocene is not clear. The phenomenon observed on the slopes has to be put in perspective with the area covered in the shelf where a complex slide area was also covered during this cruise. Altogether, the data shows that mass transport processes are not restricted to the slopes and are widespread. The present coverage is clearly not sufficient to allow a thorough evaluation of marine geohazards in this area.

References

Shaw, J., Piper, D.J.W., Skulski, T., Lamplugh, M.J., Craft, A., and Roy, A. 2011. New evidence for widespread mass transport on the Northeast Newfoundland Shelf revealed by Olex single-beam echo sounding. Geo-Marine Letters, vol. 32, p. 5-15.

5.0 Daily Narrative

(all times in Atlantic Daylight Time except where noted, all positions are the planned positions, not necessarily the actual ship position)

JD 169, Friday June 18- Science staff changeover in St. John's, N.L.

JD 170, Saturday June 19- St. John's to Notre Dame trough failure site

Sailed fron St. John's at 0600. Made way to Notre Dame failure site on NE NL shelf. Held science meeting at 11h00. At 12h00 began logging 3.5 kHz. Made 6 kts during the day due to weather. Made good time overnight.

JD 171, Sunday June 20- Notre Dame trough failure site

Arrived at first coresite at 0930.

Core 001- 51.596347 - 52.526740 in about 450 w.d.

Core target was the top of the large failed block in order to characterize the geotechnical properties of the failed material. Rigged a 9 m piston corer and recovered ~ 4 m of stiff, dark grey brown silty mud with clasts.

Core 002- 51.616489 -52.605034

Core target was a thin acoustically transparent unit over the decollement surface of the Notre Dame slide. Rigged a 12 m piston core. Got good recovery with an abrubt colour change from dark grey brown to light grey brown about 2.5 m from the base of the core, inferred to be the contact with the decollement.

Core 003- 51.653668 -52.654722

Core target was the highest level in the northwest trending trench in the Notre Dame slide area. Rigged a 9 m piston core. Recovered ~4 m piston core with implosion at top. Sand and gravel over sandy/silt in a stiff clay matrix.

Core 004- 51.632423 -52.578840

Core target was lower stratigraphy of the northwest trending trench in the Notre Dame slide area. Ship had difficulty keeping station and drifted south of the target and core hit bottom in an area slightly deeper than planned. Recovered ~3 m of stiff sediment, possibly till.

Issues with Huntec DTS discovered during preparation.
Core on deck at 1700. Made way over to first survey line.

Overnight survey plan JD 170-171

Name	Latitude DD	Longitude DD	Latitude DM	Longitude DM
SOL1	51.613375	-52.761072	51° 36.8025'	-52° 45.6643'
SOL2	51.52028	-52.588366	51° 31.2168'	-52° 35.302'
SOL3	51.617355	-52.515447	51° 37.0413'	-52° 30.9268'
SOL4	51.667878	-52.698341	51° 40.0727'	-52° 41.9005'
SOL5	51.711498	-52.660852	51° 42.6899'	-52° 39.6511'
SOL6	51.526612	-51.952803	51° 31.5967'	-51° 57.1682'
EOL6	51.618306	-52.023322	51° 37.0984'	-52° 01.3993'

The planned lines cross the major east-west trending escarpment, over the failure block imaged in the multibeam data, and across some of the failures to the east. The latter part of the planned lines cross the large berm and furrow imaged in the OLEX dataset.

Deployed gear at 1930. Earlier issues with the Huntec system appear to be fixed. First deployment of 210 cu in GI gun.

Huntec stopped working at 2030 and recovered. Intermittent loss of signal, then decision made to retrieve the towfish. Switch to 3.5 kHz. Longshot GI Gun controller failed at 2200. Meslin inspected unit and thinks hard drive and power supply are becoming unstable. Unit started up again good quality GI gun data collected overnight. Two additional short failures of the long shot system occurred overnight. Had to alter course several times overnight to avoid fishing gear. Retrieved gear at 0600.

JD 172, Monday June 21- Notre Dame trough failure site

Steamed to first core site.

Core 005- 51.552756 -52.056121

Core target was the feather edge of the fill of the large east-trending furrow in the Notre Dame failure site. Rigged a 12 m core and recovered about 4 metres of core with no obvious basal contact, however the base of the core was much stiffer than the upper portion.

Core 006- 51.554992 -52.065583

Core target was a thick sequence of transparent fill in the large east-trending furrow in the Notre Dame failure site. Full penetration on the trigger weight core. 12.2 m of penetration on the piston corer. Core recovered ~8 m of sediment. Large implosion on section E-F.

Core 007- 51.361007 -52.090970

Core target was top of a berm north of the large east-trending furrow. Poor recovery on the trigger core and only 3 m penetration on the piston core.

Core 008- 51.613918 -52.288003

Core target was pinch out of transparent zone against decollement surface. At 1630 steamed to start of line 7 ran lines:

Waypoint Name	LatDD	LongDD	LatDM	LongDM
SOL7	51.588317	-52.353287	51° 35.299'	-52° 21.1972'
SOL8	51.766802	-52.355416	51° 46.0081'	-52° 21.325'
SOL9	51.813531	-52.229957	51° 48.8119'	-52° 13.7974'
SOL10	51.570558	-51.900273	51° 34.2335'	-51° 54.0164'
SOL11	51.631982	-51.783124	51° 37.9189'	-51° 46.9874'
SOL12	51.844466	-52.096144	51° 50.668'	-52° 05.7686'
SOL13	51.890985	-52.011488	51° 53.4591'	-52° 00.6893'
EOL13	51.839650	-51.937990	51° 50.379'	-51° 56.2794'

The planned lines travel across the major east-west trending escarpment, over the very large failure block imaged in the OLEX data as well as the large berm and furrow imaged the night before.

Deployed Huntec and GI Gun at 1630 and all gear in the water by 1700. Huntec retrieved at 1800 due to failure and switch to 3.5 kHz. Ran lines 7-13 with GI Gun and 3.5 kHz. Norwegian float on airgun detached at 0430 near end of line 13 and gear recovered at 0500. Steamed to first core site of the day.

JD 173, Tuesday June 22- Notre Dame trough failure site

Core 009- 51.713797 -52.354072

Core target was pinch out of transparent interval over decollement for dating and geotechnical information on the slide. Full penetration of TWC and 10.5 m on the piston core. Piston core recovered 8.5 m of sediment.

Core 010- 51.753003 -52.148454

Core target was a 20 m high mound in the slide area. Rigged 9 m corer and recovered ~1m of soft sediment over very stiff and cohesive sediment.

Core 011- 51.792560 -52.019869

Core target was a thick acoustically transparent and stratified section in basin created by the failure evacuation. Core penetrated 12.8 m and retrieved ~8 m of sediment. Core stopped in stiff diamict.

Core 012- 51.778324 -52.002016

Core was into surface of large failure block, but deep enough to be out of the influence of iceberg turbation. Rigged a 12 m core and core stopped in a very stiff grey and red diamict, recovering ~6 m of sediment.

Core 013- 51.660558 -51.828362

Core was into large glide block which plowed the large furrow and berm in the Notre Dame slide area. No penetration on the TWC with medium sand on the cutter of the TWC. Piston core penetrated 6.2 m and recovered ~4 m of stiff sandy diamict.

Steamed to SOL 14.

Waypoint Name	**LatDD**	**LongDD**	**LatDM**	**LongDM**
SOL14	51.65807700000	-52.11662200000	51° 39.4846'	-52° 06.9973'
EOL14	52.19174500000	-50.65590400000	52° 11.5047'	-50° 39.3542'

Planned seismic line takes goes from the Notre Dame failure area, along the axes of the transverse trough, to the head of the trough mouth fan seaward of Notre Dame channel. Deployed Huntec and GI gun at 1800. Huntec operated well until 2100, then similar problems to the night before with lost signal. Recovered Huntec and switched over to 3.5 kHz. Collected excellent quality GI gun data overnight along the transverse trough, with a major Tertiary erosional unconformity with overlying prograding till wedges. Recovered seismic gear at 0600.

JD 174, Wednesday June 23- Slope off Notre Dame trough

Recovered GI gun and eel at 0600 and steamed to first core site.

Core 014- 52.001321 -50.509936

Target was a terrace approximately 50 m above the thalweg of the largest canyon in the area. The canyon is possibly fault controlled. Rigged a12 m piston corer. Trigger weight core recovered ~60 cm of olive grey silty mud with granules. Piston core penetrated 3 m. Recovered ~0.7 m of very coarse sand and gravel overlain with olive grey sandy and gravelly mud, similar to the trigger weight core.

Core 015- 51.895022 -50.396242

Target was in a broad depression and was an attempt to core sediment that preceded trough mouth fan development to the south. Core recovered similar sequence to core 014, with olive grey silty and sandy mud overlying clean coarse sand and gravel. Core likely only recovered channel facies.

Core 016- 51.995695 -50.50254

Target was a long stratigraphic section from the crest of a canyon leveee. Excellent recovery on the piston core, with several colour variations apparent through the liner.

Camera 017- 52.113301 -50.854375

Steamed to upper slope and deployed 4k camera at 1730 in ~690 m water depth. Conducted half hour camera drift with video and approximately 30 stills. At 1825 recovered camera and deployed Huntec and GI Gun. Ran line 15:

Name	LatDD	LongDD	LatDM	LongDM
SOL15	52.138401	-50.708189	52° 08.3041'	-50° 42.4913'
EOL15	53.180721	-50.396103	53° 10.8433'	-50° 23.7662'

The planned line was a somewhat oblique dip line across the Notre Dame trough mouth fan. Collected good quality Huntec and seismic data. Slightly too much lead on the streamer made it difficult for the streamer to maintain proper tow depth. Huntec stopped working at 0300 and switched to 3.5 kHz. Did not reach end of line 15 due to currents. Recovered seismic gear at 0600.

JD 175, Thursday June 24- Slope off Notre Dame trough

Recovered seismic gear at 0600. Steamed 15 nmi to core 018.

Core 018- 52.667863 -50.550951

Core target was a thick stratigraphic section from the Huntec data. Rigged a 15 m piston core. Piston core penetrated 9 m. Implosion near top of core. Core contained chocolate brown mud overlain by tan and grey sediment. Some sandy layers.

Core 19- 52. 628774 -50.562649

Core target was a 6-8 m thick stratified interval over a glacigenic debris flow. Rigged a 12 m piston core. Good trigger weight recovery. Piston core penetrated over 9 m. Core contained alternating chocolate brown mud, tan mud, and sandy beds.

Core 20- 52.842808 -50.498407

Core target was a thick acoustically stratified interval, likely a small levee, with a possible shallow mass transport deposit at the surface. Rigged a 15 m piston core. Core penetrated 12 m and recovered 10.5 of sediment.

Recovered core at 1730, steamed towards start of line 16. Deployed gear at 1800. All seismic gear in the water by 1830, then finished processing core 20. Ran line 16:

WaypointName	LatDD	LongDD	LatDM	LongDM
SOL16	52.82788400000	-50.48740400000	52° 49.673'	-52° 29.2442'
EOL16	53.77798300000	-50.88749900000	53° 46.679'	-50° 53.2499'

Seismic transect was a deepwater (~3000m) strike line across the lower slope. Collected excellent quality Huntec and GI Gun data. Early part of line showed a series of young (post trough mouth fan deposition) channel levee systems. Middle of the line crossed a pair of broad lower slope valleys. Towards the end of the line, traversed the southern end of the Hawke Saddle trough mouth fan. Recovered seismic gear at 0600. Wind came up a bit, but proceeded to first piston core site.

JD 176, Friday June 25- Slope off Hawkes Saddle

Steamed to first core site.

Core 021- 53.455981 -50.742761

Core target was a channel floor with a thin transparent drape. Rigged a 12 m core. Recovered short trigger core and a heavily damaged piston core. Liner stuck in barrel. Wind blew up by noon, 30 kts gusting to 50 with big swell. Decision made to run the 3.5 kHz sounder at 5 kts towards the mouth of Hawke Trough.

Ran 3.5 kHz lines:

Name	LatDD	LongDD	LatDM	LongDM
SOL17	53.436712	-50.741499	53° 26.2027'	-50° 44.4899'
SOL18	53.817222	-51.449633	53° 49.0333'	-51° 26.978'
EOL18	53.095750	-52.259528	53° 05.745'	-52° 15.5717'

JD 177, Saturday June 26- Hawke Saddle trough mouth fan

Terminated 3.5 kHz line at 0500. Steamed to first core site of the day, selected from 2005033B Huntec data.

Core 022- 53.123469 -51.693175

Core target was a thick stratigraphic section from a broad intercanyon ridge. Rigged a 15 m piston core. Core penetrated 12 m. Several layers obvious through core line, with a sharp contact between the lower chocolate brown unit and the upper light grey unit, laminations, and a gravelly top. Damage to the top section.

Core 023- 53.241878 -51.792789

Core target was a perched canyon on the margin of the trough mouth fan. Rigged a 9 m piston core. Core penetrated 7 m. No recovery. Stiff diamict coated the cutter, as well as soft light grey mud.

Core 024- 53.275542 -51.825912

Core target was a thin, acoustically stratified zone over a glacigenic debris flow. Full trigger weight core. Rigged a 12 m piston core with 7.2 m penetration. Recovered 3.5 m.

Steamed to camera transect 025 on the upper slope in ~900 m water depth. Fishing boat at first location, so moved south. Conduct half hour camera transect, then steamed to start of line 19.

WaypointName	LatDD	LongDD	LatDM	LongDM
SOL19	53.29115000000	-52.24676100000	53°17.4690'	-52°14.8057'
EOL19	53.74147900000	-50.85022800000	53°44.4887'	-50°51.0137'

Planned line was a long regional dip profile down the trough mouth fan. Huntec stopped working at 1930. Recovered Huntec, repaired, and redeployed at 2130. Recovered seismic gear at 0600.

JD 178, Sunday June 27- Slope off Hawke Saddle and trough mouth fan

Steamed to core site 026.

Core 026- 53.472206 -50.758129

Target was a broad canyon levee that had to be abandoned on JD 176 due to weather. Arrived at core site at 0800. Core in water at 0830. Pengo winch issues. Rigged a 15 m core and recovered ~11 m of sediment. Abundant lamina and sandy layers apparent through core liner. Steamed 35 nmi to core site 027.

Core 027- 53.444292 -51.773802

Target was a shallow, transparent glacigenic debris flow with similar acoustic facies as in Orphan basin. Very little recovery in the TWC. Piston core recovered 6 m or sediment, with a gravelly mud light gray surface layer over a dark brown layer.

Steamed to SOL 20:

WaypointName	LatDD	LongDD	LatDM	LongDM
SOL20	53.65717200000	-51.81964200000	53° 39.4303'	-51° 49.1785'
EOL20	52.19214300000	-50.65295700000	52° 11.5286'	-50° 39.1774'

Survey plan was a regional strike line near the 2000 m isobath from the Hawke TMF, across the canyon/levee complex, to the Notre Dame TMF. Deployed GI Gun and Huntec DTS at 17h00. Collected excellent quality Huntec and GI Gun data. Some minor gun firing issues overnight. Recovered gear at 06h00.

JD 179, Monday June 28- Slope of Hawke Saddle

Recovered seismic gear at 06h00. Steamed to piston core site 028.

Core 028- 52.743832 -51.087744

Coring target was an acoustically transparent interval overlying a strong regional reflection identified in the Huntec data. Rigged a 15 m piston core and penetrated 9 m. Only 30 cm in the trigger weight core. Piston core recovered ~7 m of sediment. Steamed to second core site.

Core 029- 52.790013 -51.124308

Coring target was a thick, acoustically stratified interval. Rigged a 15 m piston core. Full trigger weight core recovery. Recovered 10 m of sediment in piston core.

Core 030- 52.609539 -50.981126

Coring target was a large mass transport deposit with a thin drape of stratified sediment. Rigged a 12 m piston core and recovered 6 m of sediment. Short trigger weight core. Steamed to start of line 21.

Waypoint Name	LatDD	LongDD	LatDM	LongDM
SOL21	52.631584	-51.121665	52° 37.895'	-51° 07.2999'
21A	52.609406	-50.980972	52° 36.5644'	-50° 58.8583'
SOL22	52.386025	-50.200164	52° 23.1615'	-50° 12.0098'
EOL22	51.589297	-49.438460	51° 35.3578'	-49° 26.3076'

Planned lines crossed the distal Notre Dame trough mouth fan to the canyoned area south of the fan and north of Orphan Spur. Collected good quality Huntec DTS and GI gun data. Recovered gear at 06h00.

JD 180, Tuesday June 29- South of Notre Dame trough mouth fan

Recovered seismic gear at 06h00. Steamed to first core site.

Core 031- 52.044595 -49.872681

Core target was an acoustically stratified terrace in a large U-shaped canyon. Rigged a 12 m piston core. Approximately 9 m of recovery. Brown sandy and muddy turbidites overlain with grey mud and gravelly mud.

Core 032- 52.089271 -49.914955

Core target was the top of a stratified ridge for regional lithostratigraphy. Rigged a 15 m piston core. Excellent recovery with over 12 m of recovery.

Core 033- 51.994458 -49.824075

Core target was a small channel levee with in the large U-shaped canyon. Rigged a 15 m piston core. Recovered ~9m of mixed mud, sand layers, and an upper layer of light grey gravelly mud.

Recovered piston core at 1730. After core breakdown, begin steam back to BIO at 1930. Continue to run 3.5 kHz sounder across slope and shelf. Shut down 3.5 kHz near entrance to the Strait of Belle Isle. Arrived at BIO on the morning of July 3rd (JD 184).

6.0 Equipment and Procedures

6.1 Navigation

P. Fraser

Primary GPS information for the cruise was provided by a Thales ADU5 positional and attitude determination system. Real time differential corrections were received from the Coast Guard radio beacon in Cape Norman, Newfoundland. A Novatel DL-V3 GPS system was used as a secondary positioning system. NMEA sentences from the primary GPS receiver were combined with NMEA sentences from the Knudsen 12 kHz sounder, the ship’s log, the ship’s gyro, and the Trackpoint II USBL acoustic positioning system for distribution throughout the ship serially at 9600 baud. Selected sentences were rebroadcast throughout the ship at 4800 baud. In addition to the serial distribution, the GSC Navigation Net system (GSC IO Portal) was used to add metadata and a time stamp to each NMEA sentence. These sentences were rebroadcast as multicast packets over the ship’s network. The GSC survey manager software was also used to calculate and broadcast realtime offset positions for the ship’s central reference point (CRP – centre of stern) and other selected ship locations (e.g. coring location and winch room position). The GSC Navigation Net data was logged using the GSC Nav Net Master Logger. The Dimension4 network time client software was used on all computers that were used for logging or displaying seismic or navigation data to synchronize each computer’s clock to the GSC Nav Net Hudson Time Server.

All computers that were used for logging seismic or navigation data were running the Dimension4 network time client to synchronize their clocks to the GSC Nav Net Hudson Time Server.

Four Regulus systems were used on the ship to view and log the serial navigation data. The systems were set up in the Drawing Office, the Winch Room, the Forward Lab, and the GP Lab. Due to some bugs/issues with the most current Regulus software release all four systems were running on a previous release, build 28894.

Navigation data was provided to the GSC Dig computers that were used to digitize the to the SEGY file trace headers. The GI Arigun digitizer received the pimary GPS antenna position serially at 4800 baud. The Trackpoint II USBL acoustic positioning system was used to calculate positions for the Huntec towfish. The trackpoint data was cleaned and processed in realtime using the GSC USBL RT Processor. GSC Nav Net NMEA formatter was then used to reformat the cleaned trackpoint data into a simulated GPS NMEA sentence ($GPGGA) and to send the sentence to the Huntec digitizer via a virtual serial port. This allowed the acoustic beacon positions to be written to the Huntec SEGY trace headers.

The Trackpoint II acoustic positioning system was also used to provide positions for the 4k Camera system. The Trackpoint data was again cleaned and processed in real time and the program GSC Nav Net JPEG Merge was then used to write the processed Latitudes and Longitudes to the JPEG metadata. Processed Trackpoint positions were not available for Station 17 so the raw Trackpoint data was merged with those photos.

Cruise navigation data was cleaned and merged using custom tools in ArcGIS to generate A format files and shapefiles from the raw NMEA E format files and from the GSC Nav Net real time offset locations file. These files were archived and merged on a daily basis.

6.2 Piston Coring

B. Murphy and R. Pyke

The piston coring system used was the AGC Long Corer. This device obtains a core sample with an ID of 99.2 mm and an OD of 106 mm. Barrel lengths for this system are 10 ft (305cm) and the system is typically rigged to a maximum of 5 barrels. During this cruise the system was rigged with three to five barrels depending upon the seismic interpretation of the sediment. The core head is 3m long, 0.6 m in diameter and weighs approximately 3000 lb (1350Kg). Each barrel has an ID of 4.25” (10.8cm), a 3/8” (9.5 mm) wall thickness, and exterior couplings secured by set screws. The liner was a CAB plastic in 10 ft (305 cm) lengths. A split piston with O-rings and a variable orifice size (split piston orifice used was either 5/64 to 7/64 in size) was used and a standard core catcher was used at all coring sites, in addition a sock was added to those site’s that were believed to have a sandy bottom. The trip arm for the core system also supported a 4.25” (10.8 cm) diameter gravity corer with a single 7ft 10” (2.14 m) barrel and 300 lb (135 kg) head comprised of circular lead weights. In addition an acoustic pinger was used to track the core in water depths over 2500 m as it becomes difficult to see the core hit bottom at greater depths.

The corer uses the ship's Pengo winch with a ¾" wire cable, the starboard foredeck crane and GSCA trawl block to deploy and retrieve the corer. This has been the preferred method for a great many years. Unfortunately, the recent shortening of the foredeck crane from 30' to 24' makes coring operation extremely difficult and unsafe during deployments, and has resulted in a very narrow weather window to allow sampling. For example, on this expedition, half a sampling day was lost due to weather that in the past would not have been the case. Additionally, during this expedition the Pengo winch would not go into high gear, resulting in ~30% reduction in the down and up time at core sites. The Pengo winch speed was the limiting factor on several coring days when 4 piston cores would have been possible if the winch was operating normally.

The corer was handled on deck using a system that includes a rotating core-head cradle, outboard support brackets, a monorail transport system with 2 one ton chain hoists, a lifting winch and a processing half-height container. Each recovered core was broken down at the barrel joints and moved to the processing half-height container via the monorail, where each 10 ft (305 cm) section of liner was extruded from the barrel and cut in half and labelled.

Piston coring was successful at 30 of the 31 attempted sites having only one core return with only a trigger weight sample. Liner implosions occurred in approximately 20 percent of all piston cores and are believed to have occurred due to the sandy bottom of these sites. Damage on the equipment was kept to a minimum as only 6 cutters and 10 catchers were damaged during the cruise.

6.3 Onboard core processing and subsampling

O. Brown

A total of 225.8 m of sediment core was obtained. All cores were processed according to standard GSC Atlantic core procedures (refer to GSC Open File #1044). All cores were identified alphabetically by section at the time of dismantling individual 10 ft core barrels from the bottom to the top, commencing with the bottom-most core barrel and proceeding to the uppermost barrel containing sediment. Each 10 ft length of liner was extruded from the barrel and cut in half, using a modified pipe cutter, in the half height container (Figure 6.1). The sediment in the liner was cut using a wire saw and the section ends were carefully capped to minimise disturbance to the sediment surface. The top end cap was labelled with the cruise number, station number, section label and top. The base of the core is designated with the letter A and the top of the base section is designated as B. The base section is AB. Each section was brought into the GP Lab and stored horizontally on the benches. Each core, starting with the base section AB, was processed using the following procedure. The core liner was labelled with an up arrow, cruise number, station number, section label and the top and base of the section were labelled with the appropriate letter. End caps were removed if the sediment was not too fluid, and the section length was recorded.

Figure 6.1 Cutting a 10ft liner section in the half height container.

Undrained shear strength measurements and constant volume samples were taken at the top and base of each section where possible. Inert packing was placed in the voids created by the constant volume sampling, and the ends of each core section were re-capped, taped then sealed with wax at both ends to prevent water loss.

The sealed core sections were stored upright in the refrigerated reefer container and maintained at 4°C. All core cutters and catchers were measured, labelled, placed in sections of liner, waxed and stored upright in buckets in the refrigerated container. All extruded core sections due to sediment expansion or core processing methods were likewise labeled and stored. All samples and subsamples were catalogued and their location information within the container was recorded in an excel spreadsheet.

All station location information, core section lengths, extruded pieces and cutter/catcher lengths, sediment description and core performance information have been documented on deck sheets and then input into the ED (Expedition) database. The ED database has been backed up and will be verified before downloading into the main ORACLE sample database.

Physical properties measurements

Undrained shear strength measurements and constant volume samples were taken at the ends of each section if the condition of the sediment allowed (Table 6.1). The constant volume sampler was inserted into the end of the section, the undrained shear strength measurement was taken and then the constant volume sampler was removed.

The undrained shear strength was measured using a hand-held Hoskin Scientific Torvane according to ASTM Test Method D2573-94 Standard Test Method for Field Vane Shear Test in Cohesive Soil. The dial on the Torvane was zeroed, the fins on the vane was gently pushed into the sediment until they were completely inserted. The dial was rotated at a constant rate until the sediment failed (Figure 6.2).

The Torvane dial reading ranges from 0 to 1 and reports values in kg-force/cm^2 units (1 kg/cm^2 = 98.07 kPa). The Torvane has three adapter vanes as described below:

L - Sensitive vane has a range of 0 to 0.2 Kg-force/cm^2
Su = dial reading * 0.2 Kg-force/cm^2

M - Regular vane has a range of 0 to 1.0 Kg-force/cm^2
Su = dial reading * 1 Kg-force/cm^2

S - High capacity vane has a range of 0 to 2.5 Kg-force/cm^2
Su = dial reading * 2.5 Kg-force/cm^2

Figure 6.2 Taking a Torvane measurement.

The L - Sensitive vane and the M – Regular vane were used for a total of 155 undrained shear strength measurements taken during the cruise.

Constant volume samples for bulk density and water content determinations were taken by inserting stainless steel samplers of a known volume. Prior to insertion, the sampler was lightly sprayed with Pam cooking oil and gently wiped with a small Kimwipe tissue. The bevelled edge of the sampler was placed on the flat sediment surface and the carefully inserted into the sediment at a constant rate using two flat headed spatulas (Figure 6.3). The sampler is inserted at a constant rate to minimize compression of the sediment within the sampler. The sampler was then carefully removed and the sediment was trimmed using a wire saw and extruded into a pre-weighed 1 oz screw-top glass bottle. The bottle cap was then labelled and sealed using electrical tape to prevent the lid from loosening. A total of 156 constant volume samples were taken during the cruise. The samples will be weighed, dried at 105°C for 24 hours and re-weighed to determine bulk density, dry density and

Figure 6.3 Inserting the constant volume sampler.

water content according to ASTM Test Method D 2216-90 (revision of 2216-63, 2216-80) Standard method for laboratory determination of water (moisture) content of soil and rock. All relevant information for the Torvane measurements and constant volumes was recorded on data sheets and input into excel spreadsheets and will be incorporated into the physical property database.

Table 6.1

SUMMARY OF 2010023 PHYSICAL PROPERTY SAMPLING			
Station Number	**Sample Type**	**Number of Torvane (Shear Strength) Measurements**	**Number of Constant Volume Samples**
0001	TWC	0	0
0001	PC	5	5
0002	TWC	0	0
0002	PC	6	6
0003	TWC	0	0
0003	PC	2	2
0004	TWC	0	0
0004	PC	1	1
0005	TWC	0	0
0005	PC	3	3
0006	TWC	0	0
0006	PC	9	9
0007	TWC	0	0
0007	PC	2	2
0008	TWC	0	0
0008	PC	6	6
0009	TWC	0	0
0009	PC	5	6
0010	TWC	0	0
0010	PC	0	0
0011	TWC	0	0
0011	PC	9	9
0012	TWC	0	0
0012	PC	6	6
0013	TWC	0	0
0013	PC	1	1
0014	TWC	0	0
0014	PC	0	0
0015	TWC	0	0

0015	PC	0	0
0016	TWC	0	0
0016	PC	9	9
0018	TWC	0	0
0018	PC	7	7
0019	TWC	0	0
0019	PC	8	8
0020	TWC	0	0
0020	PC	10	10
0021	TWC	0	0
0021	PC	4	4
0022	TWC	0	0
0022	PC	9	9
0023	TWC	0	0
0023	PC	0	0
0024	TWC	0	0
0024	PC	2	2
0026	TWC	0	0
0026	PC	0	0
0027	TWC	0	0
0027	PC	2	2
0028	TWC	0	0
0028	PC	8	8
0029	TWC	0	0
0029	PC	10	10
0030	TWC	0	0
0030	PC	4	4
0031	TWC	0	0
0031	PC	7	7
0032	TWC	0	0
0032	PC	9	9
0033	TWC	0	0
0033	PC	11	11

6.4 Seafloor Photography

4K Camera System

The 4K (4000 m depth capability) camera system was designed and built at GSCA in 2008 and was modified during early 2010 for the summer season. The system takes high definition still photos of the seabed when the camera is within a couple of metres elevation above the seabed. A new camera was housed in the underwater pressure case for the 2010 season (Canon EOS Rebel T2i 18 megapixel digital SLR coupled to a 28 mm Canon lens). Two Canon flashes housed within pressure cases provided the illumination. A Benthos stainless steel compass fin with a Ritchey yacht compass hung below the camera on a 2 m stainless cable attached to a magnetic plunger switch which activated the camera shutter when the camera was lowered near the seabed and turned off the ping from a 12 kHz pinger mounted on the sled. A Deep Sea Power & Light 12 volt battery provided the power for the flash units and camera.

The digital Canon EOS Rebel camera was set at fixed manual focus with multi pattern metering. Exposure was set at $1/30^{th}$ of a second and the F-stop was set at F/16 with no exposure compensation.

All the components were bolted within a rugged powder coated aluminum roll cage that weighed approximately 250 kg. The sled was lowered to the seabed using the hydrostatic winch in the upper deck winch room while listening to the 12 kHz ping set at 1 Hz intervals. A 12 kHz Rayetheon sounder was monitored during the bottom drops in order to follow the pinger location and provide an audible beacon of seabed touch downs. Station 0017 resulted in exceptionally good photos (34 on bottom in 670 m depth) while station 0025 was not as successfully (23 on bottom in 936 m depth) possibly due to abrupt winch payout.

VLADCam Bullet HD Video

A Sony HDR-CX 520 high definition camcorder is located inside the VLADCam Bullet system. The underwater pressure housing was honed from a Catalina S30 Scuba air cylinder. The view port was constructed of a flat 1.25” thick acrylic plate with one face o-ring seal and attached with 5 radial bolts to the valve end of the cylinder. The non-valve end was bored and a circular plug was built with two piston o-rings. The system was built during 2009 and tested to depths over 2000 m.

The camera was self powered by large capacity Sony NP-FH100 lithium ion batteries and the video data was recorded on 32 GB Sony HG Duo memory sticks. Approximately 8 GB per hour were produced when the camera was set at the highest HD-FH setting. The removable memory sticks allowed for a relatively quick turn around time of approximately 10 minutes between station dives.

Due to the autonomous nature of the camera it was mounted on the 4K Camera sled. Two dive stations were conducted during the mission, station 0017 and station 0025 and both provided useful video transects. Station 0025 had some blackout periods due to the camera resting on the bottom for many seconds. For some unknown reason the 4K camera pinger was not consistently shutting off properly on touchdown.

The camera was set to auto focus and auto white balance for the majority of the dives. The seafloor was lit under a Deep Sea Power & Light (DSPL) high intensity Matrix LED drawing just 44 watts and producing light at a high colour temperature of 6800° K. The camera appeared to be very stable and showed good colours under the LED which approached true daylight colour temperatures. This light was powered on the 4K sled by the DSPL 12 volt deep ocean battery system.

Subsea Positioning via USBL

An Applied Acoustics 915 HD beacon was attached to the 4K camera sled and was tracked using an ORE Trackpoint II deck unit and transducer lowered on a ram beneath the vessel. GSCA NavNet Master Logger software version 1.9.4 was used in conjunction with GSCA NavNet USBL RT v1.2. to record the raw and processed USBL positions.

During station 0017 there was fairly constant thrusting by the vessel that may have disrupted subsea acoustics preventing a merge of the processed USBL so raw USBL was used for positioning on this station. On station 0017 the deck unit was configured to telemetry mode. Processed USBL was successfully merged for station 0025 with the deck unit set to calculated mode.

Position information was embedded into the still photos using GSCA NavNet JPEG Merge version 1.3. A .par file was provided to the navigation team as a guide for 10 second navigation for the HD video.

HD Video Editing & Backup

The video stations were edited using Sony Picture Motion software version 5.0.02.11130. The software automatically split the files at approximately 16 minute intervals so there were numerous files per station. The files were then edited so as to display only seafloor footage eliminating deck footage and the travel times descending and ascending. Station 0017 consisted of three edited files (00002.m2ts, 00003.m2ts & 00004.m2ts) while station 0025 consisted of two edited files (00002,m2ts & 00003.m2ts). The raw video files were also kept. The bottom footage was approximately 30 minutes in each case.

The files were stored on Lacie 1TB external hard drives, one to be kept with the chief scientist and one to be archived with GSCA curation.

6.5 Acoustic Systems

D. Manning and P. Meslin

During Hudson 2010-023 a suite of standard seismic surveying tools were used. Most days, surveying occurred on a nightly basis. On a few occasions we ran for longer periods of time.

The equipment used on Hudson cruise 2010-023 for collection of seismic data was as follows:

1. Single channel seismic system consisting of a pneumatic sound source and hydrophone streamer.
2. Huntec DTS (sparker source)
3. Knudsen 12 KHz ram-mounted and 3.5 KHz hull-mounted transducer.

Single Channel Seismic System

Seismic Source:

One Sercel 210 cubic inch GI gun suspended from an I-beam and a large Norwegian buoy was used for primary floatation with a small secondary buoy used to keep the slack deployment and recovery line away from the gun during the survey. The GI gun, once deployed, was towed from a portside outrigger ("ironing board") to insure separation of the gear during turns. Towing depth was 1.5 to 2 meters for this survey. Figure 6.4 below illustrates the floatation and towing arrangement.

The MITS was used to supply the master trigger to the Long Shot Seismic Source Controller and the Four Shot Seismic Source Power Supply unit. All parameters used to tune the GI Gun were set using the Long Shot/Sure Shot system. A blast phone mounted to the GI Gun was the primary sensor used in monitoring performance.

The Ironing boards from which the seismic source and streamer were towed as well as the placement of the Huntec DTS and sidescan sonar on the quarterdeck are illustrated in Figure 6.5.

Figure 6.4

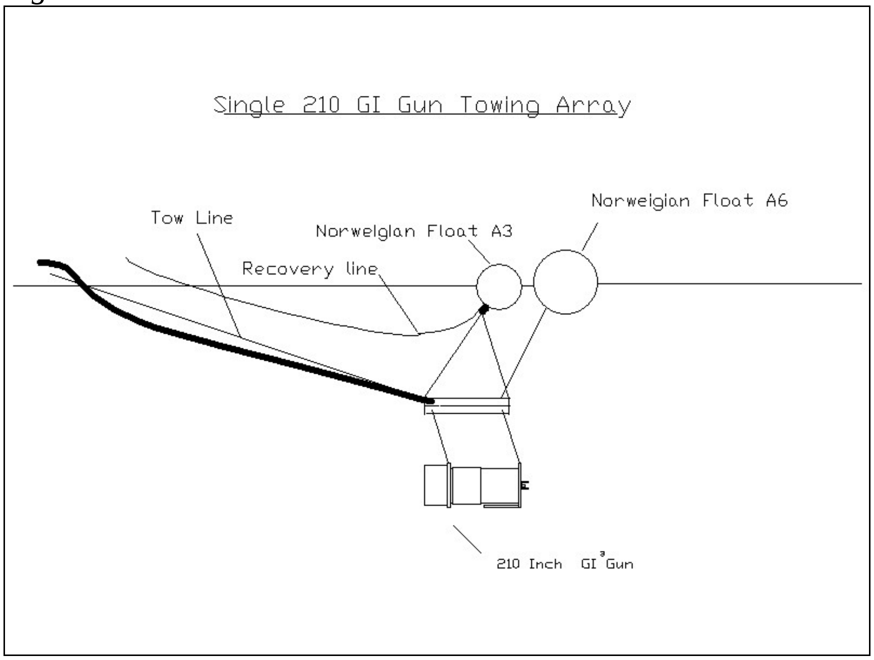
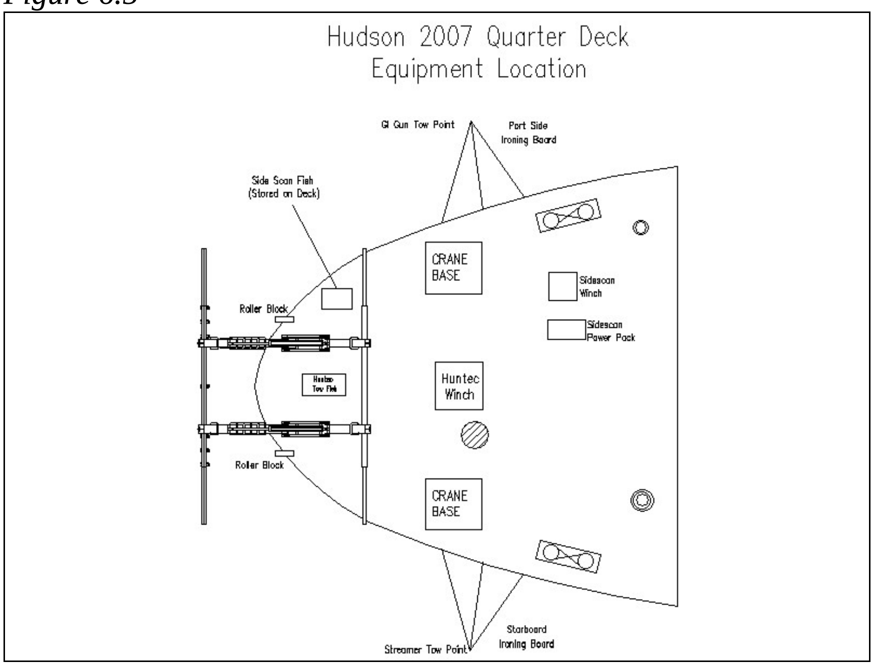


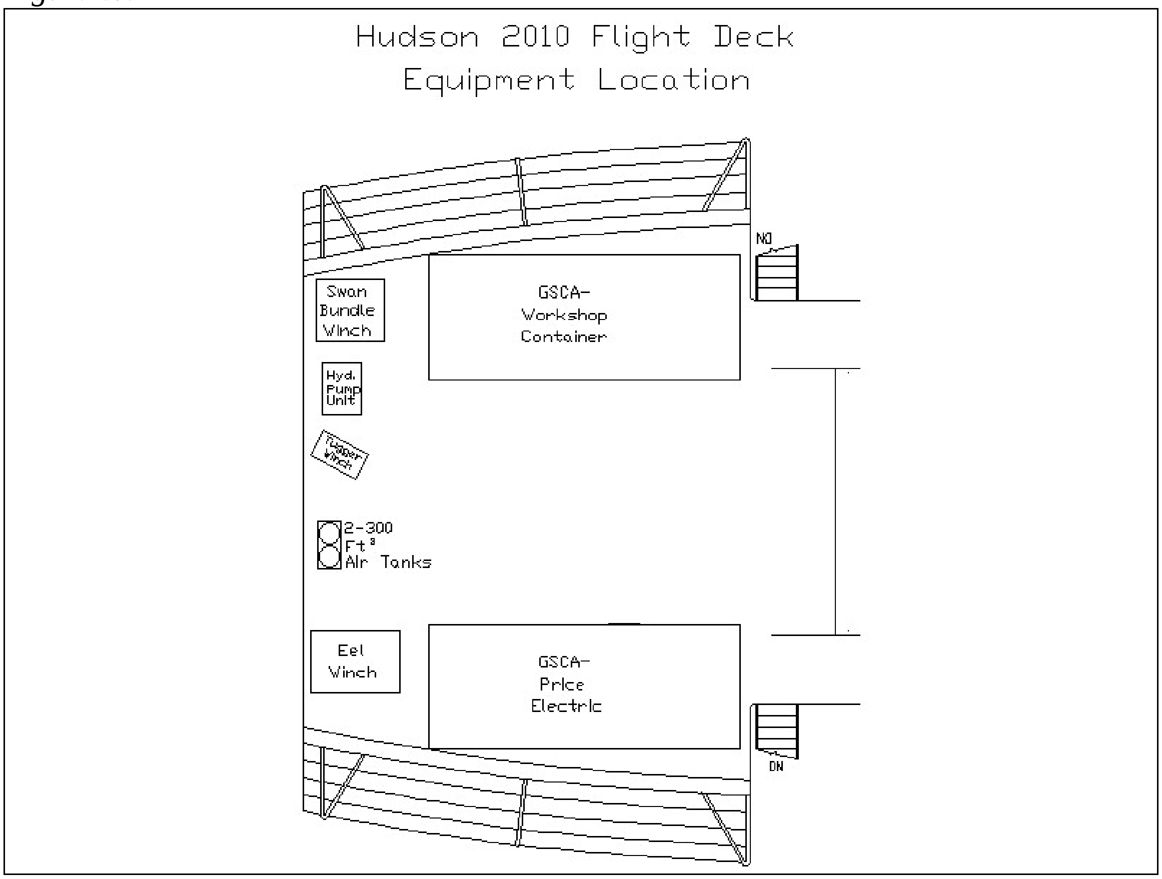
Figure 6.5



A Price W2 Air Gun Master capable of supplying air at 185 SCFM and 2000 psi was employed to fire the GI gun at 1700-1750 psi every six seconds. The compressor was driven by a 200 HP AC motor which was, in turn, controlled by a Cutler Hammer SV9000 Variable Frequency Controller located in the workshop container.

The air umbilical to the gun was contained and deployed using a winch located on the port side of the ship. A small M7 Pullmaster tugger winch was used to take up the strain during deployment and recovery of the GI Gun and umbilical. The steamer was deployed from a winch located at the starboard flight and towed for an ironing board located on the starboard rail or the quarterdeck. One 25 HP pumping unit supplied hydraulic power one winch at a time. The flight deck arrangement is illustrated in Figure 6.6.

Figure 6.6



Hydrophone Streamer:

The streamer was deployed from a winch on the flight deck and towed from an outrigger ("ironing board") mounted to the starboard side of the ship. The streamer was re-fitted in 2007 by Swain Geophysical in Texas. During the refit the streamer was outfitted with two coils for operating two DigiBird streamer birds. The Streamer has a 27ft dead section at the head and a 16ft dead section at the tail. The active section is approximately 150ft long containing 48 Teledyne B-1 acceleration-canceling hydrophone cartridges. As in previous years the streamer was towed approximately 100 metres behind the ship at a depth of 1 to 2 meters. A small drogue provided some drag for stability.

The 48 hydrophones make up 6 groups of 8 elements each. These 6 groups are summed together, amplified and the sent to the GSCDIGS for digitizing and storage. The signal is also sent to a Krohn-Hite filter and then to an EPC 9801 Thermal Recorder for a hardcopy.

Streamer tow depth was controlled using a combination of drag, ship log speed, and primarily, two DigiBirds programmed through a modem using the DigiCourse software. The streamer worked well with two DigiBirds. Depth settings and fin angles were changed according to tow and sea conditions.

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Data Acquisition, Display, and Storage:

Filters- Krohn-Hite Model 3323 Filter
Settings High Pass 20db 80Hz
Low Pass 0db 1.5KHz

Applies filtered acoustic signal to the EPC Model 9801 Thermal Hardcopy

EPC-	Model 9801	Thermal Hardcopy
	Settings	1 to 2 Second Sweep

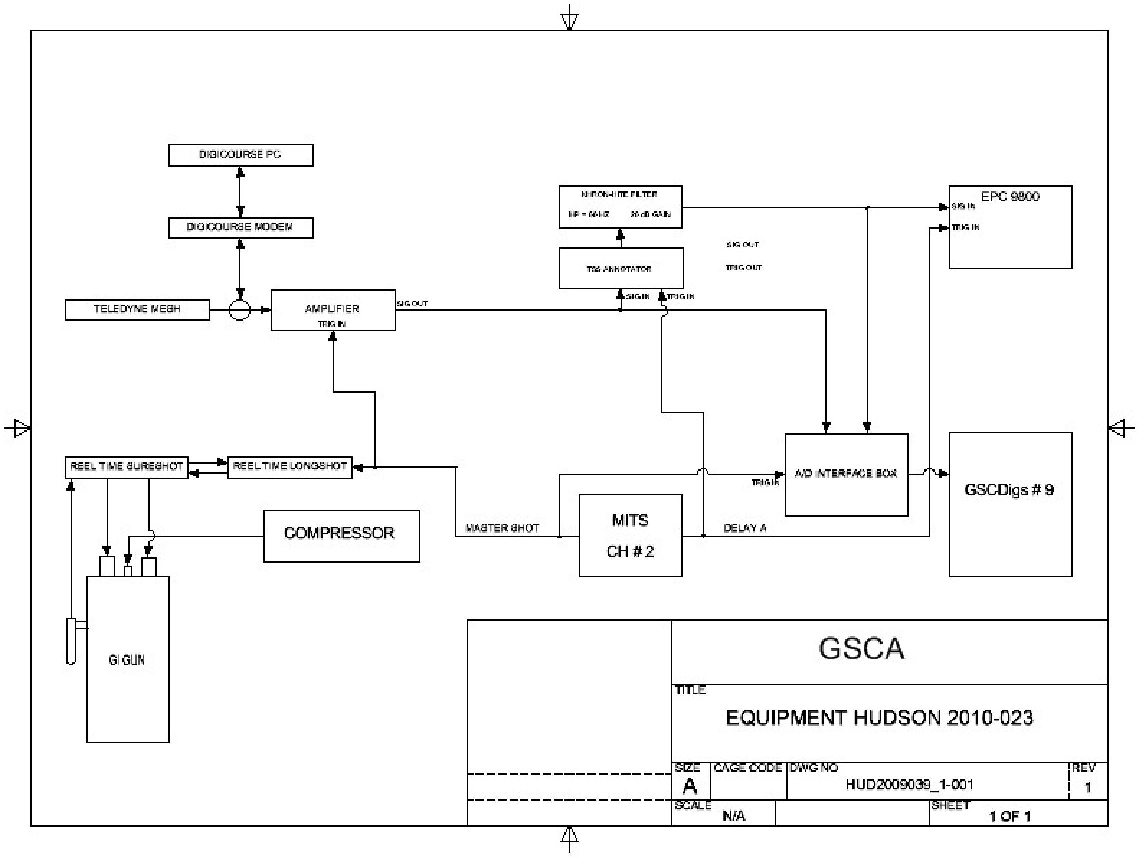
GSC Digs- GDAIMS Ver 1.4 18 – Filtered and unfiltered versions of the data were recorded

GI Guns:

Firing rate: 6.0 sec
Sample rate: 250uS for a 2 second window.

The schematic shown in Figure 6.7 illustrates the seismic equipment setup for this cruise.

Figure 6.7



Huntec Deep Towed System

The Huntec DTS was used in Boomer mode for the first part of the cruise while the Sparker was used for the deep water work. Internal and external raw data was logged to a GSC Digitizer and the filtered signals were printed to the EPC on channels A and B respectively. Filter settings of 1.2 KHz and 10 KHz were used.

Difficulties with the DTS resulted in considerable down time during the first part of the cruise. The problems with the system were intermittent which resulted in several deployments where the system had to be recovered within a short time. Repairs to the Attitude Sensor Unit inside the Deep Tow fish were successful in time for much of the deep water work.

Knudsen Sounder

During much of the program a ram mounted 12kHz transducer, transceiver and recorder were used to track bottom and gather some sub-bottom data when sampling. During transit, or when the Huntec DTS was unavailable during survey, the 3.5 KHz hull mounted transducer was used.

Timing

The triggers for the Huntec DTS, the GI gun, and the data recorders were handled by the GSCA-MITS Trigger unit which is accurate to 1 millisecond. Timing changes and applied delays kept the individual systems from interfering with each other. Delays applied to the EPC recorders allow for shifting the print window to minimize the water column. The Master timing for the 4 Channel TSS 312B Record Annotator originates from the Ship's Clock system and gets its delay timing for the EPC recorders from the appropriate GSCA-MITS channel.

The GSCA-MITS supplied the timing for the Huntec EPC recorder (Chan 1B) through a TSS 312B Record Annotator channel, and the Air gun EPC (Chan 2A) recorder through a TSS 312B Record Annotator channel.

The GSCA-MITS (Chan 2) supplied the trigger for the LongShot Seismic Source Controller, the Four Shot Seismic Source Power Supply units which generate the Generator and Injector Fire Pulses for the GI Gun and the GSC Digs.

Sercel 210 GI Gun (2)

The GSCA-MITS (Chan 2) time interval for the GI Guns was approximately 6 seconds except where a longer interval was required to minimize interference with the Huntec DTS. The air volume was set to 105 cu. in. The Injector timing for the gun was 55 ms with an 80 ms Bubble. The LongShot Seismic Source Controller was used to set the above parameters. The LongShot and the Four Shot Seismic Source Power Supply units worked well during the survey period except in a couple of instances where the system was freezing or rebooting. A power supply was swapped out to correct the problem.

Huntec DTS

The GSCA-MITS (Chan 1A) timing for the Huntec DTS was supplied by the GSCA-MITS. To keep the Huntec from interfering with the Air Gun Data, the time interval and corresponding EPC delay (Chan 1B), was adjusted as needed. The GSCA-MITS (Chan 1A) also provides the trigger for the GSC Digs Data handling system.

Performance

One Sercel 210 GI gun was used on a single beam and experienced no problems for the entirety of the cruise. The LongShot Seismic Source Controller and the Four Shot Seismic Source Power Supply units were used to minimize the Bubble by controlling the timing of the generator and injector pulses. The data was stored on the GSC Digs unit and a filtered signal was sent to an EPC 9801 Thermal Recorder.

This expedition experienced virtually no down time due to equipment failure.

2010023 SEGY → JPEG2000 Conversions

Seismic data from the GI Airgun, Huntec, and the Knudsen 3.5 kHz and 12 kHz sounders were digitally recorded in SEG-Y format. The raw SEG-Y files were then concatenated using the GSCA software CombineSEGY. The combined SEG-Y files were then compressed to JPEG2000 format using the SEGYJp2 software. Unfiltered JPEG2000 files of the signal power envelope were created for both the Knudsen 12 kHz and 3.5 kHz data using a prescribed compression ratio of 10. The Huntec external streamer data was converted to both a signal power envelope and a halfwave rectified JPEG2000. The external streamer data was filtered from 1000 Hz to 4000 Hz with a taper of 300 Hz. The GI Airgun data was also converted to a signal power envelope JPEG2000 and to a halfwave rectified one. In addition, JPEG2000 files were also created using the full waveform. In each case the data was filtered using a low cut of 60 Hz with a taper of 30 Hz. Unfiltered JPEG2000 files were also created from the digitized GI Airgun data that had been pre filtered and recorded on the EPC recorder.

Acknowledgments:

The authors of this report would like to thank the Chief Engineer, Senior Engineer and 1st engineer for supplying cooling water for the compressor.

The Bosun and Deck Crew did an excellent job in recovering and deploying gear on the quarterdeck. No cables, hoses or equipment were damaged during deployment or retrieval.

Finally we would like to extend a special thanks to Borden Chapman and Ken Asprey for their support and timely help in preparing for the cruise. We would also like to thank Bob Murphy and Ryan Pike for their efforts and assistance throughout the trip on many levels.

7.0 Data Tables and Summaries

SEISMIC GI AIRGUN				
DVD #	Start Time	End Time	Line #	Notes
1	1712241	1720857	1 to 6	
	1722012	1730744	7 to 13	
	1732047	1740858	14	
	1742210	1750900	15	
	1752136	1760905	16	
	1772144	1780900	19	
2	1782024	1790859	20	
	1792045	1800900	21,22	

SEISMIC HUNTEC				
DVD #	Start Time	End Time	Line #	Notes
1	1712228	1712338	1	
	1732045	1732224	14	
	1742206	1750636	15	
	1752137	1760905	16	
2	1772139	1772152	19	
	1780058	1780900	19	
	1782019	1790859	20	
3	1792039	1800900	21,22	

Knudsen 12 khz and 3.5 khz				
DVD #	Start Time	End Time	Line #	Notes
1	1701502	1720908	1 to 6	
2	1720908	1740859	7 to 14	
3	1740859	1751115	15	
	1751255	1751430		
	1751635	1751813		
	1752013	1760044	16	
	1760055	1761305	16	
	1761540	1771928	17,18	
	1772037	1780900	19	
4	1780900	1781128	20,21,22	
	1781224	1801051		
	1801157	1811505		

225.8 meters TOTAL sediment core

58 digital still images
65 minutes of digital video

Station Number	Instrument	Piston Corer Length (cm) Recovery	Trigger Weight Core Recovery (cm)	STATION SITES Site Descriptor	Seismic Record Expedition	Seismic Record Julian Day & UTC	Latitude	Longitude	Water depth (m) DBT	Water depth (m) LWL
0001	AGC Long Core	391.5	52	top of failure block	2009032	204 0950	51.596347	-52.526740	385	391
0002	AGC Long Core	671	154	core to date slide	2009032	204 1010	51.616489	-52.605034	450	456
0003	AGC Long Core	346	108	first trough	2009032	204 1243	51.653668	-52.654722	344	350
0004	AGC Long Core	324	131	lower trough	2009032	204 1220	51.632423	-52.578840	414	420
0005	AGC Long Core	540.5	133	edge of large trough	2010023	172 0801	51.552756	-52.056121	500	506
0006	AGC Long Core	999	146	middle of large trough	2010023	172 0758	51.554992	-52.065583	520	526
0007	AGC Long Core	204	28	top of berm	2010023	172 0749	51.561007	-52.090970	350	356
0008	AGC Long Core	501	146.5	pinch out of evacuated zone	2010023	172 0623	51.613918	-52.288003	470	476
0009	AGC Long Core	754	150	pinch out of evacuated zone	2010023	172 2143	51.713797	-52.354072	470	476
0010	AGC Long Core	132	153.5	top of mound (small target)	2010023	172 2355	51.753003	-52.148454	470	476
0011	AGC Long Core	879.5	72	long stratigraphic section	2010023	173 0558	51.792560	-52.019869	498	504
0012	AGC Long Core	578.2	148.5	top of large slump block	2010023	173 0547	51.778324	-52.002016	460	466
0013	AGC Long Core	253.5	0	top of large glide block	2010023	173 0404	51.660558	-51.828362	275	281
0014	AGC Long Core	211	48	terrace in canyon (small target)	2005033B	214 1301	52.001321	-50.509936	1685	1691
0015	AGC Long Core	325	135	deep stratigraphy	2005033B	214 1111	51.895022	-50.396242	1595	1601
0016	AGC Long Core	835.5	50	long stratigraphic section into canyon levee	2005033B	214 1255	51.995695	-50.502654	1584	1590
0017	4K Camera system & Vlad bullet video			SE transect over downslope section, 30 minute bottom time	2010023	174 0717	52.113301 52.112212	-50.854375 -50.851440	670	676
0018	AGC Long Core	856	51.5	thick stratigraphic section 15 N mi from end of line	2010023	175 0631	52.667863	-50.550951	2520	2526
0019	AGC Long Core	695	162	stratigraphy over glacigenic debris flow 2.5 N mi from Stn 0018	2010023	175 0600	52.628774	-50.562649	2450	2456
0020	AGC Long Core	1089.5	149	channel 2.5 N mi from Stn 0019	2010023	175 0840	52.842808	-50.498407	2770	2776
0021	AGC Long Core	502.5	147.5	thin stratified over channel fill 20 N mi from end of line	2010023	176 0518	53.435981	-50.742761	3150	3156

0022	AGC Long Core	1028.5	136.5	thick stratigraphic section 17 N mi from end of line	2005033B	215 0642	53.123469	-51.693175	1661	1667
0023	AGC Long Core	0	84	perched canyon floor 8 N mi from Stn 0022	2005033B	215 0824	53.241878	-51.792789	1660	1666
0024	AGC Long Core	405.5	150	thin stratigraphy over regional glaigenic debris flow 2 N mi from Stn 0023	2005033B	215 0852	53.275542	-51.825912	1595	1601
0025	4K Camera system & Vlad bullet video			Southerly transect over fishing zone and suspect coral species habitat. Fishing vessel on station required a slight deviation from the original start position	2010023	177 1925	53.228336	-52.028811	936	942
							53.225280	-52.027628	?	
0026	AGC Long Core	1142	119	thick stratigraphy on channel levee ~ 15 N mi form core end of line	2010023	176 0545	53.472206	-50.758129	3060	3066
0027	AGC Long Core	306	0	transparent glacigenic debris flow	2010023	178 0156	53.444292	-51.773882	1866	1872
0028	AGC Long Core	685	18.5	smooth transparent interval over regional reflection (small target)	2010023	179 0614	52.743832	-51.087744	2070	2076
0029	AGC Long Core	1017.5	153.5	thick stratified interval ~3 N mi from Stn 0028	2010023	179 0540	52.790013	-51.124308	2013	2019
0030	AGC Long Core	555	51	stratigraphy over reginal mass transport deposit ~12 N mi from Stn 0029	2010023	179 0807	52.609539	-50.981126	1976	1982
0031	AGC Long Core	918	77	stratified terrace ~10 N mi from end of line	2010023	180 0717	52.044595	-49.872661	2780	2786
0032	AGC Long Core	1234	144.5	thick stratified interval ~3 N mi from Stn 0031	2010023	180 0645	52.089271	-49.914955	2620	2626
0033	AGC Long Core	1029.5	69	thick stratified interval ~6 N mi from Stn 0032	2010023	180 0753	51.994458	-49.824075	2765	2771

8.0 Appendix 1- Maps showing locations of seismic reflection profiles and samples

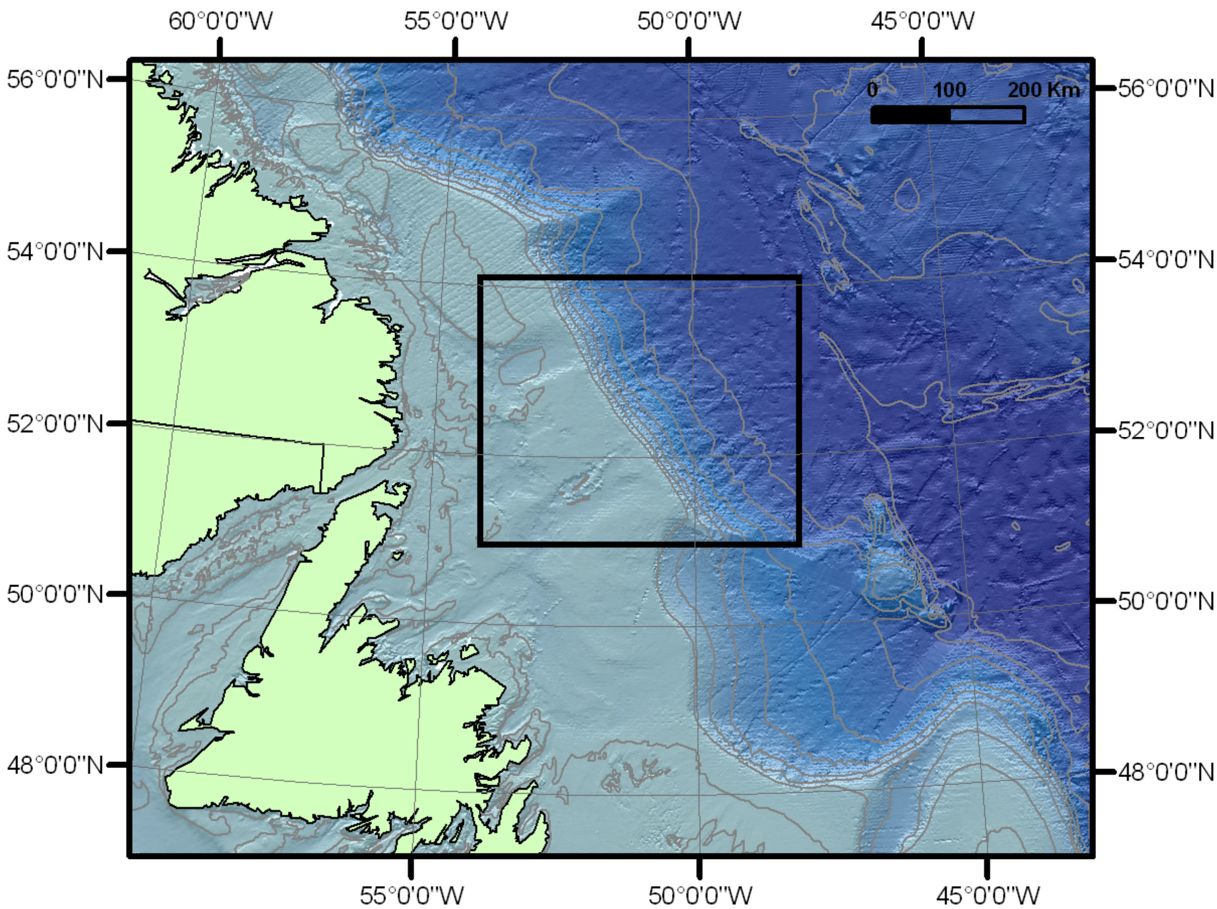


Figure A1.1- Map showing general work location during Hudson 2010023 on the N.E. Newfoundland Shelf and Slope.

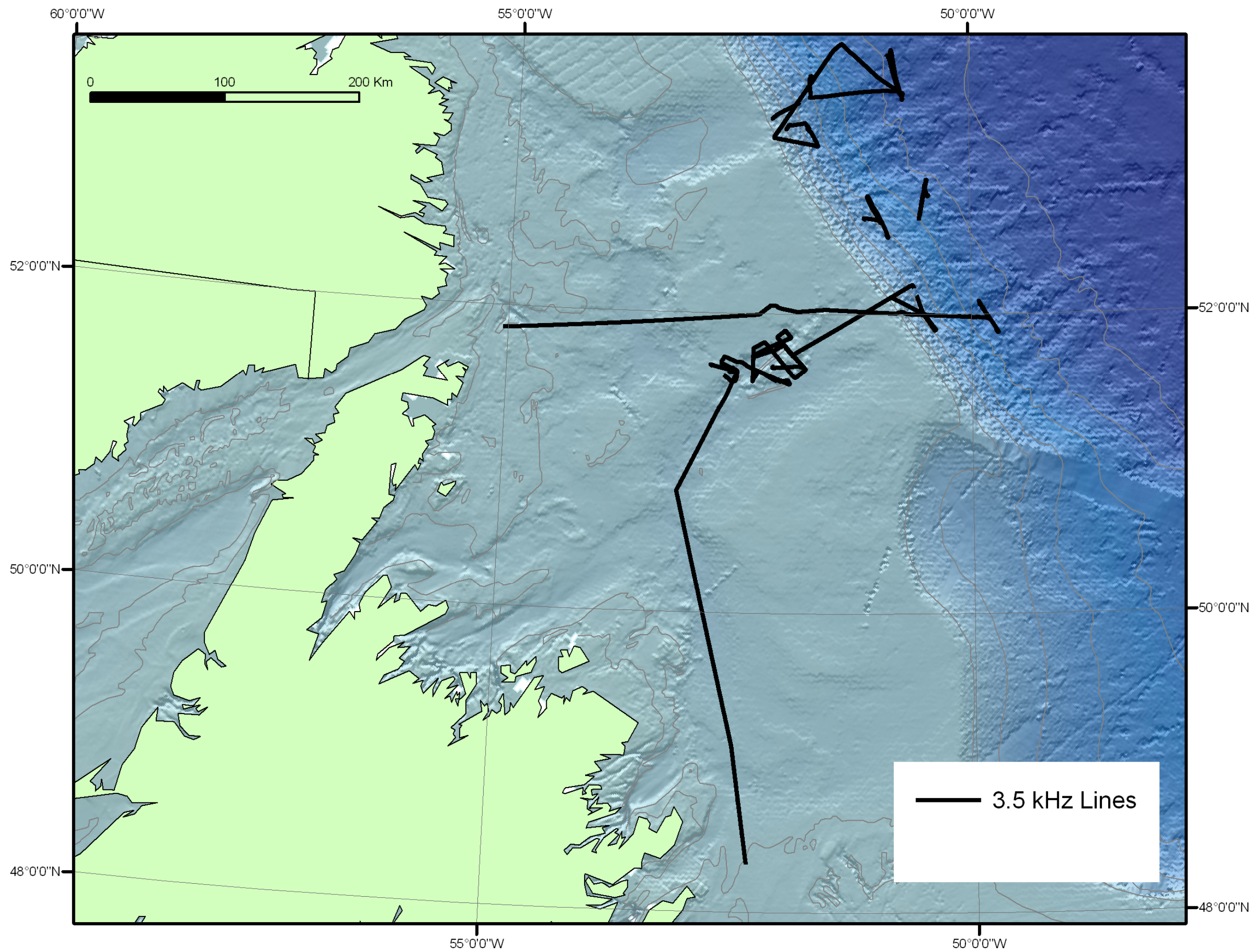


Figure A1.2- Distribution of 3.5 kHz profiles.

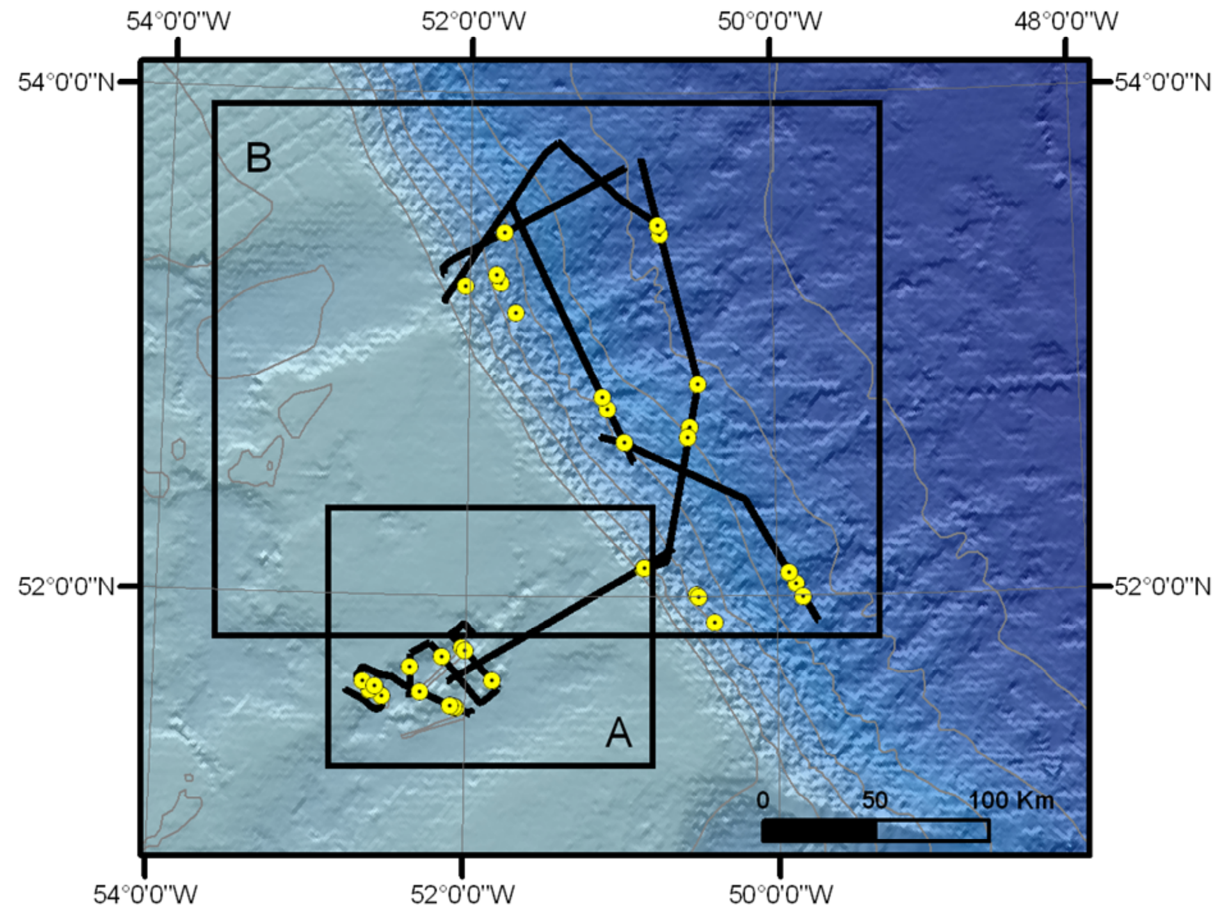


Figure A1.3- Regional map showing location of survey lines and samples during Hudson 2010023.

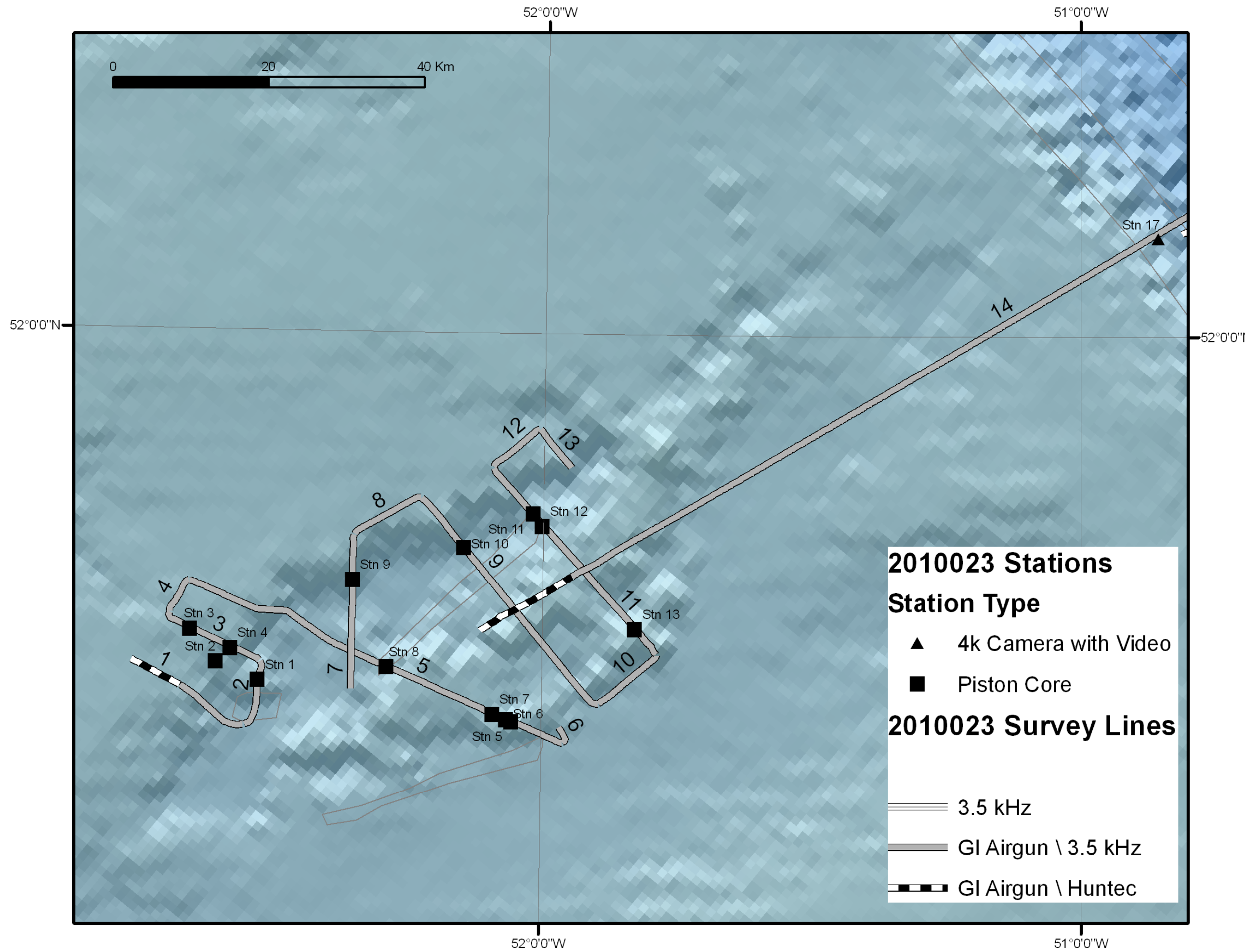


Figure A1.4- Sample and survey line locations in Notre Dame Trough.

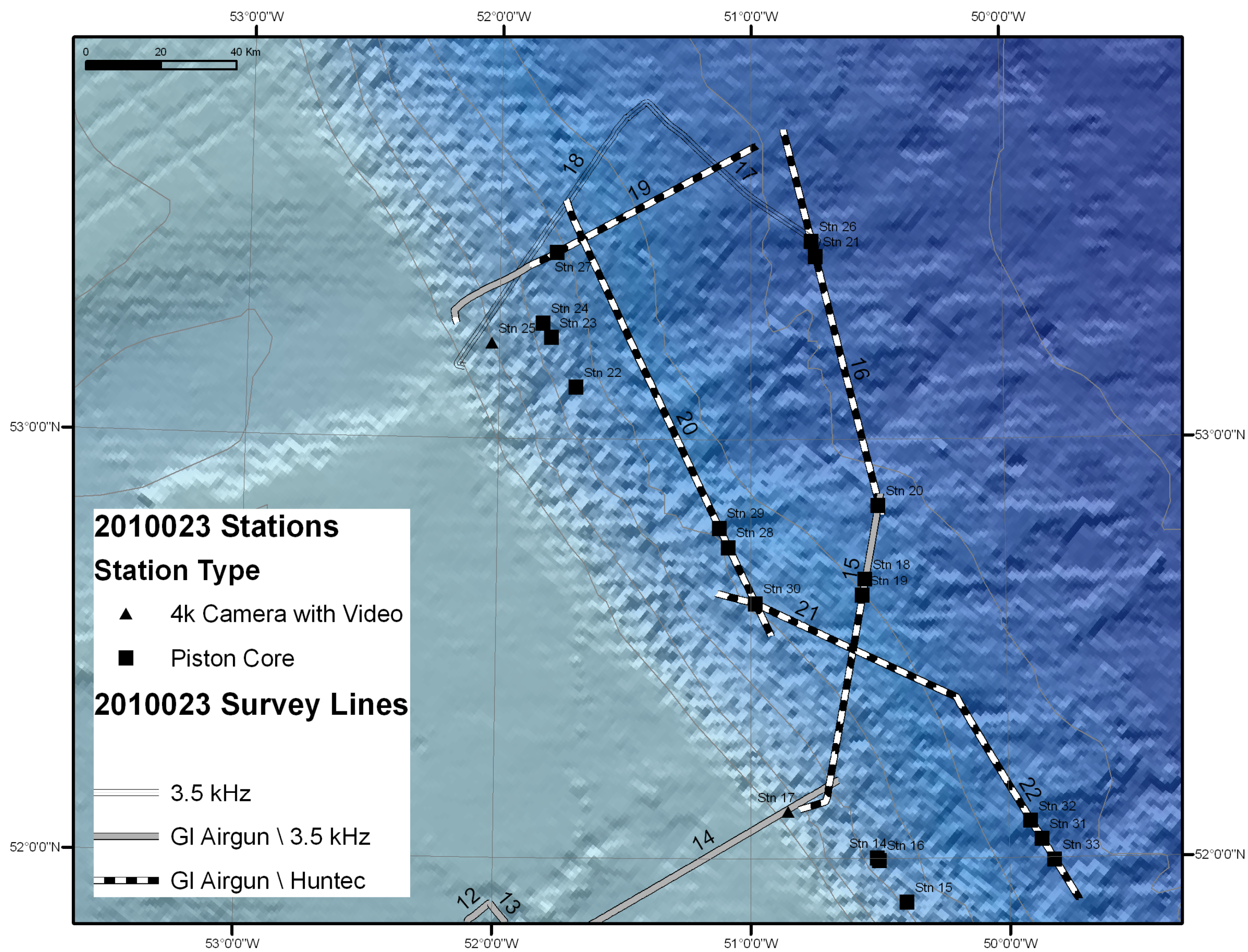
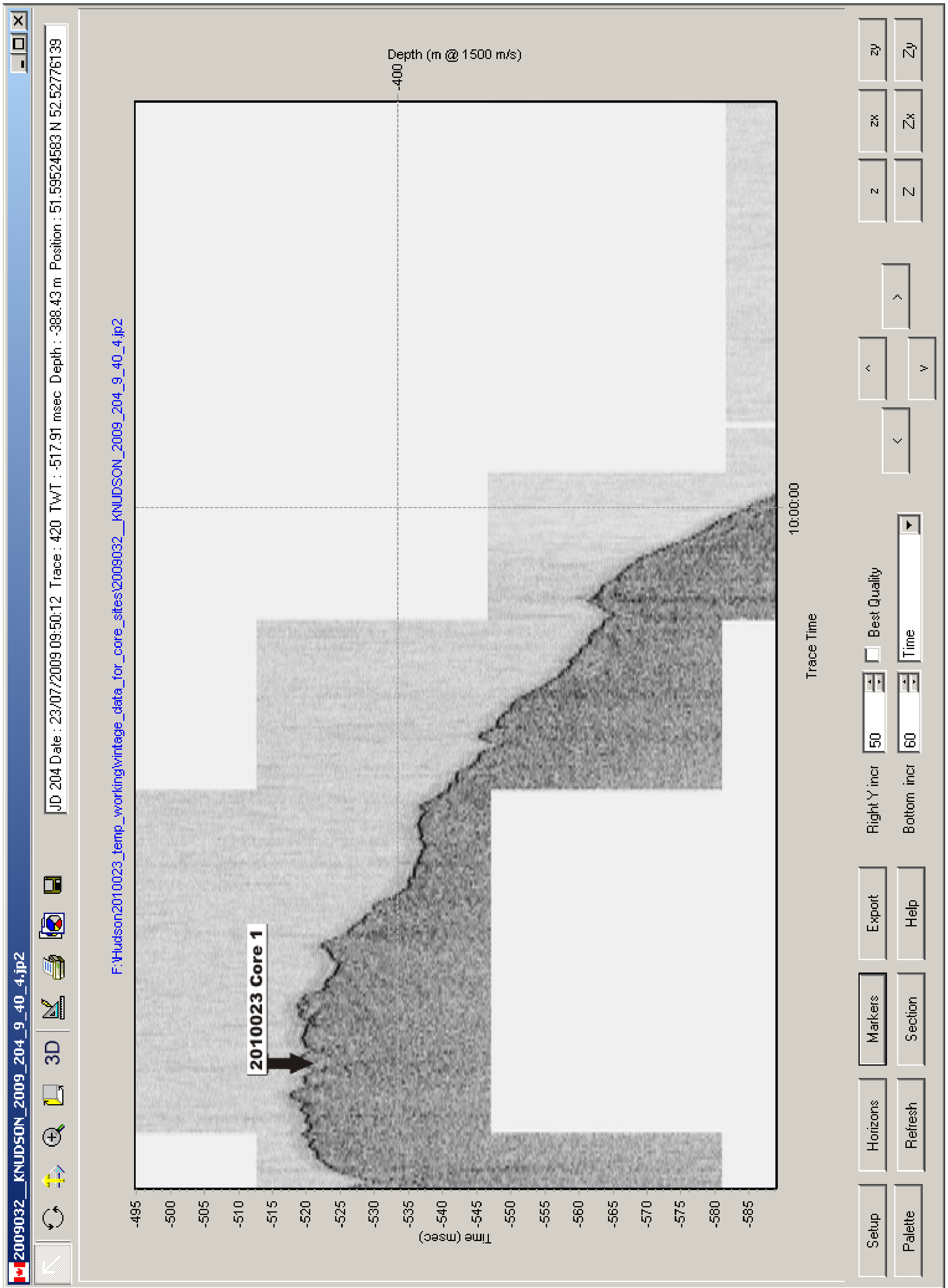
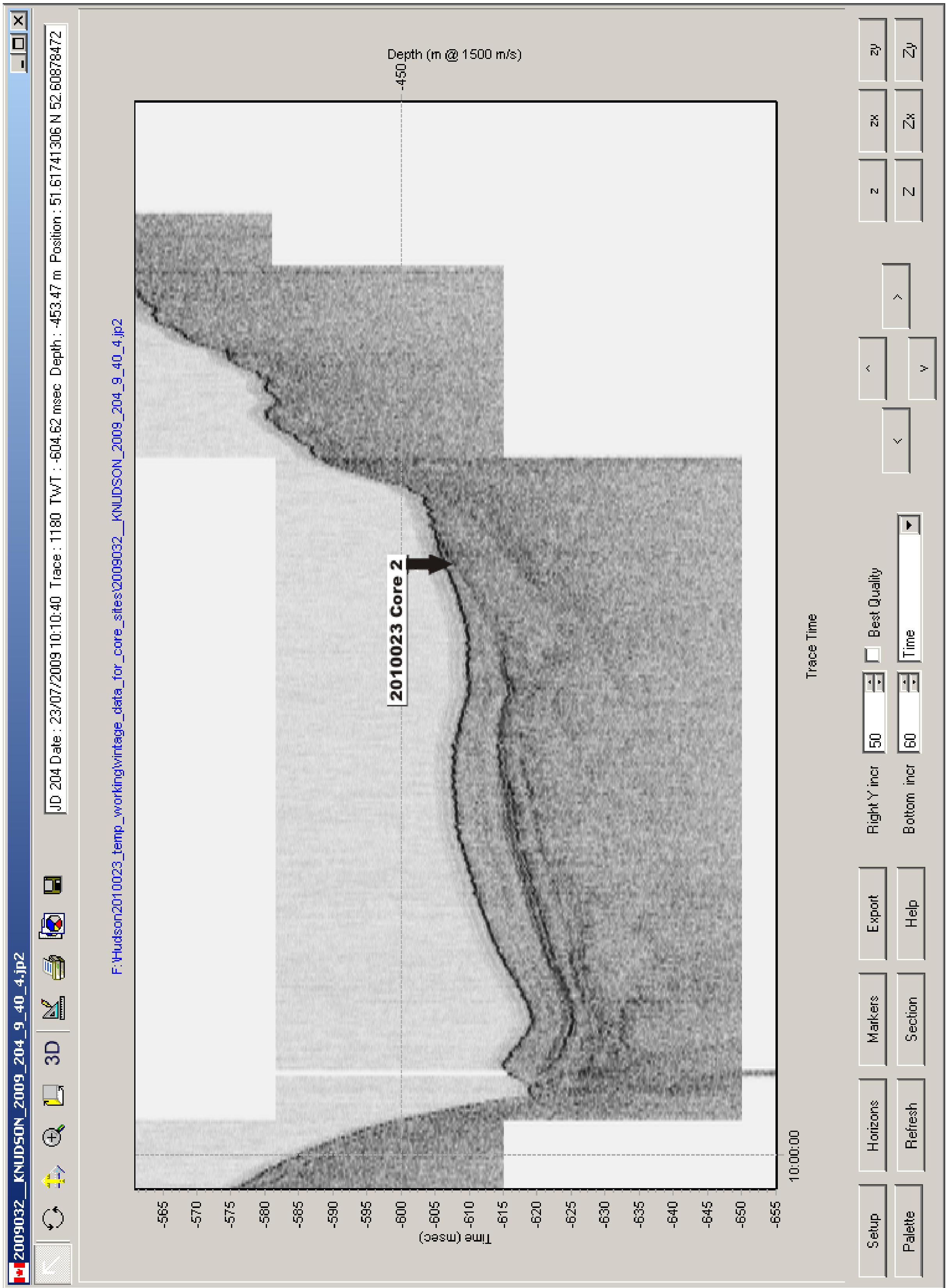
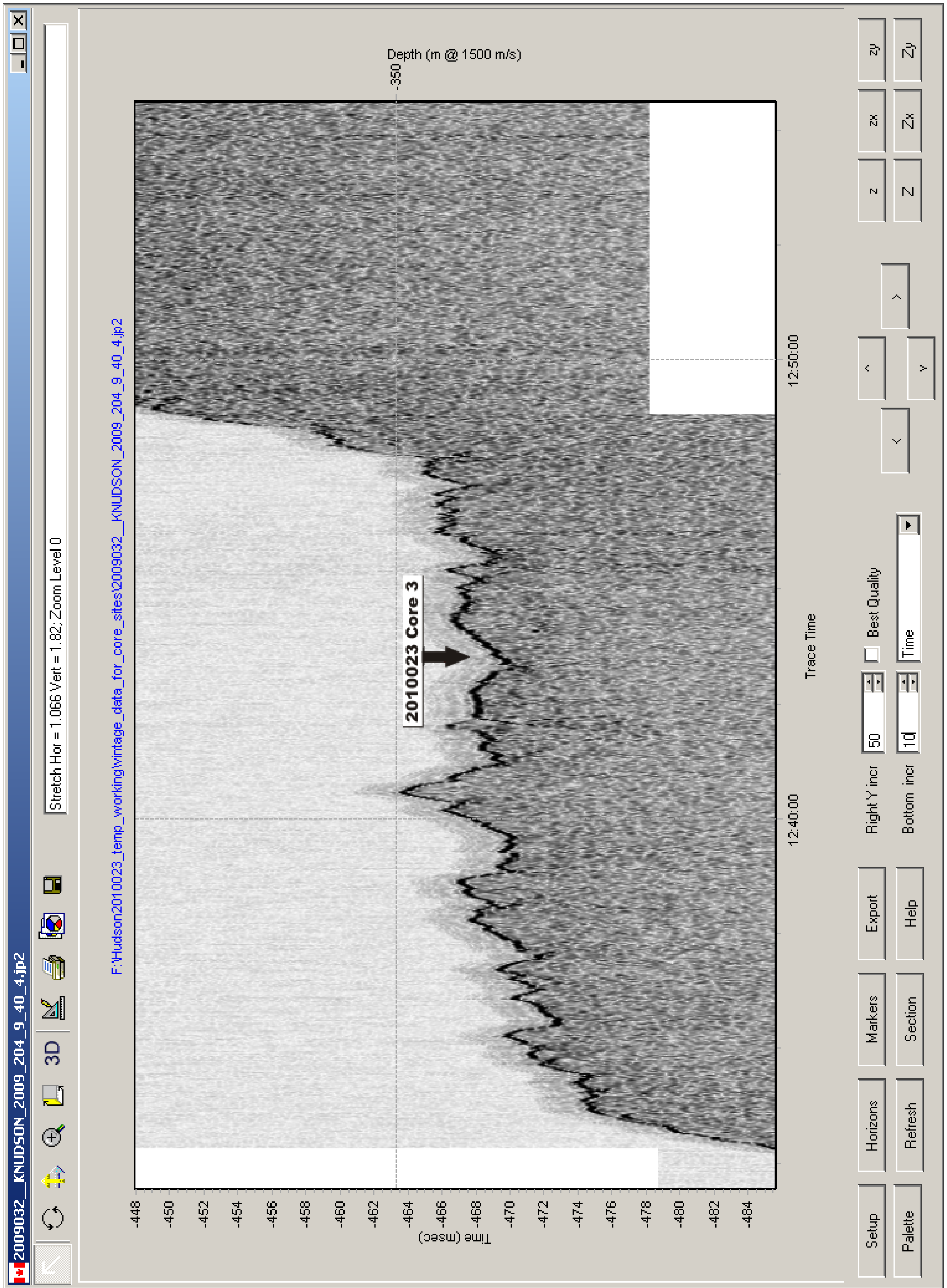


Figure A1.5- Sample and survey line locations on the N.E. Newfoundland Slope.

9.0 Appendix 2- Seismic profiles at sample locations.


2009032__KNUDSON_2009_204_9_40_4.jp2
JD 204 Date : 23/07/2009 09:50:12 Trace : 420 TWT : -517.91 msec Depth : -388.43 m Position : 51.59524583 N 52.52776139
F:\Hudson2010023_temp_working\vintage_data_for_core_sites\2009032__KNUDSON_2009_204_9_40_4.jp2
Depth (m @ 1500 m/s)
-400
2010023 Core 1
Time (msec)
Trace Time
10:00:00
Setup
Palette
Horizons
Refresh
Markers
Section
Export
Help
Right Y incr
Bottom incr
Best Quality
Time


2009032__KNUDSON_2009_204_9_40_4.jp2
JD 204 Date : 23/07/2009 10:10:40 Trace : 1180 TWT : -604.62 msec Depth : -453.47 m Position : 51.61741306 N 52.60878472
F:\Hudson2010023_temp_working\vintage_data_for_core_sites\2009032__KNUDSON_2009_204_9_40_4.jp2
Depth (m @ 1500 m/s)
-450
2010023 Core 2
Time (msec)
-565
-570
-575
-580
-585
-590
-595
-600
-605
-610
-615
-620
-625
-630
-635
-640
-645
-650
-655
10:00:00
Trace Time
Setup
Horizons
Markers
Export
Palette
Refresh
Section
Help
Right Y incr
50
Bottom incr
60
Best Quality
Time
z
zx
zy
Z
Zx
Zy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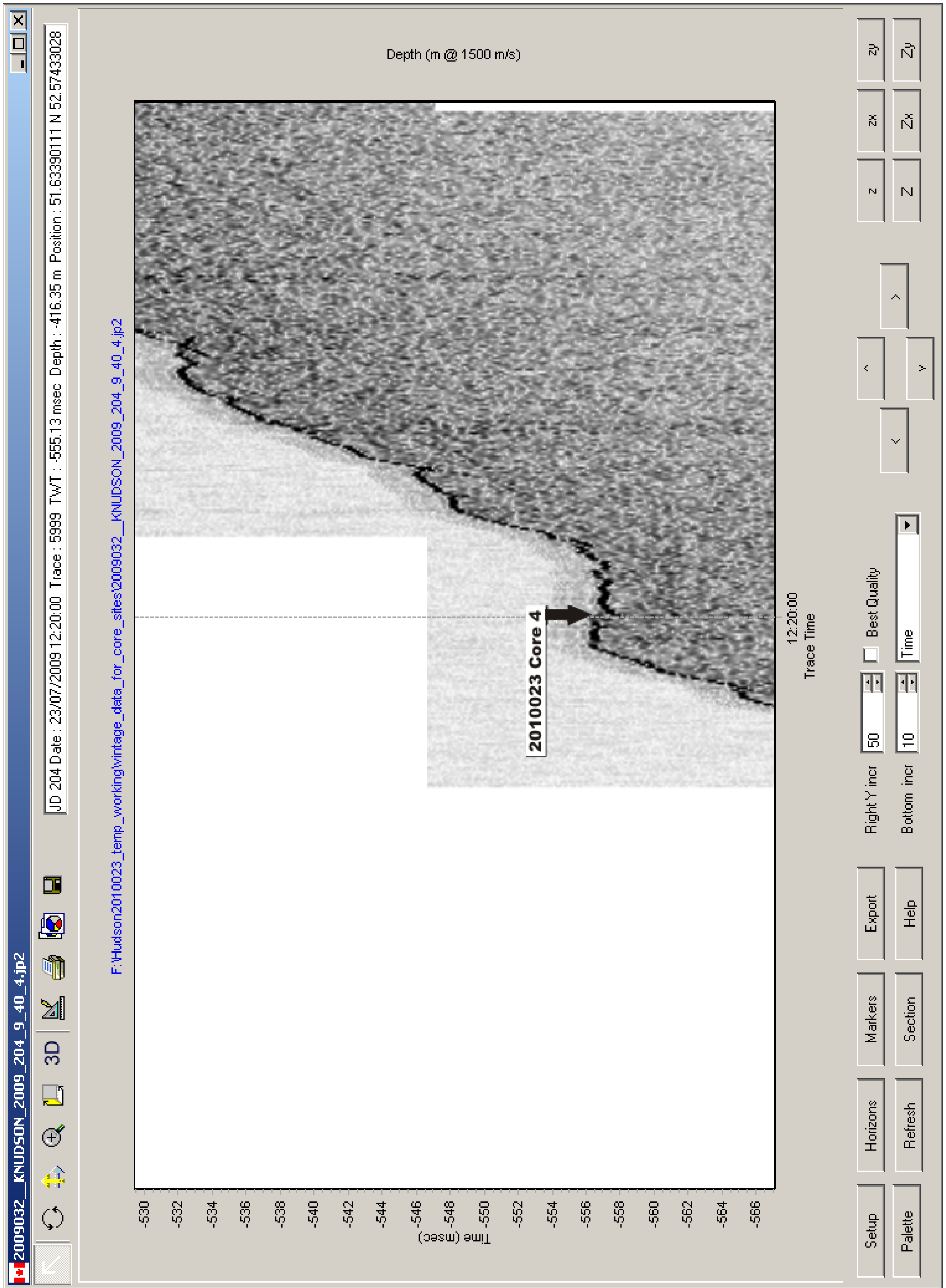
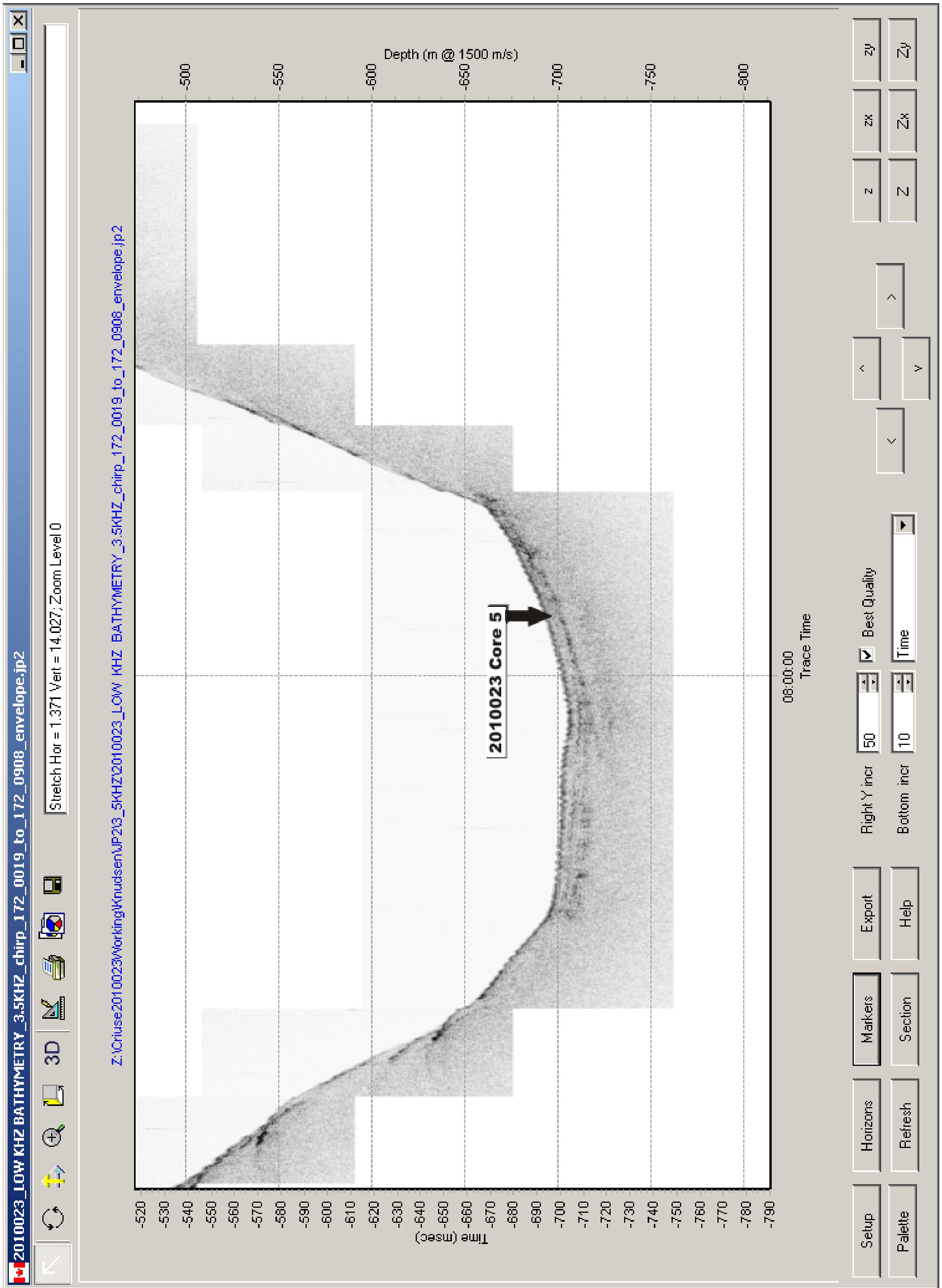
Depth (m @ 1500 m/s)
-350
Time (msec)
-448
-450
-452
-454
-456
-458
-460
-462
-464
-466
-468
-470
-472
-474
-476
-478
-480
-482
-484
2010023 Core 3
12:40:00
12:50:00
Trace Time
Setup
Palette
Horizons
Refresh
Markers
Section
Export
Help
Right Y incr
50
Bottom incr
10
Best Quality
Time
z
zx
zy
Z
Zx
Zy


2009032__KNUDSON_2009_204_9_40_4.jp2
JD 204 Date : 23/07/2009 12:20:00 Trace : 5999 TWT : -555.13 msec Depth : -416.35 m Position : 51.63390111 N 52.57433028
F:\Hudson2010023_temp_working\vintage_data_for_core_sites\2009032__KNUDSON_2009_204_9_40_4.jp2
Depth (m @ 1500 m/s)
2010023 Core 4
Time (msec)
12:20:00
Trace Time
Setup
Palette
Horizons
Refresh
Markers
Section
Export
Help
Right Y incr
Bottom incr
Best Quality
Time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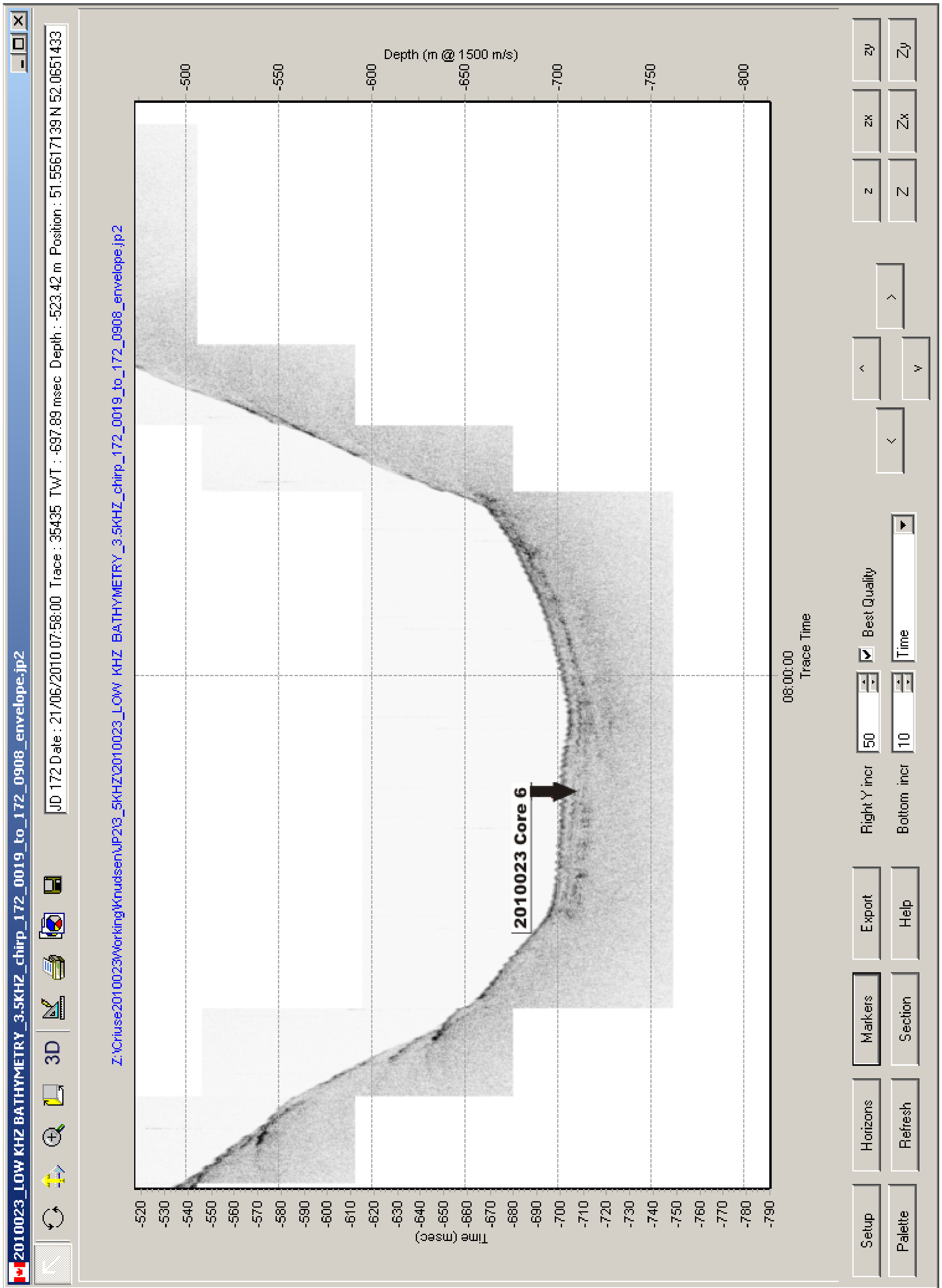
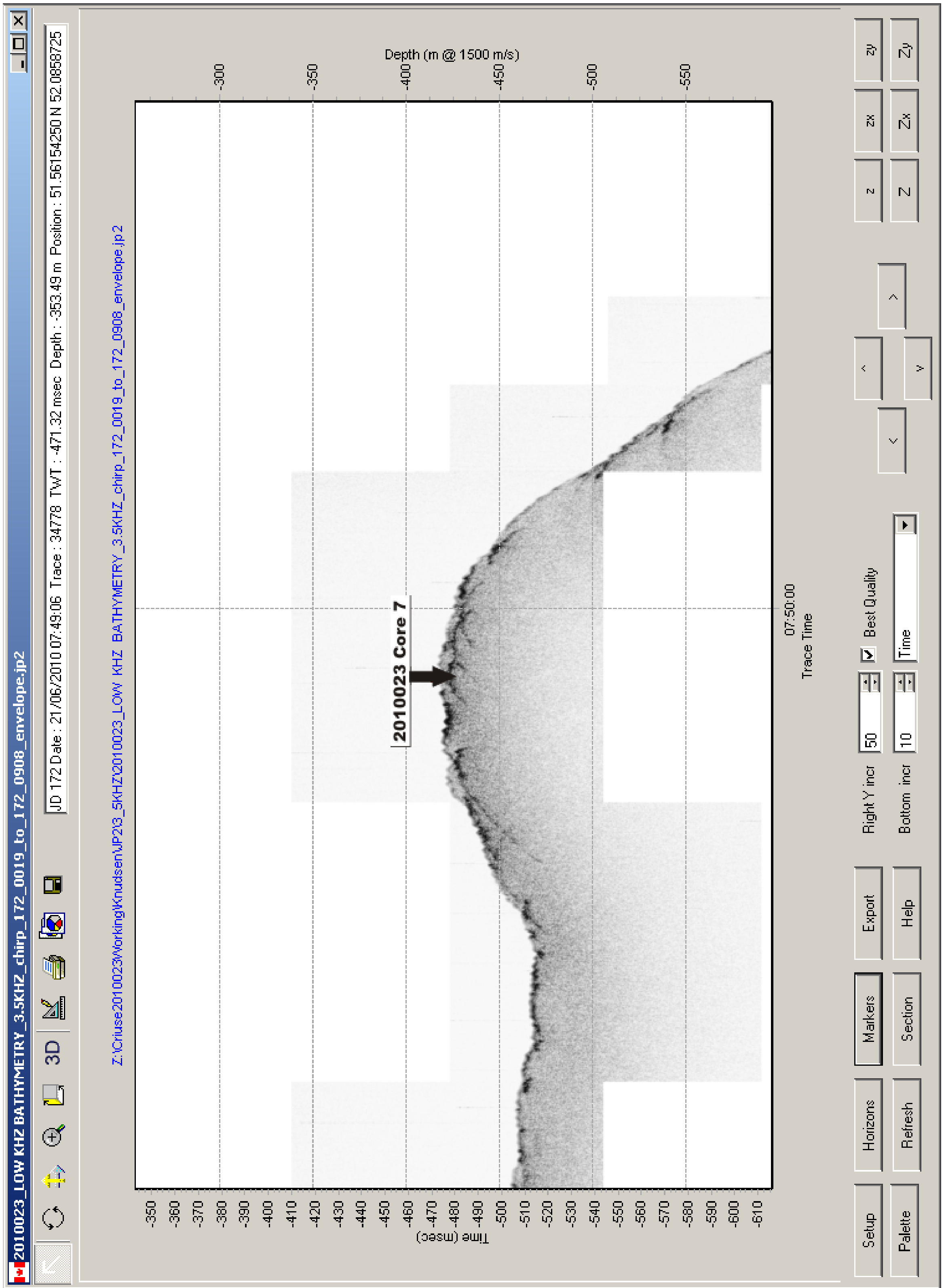
Z:\Criuse2010023\Working\Knudsen\JP2\3_5KHZ\2010023_LOW KHZ BATHYMETRY_3.5KHZ_chirp_172_0019_to_172_0908_envelope.jp2
Depth (m @ 1500 m/s)
Time (msec)
2010023 Core 5
08:00:00
Trace Time
Right Y incr
Bottom incr
Best Quality
Time
Setup
Palette
Horizons
Refresh
Markers
Section
Export
Help


2010023_LOW KHZ BATHYMETRY_3.5KHZ_chirp_172_0019_to_172_0908_envelope.jp2
JD 172 Date : 21/06/2010 07:58:00 Trace : 35435 TWT : -697.89 msec Depth : -523.42 m Position : 51.55617139 N 52.0651433
Z:\Cruise2010023\Working\Knudsen\JP2\3_5KHZ\2010023_LOW KHZ BATHYMETRY_3.5KHZ_chirp_172_0019_to_172_0908_envelope.jp2
Depth (m @ 1500 m/s)
Time (msec)
2010023 Core 6
08:00:00
Trace Time
Setup
Palette
Horizons
Refresh
Markers
Section
Export
Help
Right Y incr
Bottom incr
Best Quality
Time
z
Z
zx
Zx
zy
Zy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Depth (m @ 1500 m/s)
-300
-350
-400
-450
-500
-550
Time (msec)
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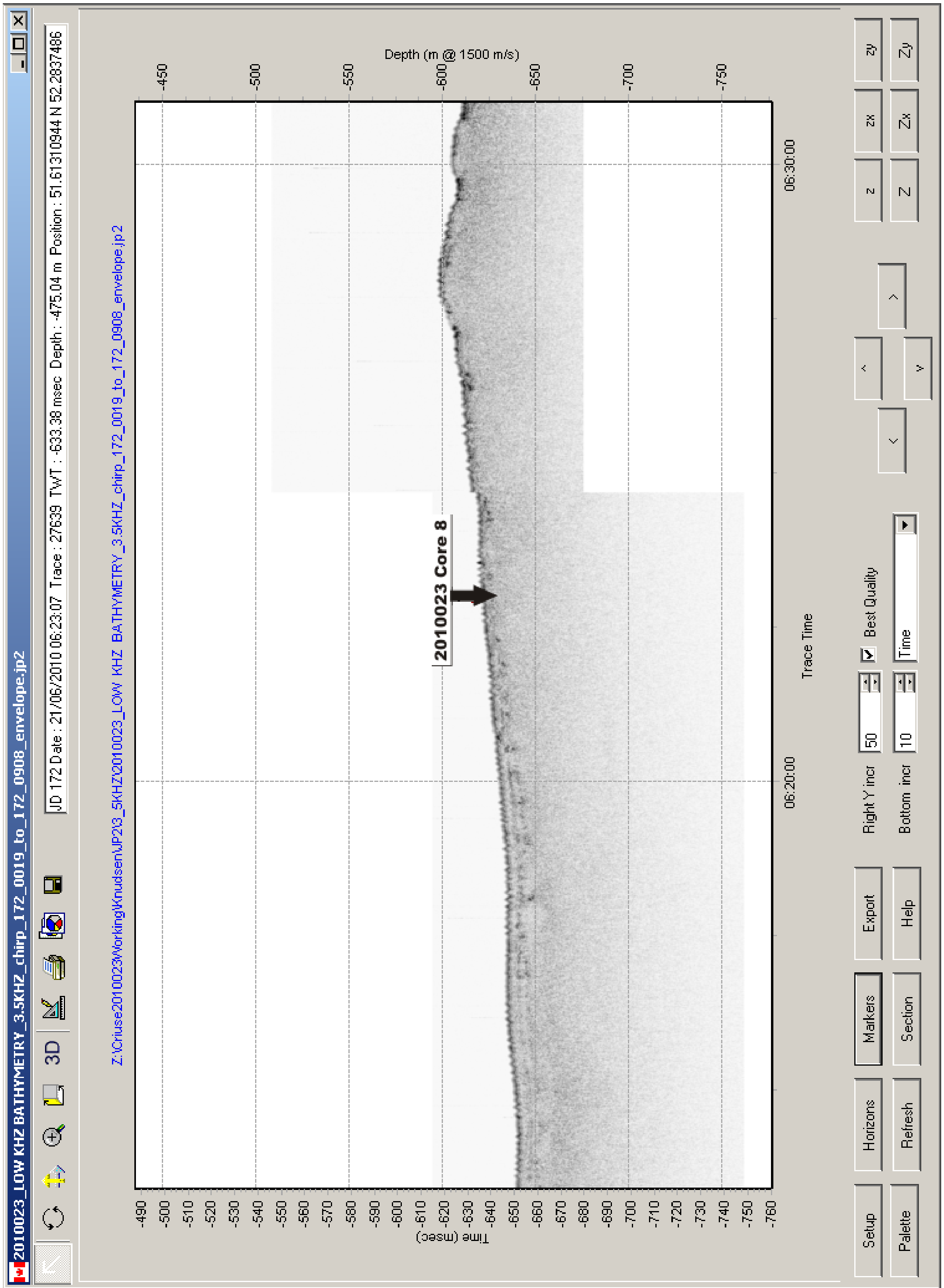
-360
-370
-380
-390
-400
-410
-420
-430
-440
-450
-460
-470
-480
-490
-500
-510
-520
-530
-540
-550
-560
-570
-580
-590
-600
-610
2010023 Core 7
07:50:00
Trace Time
Setup
Palette
Horizons
Refresh
Markers
Section
Export
Help
Right Y incr
50
Bottom incr
10
Best Quality
Time
z
zx
zy
Z
Zx
Zy



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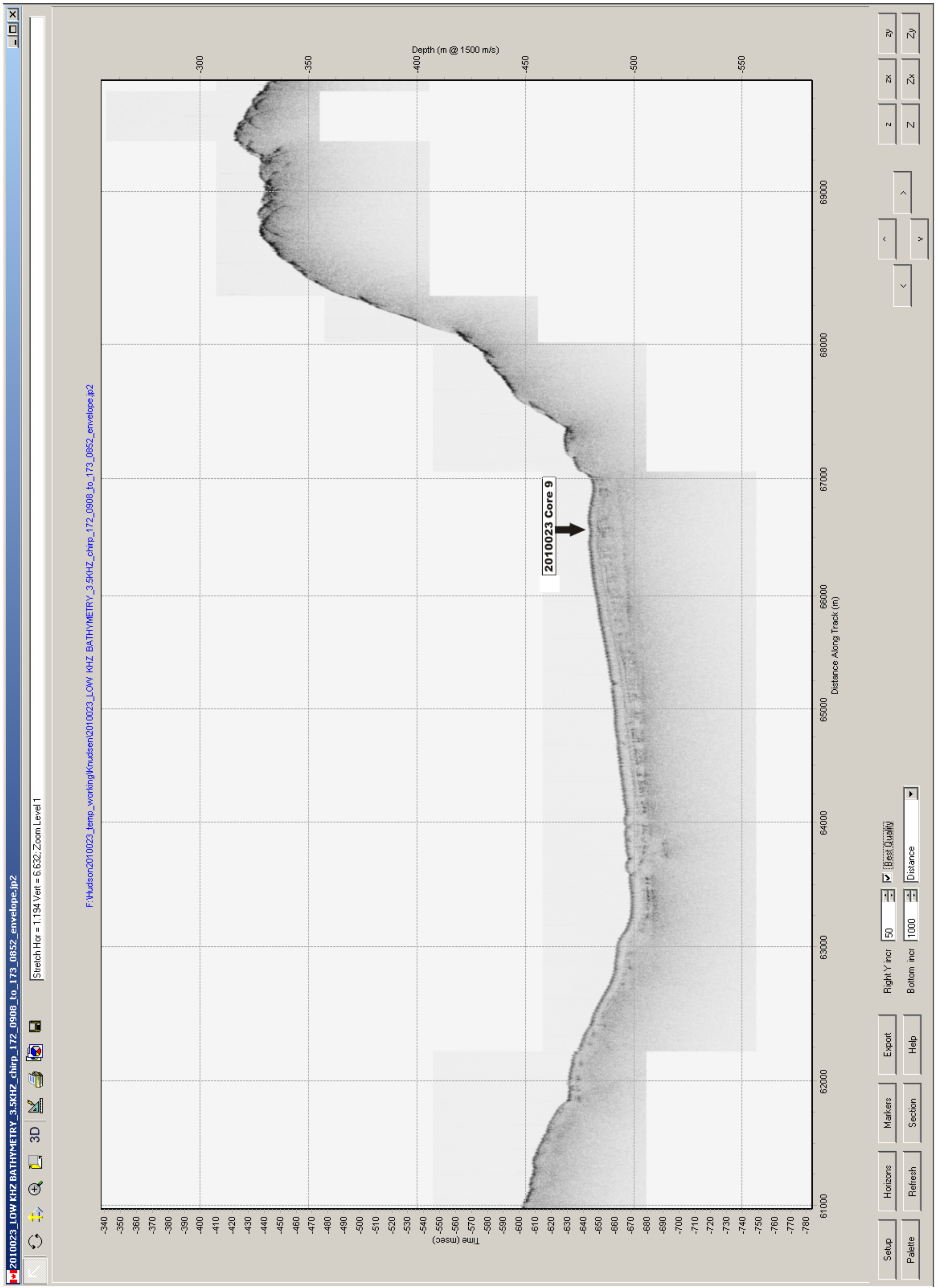
Z:\Criuse2010023\Working\Knudsen\JP2\3_5KHZ\2010023_LOW KHZ BATHYMETRY_3.5KHZ_chirp_172_0019_to_172_0908_envelope.jp2
Depth (m @ 1500 m/s)
2010023 Core 8
Time (msec)
Trace Time
06:20:00
06:30:00
Setup
Horizons
Markers
Export
Palette
Refresh
Section
Help
Right Y incr
Bottom incr
Best Quality
Time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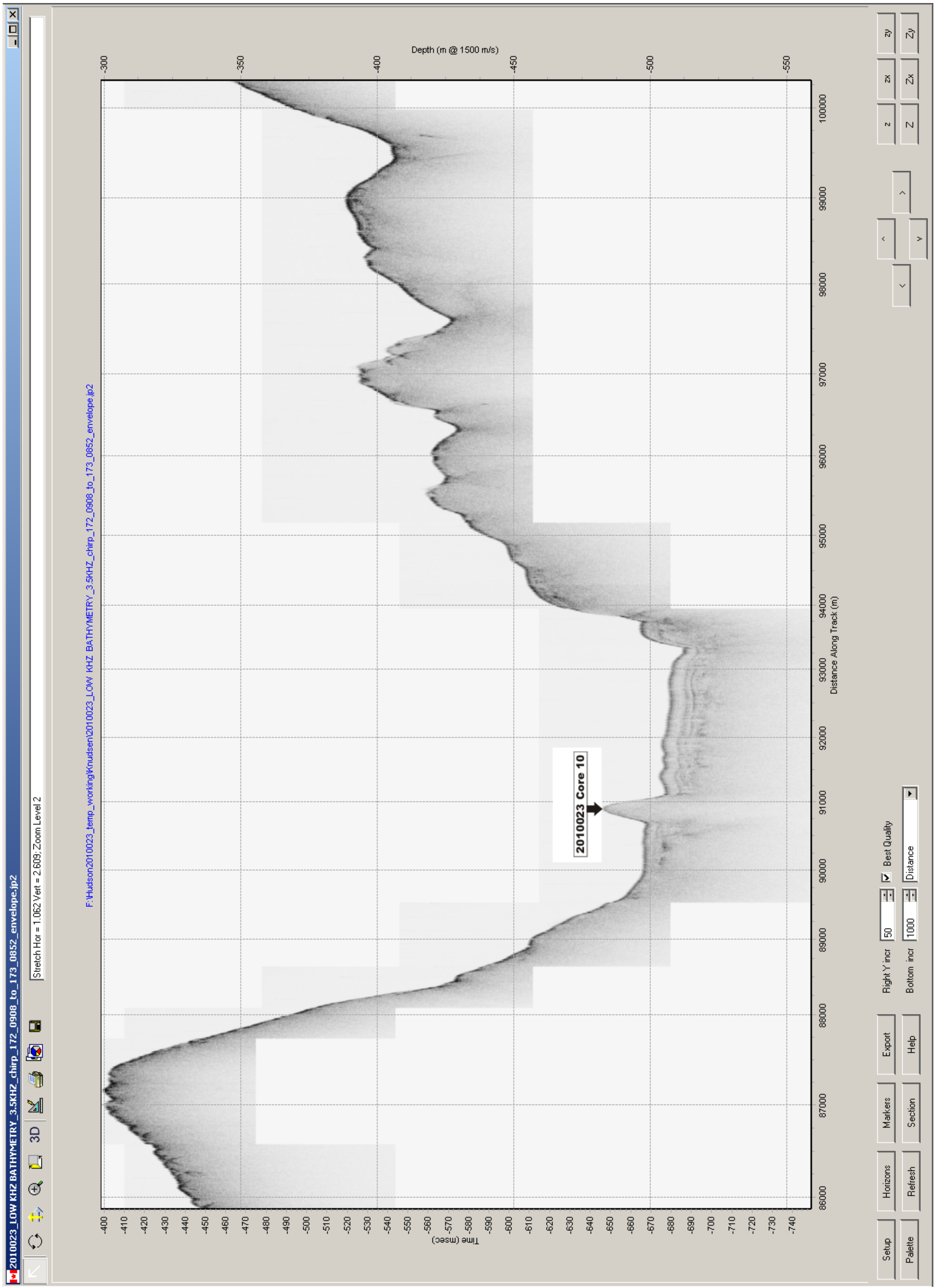
2010023 Core 9
Depth (m @ 1500 m/s)
Time (msec)
Distance Along Track (m)
Setup
Horizons
Markers
Export
Palette
Refresh
Section
Help
Right Y incr
Bottom incr
Best Quality
Distance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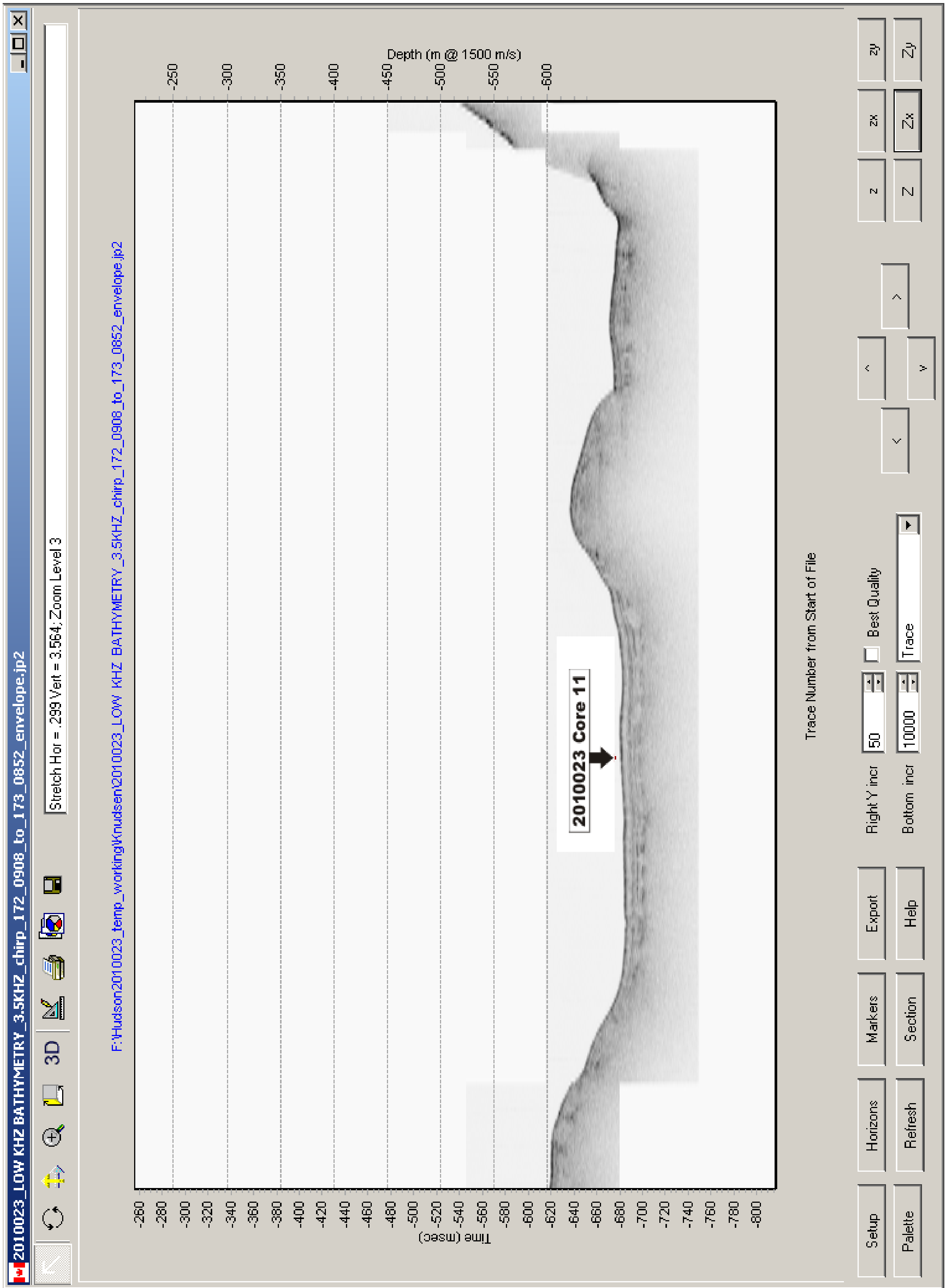
Depth (m @ 1500 m/s)
Time (msec)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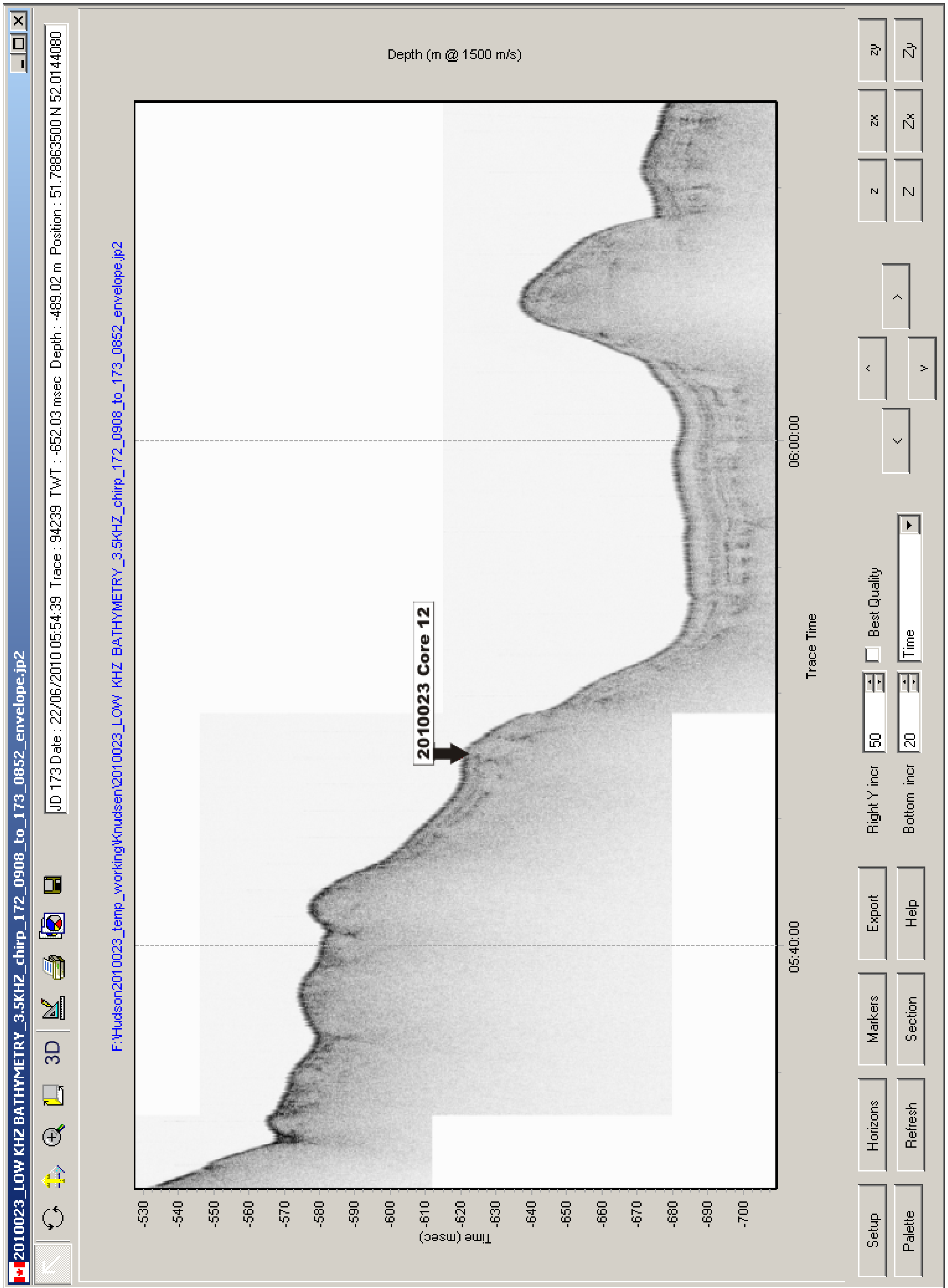
Depth (m @ 1500 m/s)
Time (msec)
2010023 Core 11
Trace Number from Start of File
Setup
Palette
Horizons
Refresh
Markers
Section
Export
Help
Right Y incr
50
Bottom incr
10000
Best Quality
Trace
z
Z
zx
Zx
zy
Zy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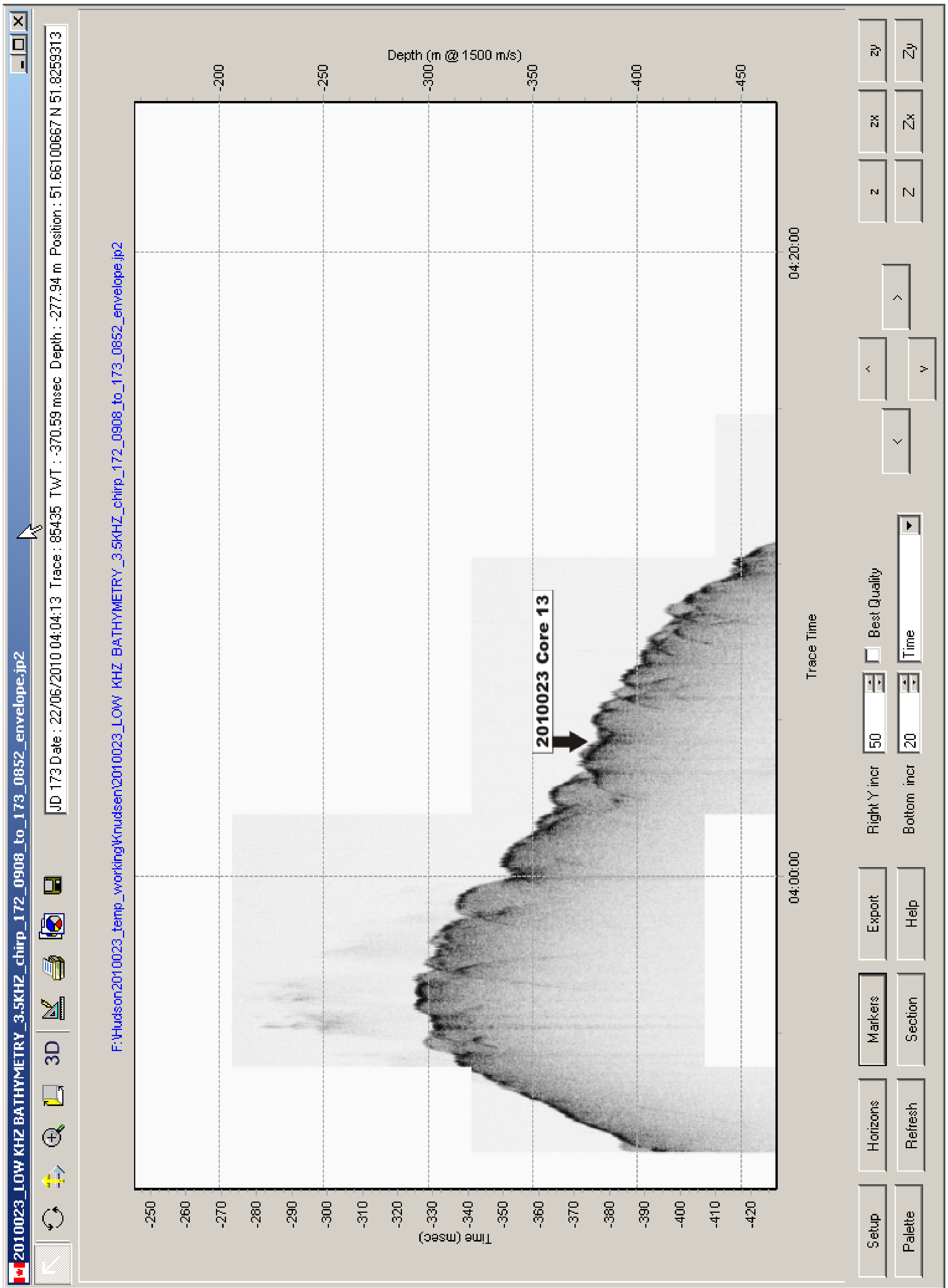
Depth (m @ 1500 m/s)
2010023 Core 12
Time (msec)
-530
-540
-550
-560
-570
-580
-590
-600
-610
-620
-630
-640
-650
-660
-670
-680
-690
-700
05:40:00
06:00:00
Trace Time
Setup
Palette
Horizons
Refresh
Markers
Section
Export
Help
Right Y incr
50
Bottom incr
20
Best Quality
Time
z
Z
zx
Zx
zy
Zy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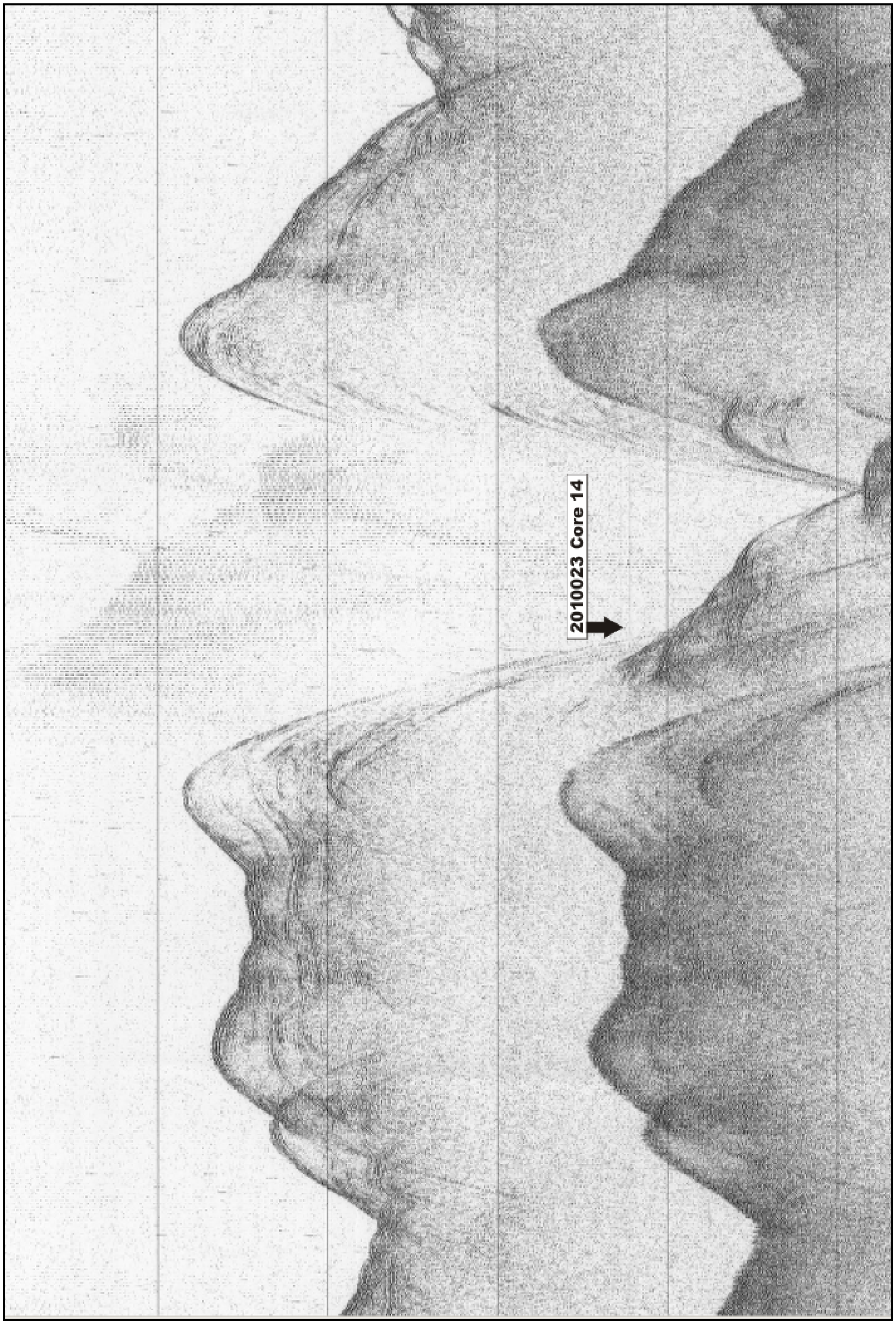
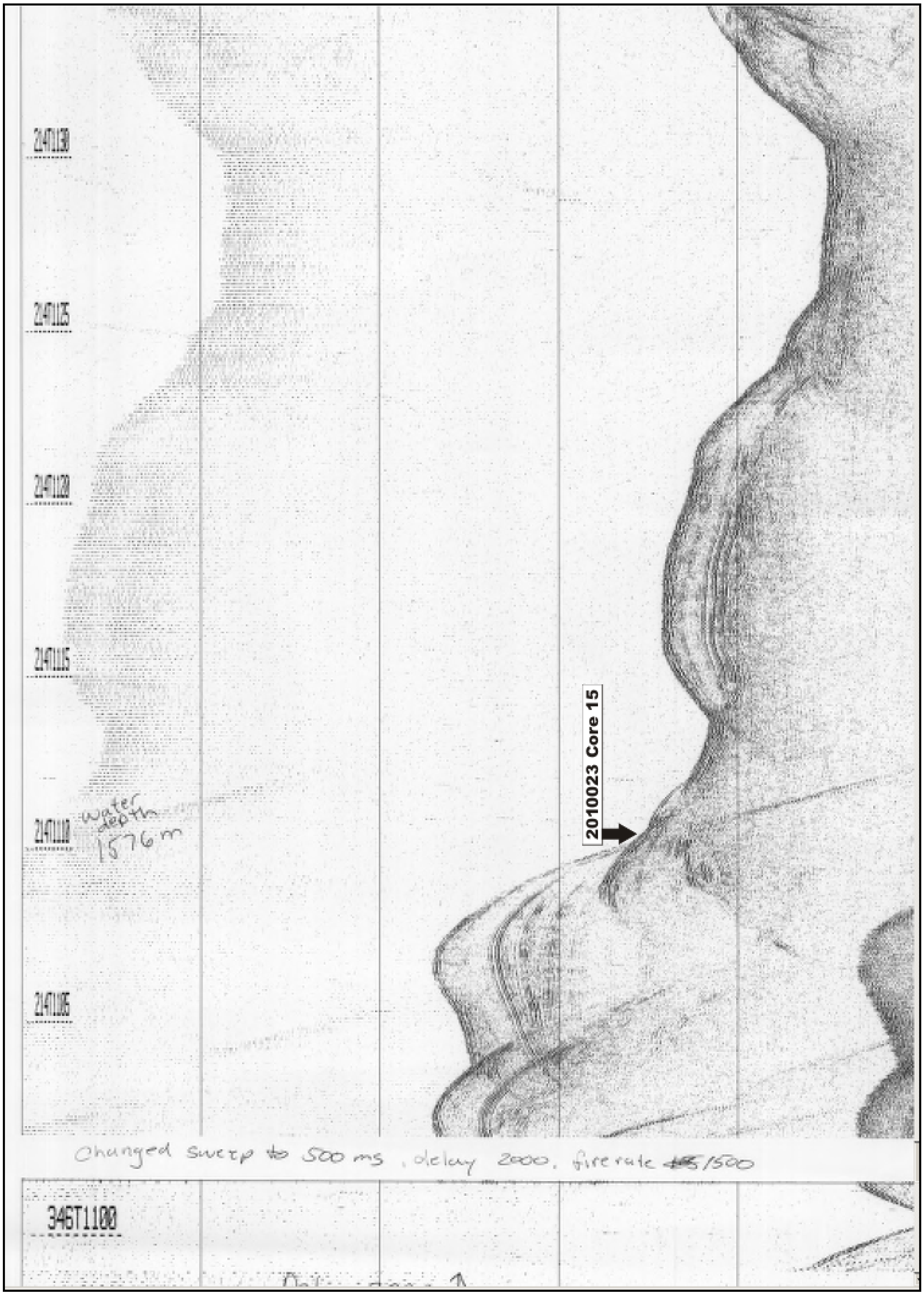
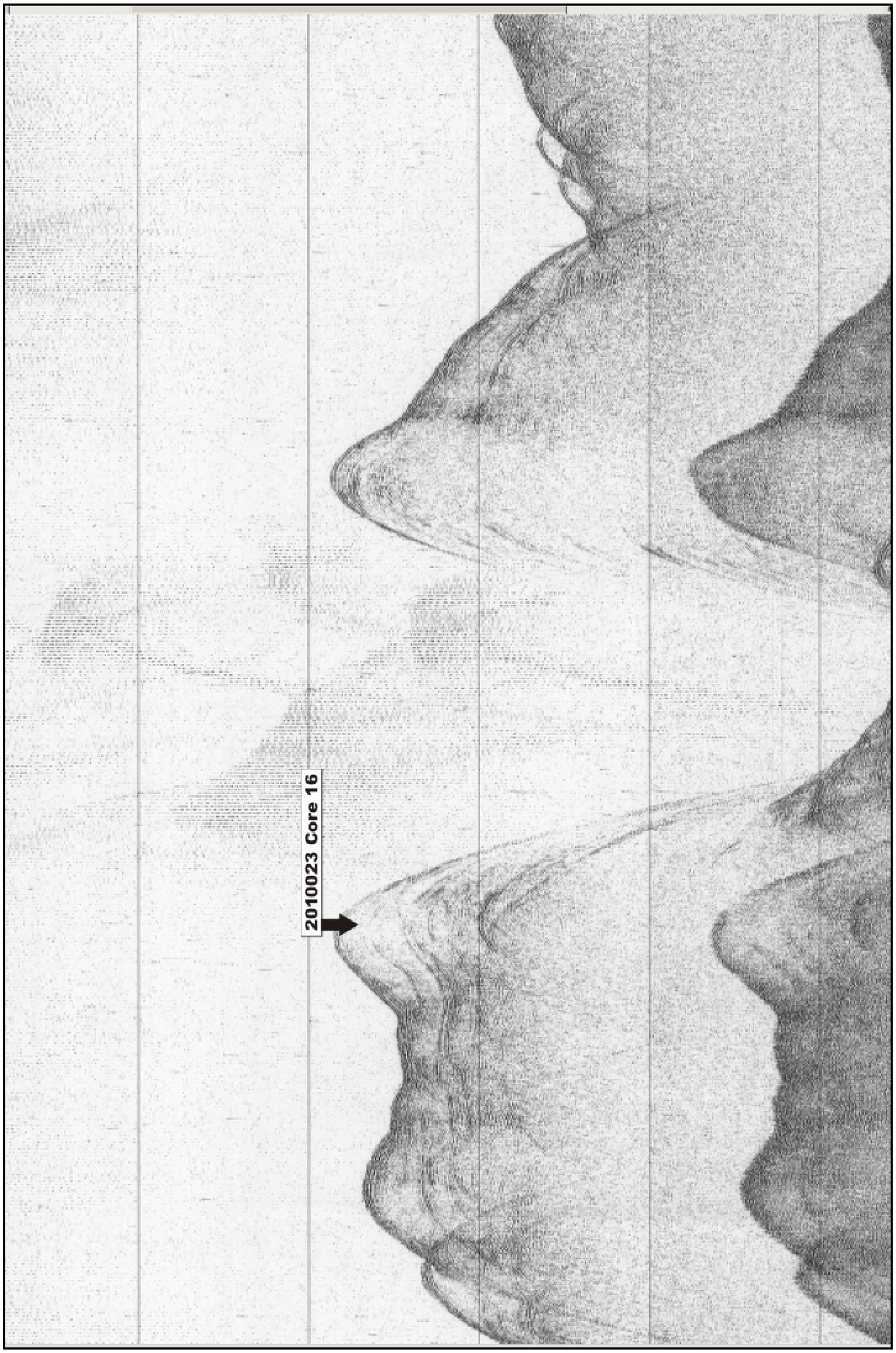
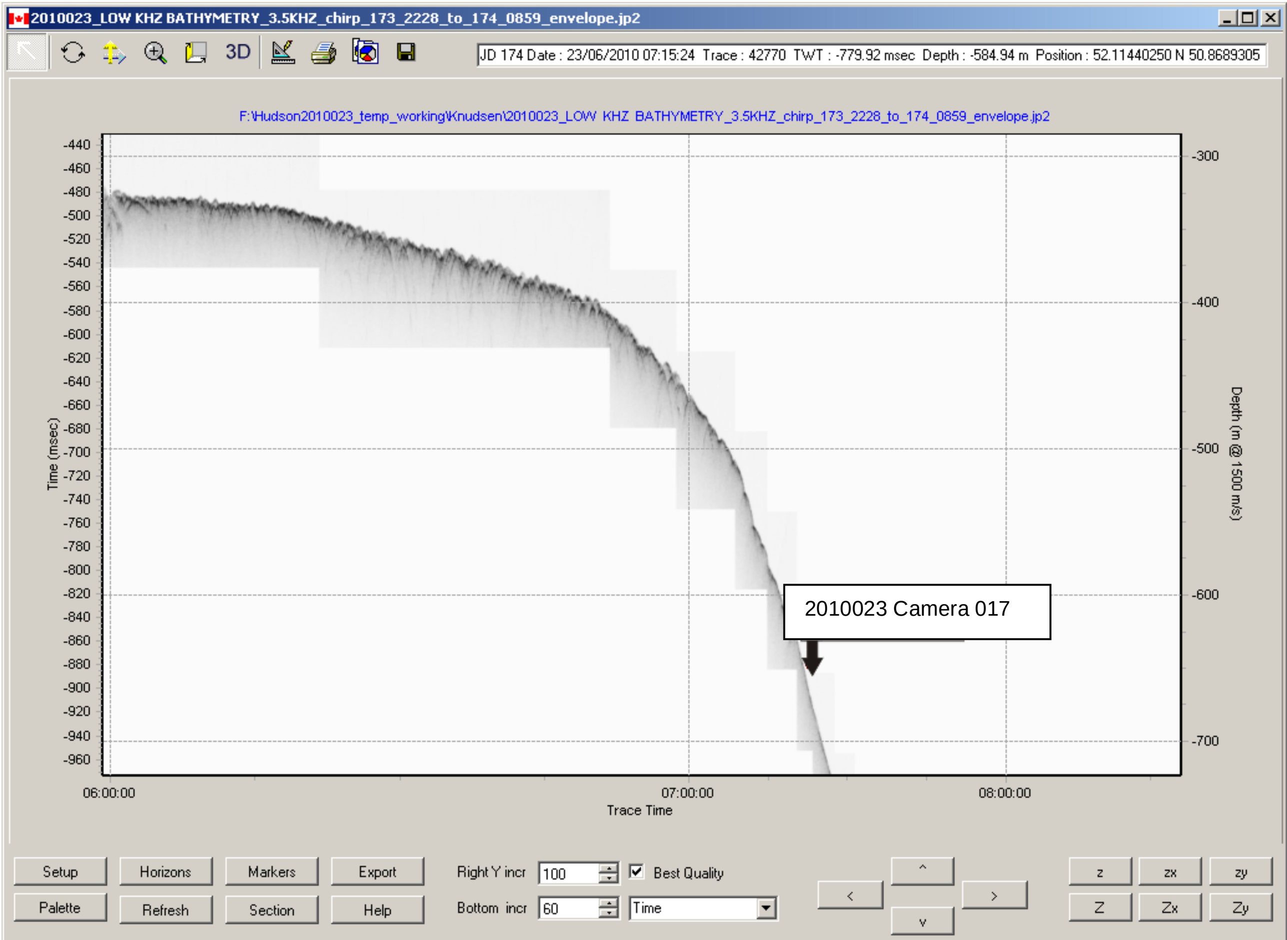
JD 173 Date : 22/06/2010 04:04:13 Trace : 85435 TWT : -370.59 msec Depth : -277.94 m Position : 51.66100667 N 51.8259313
F:\Hudson2010023_temp_working\Knudsen\2010023_LOW KHZ BATHYMETRY_3.5KHZ_chirp_172_0908_to_173_0852_envelope.jp2
2010023 Core 13
Time (msec)
-250
-260
-270
-280
-290
-300
-310
-320
-330
-340
-350
-360
-370
-380
-390
-400
-410
-420
Depth (m @ 1500 m/s)
-200
-250
-300
-350
-400
-450
04:00:00
04:20:00
Trace Time
Setup
Horizons
Markers
Export
Palette
Refresh
Section
Help
Right Y incr
50
Bottom incr
20
Best Quality
Time
z
zx
zy
Z
Zx
Zy

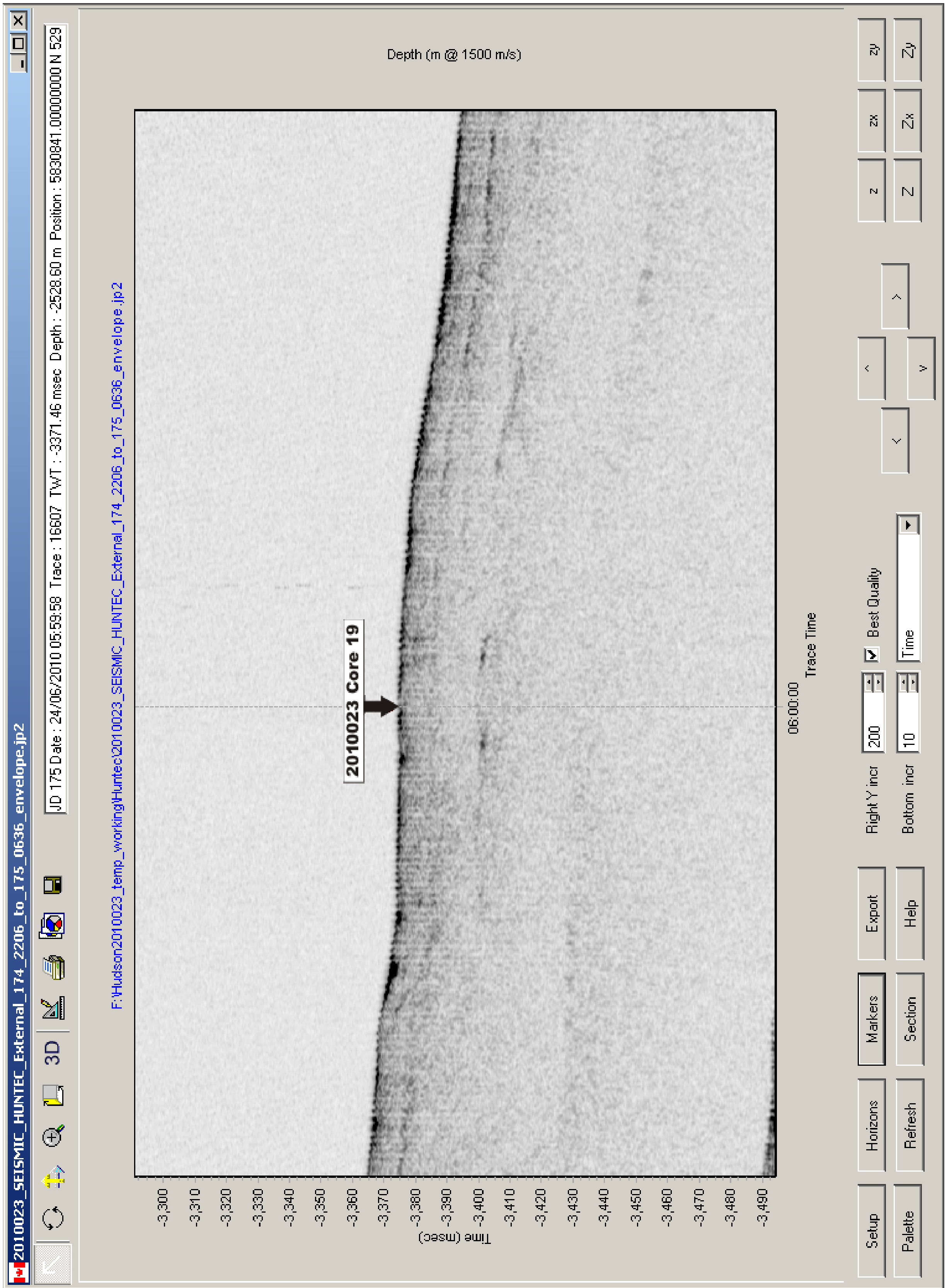

2010023 Core 14


water depth
1576 m
2010023 Core 15
Changed sweep to 500 ms, delay 2000, fire rate /500
346T1100

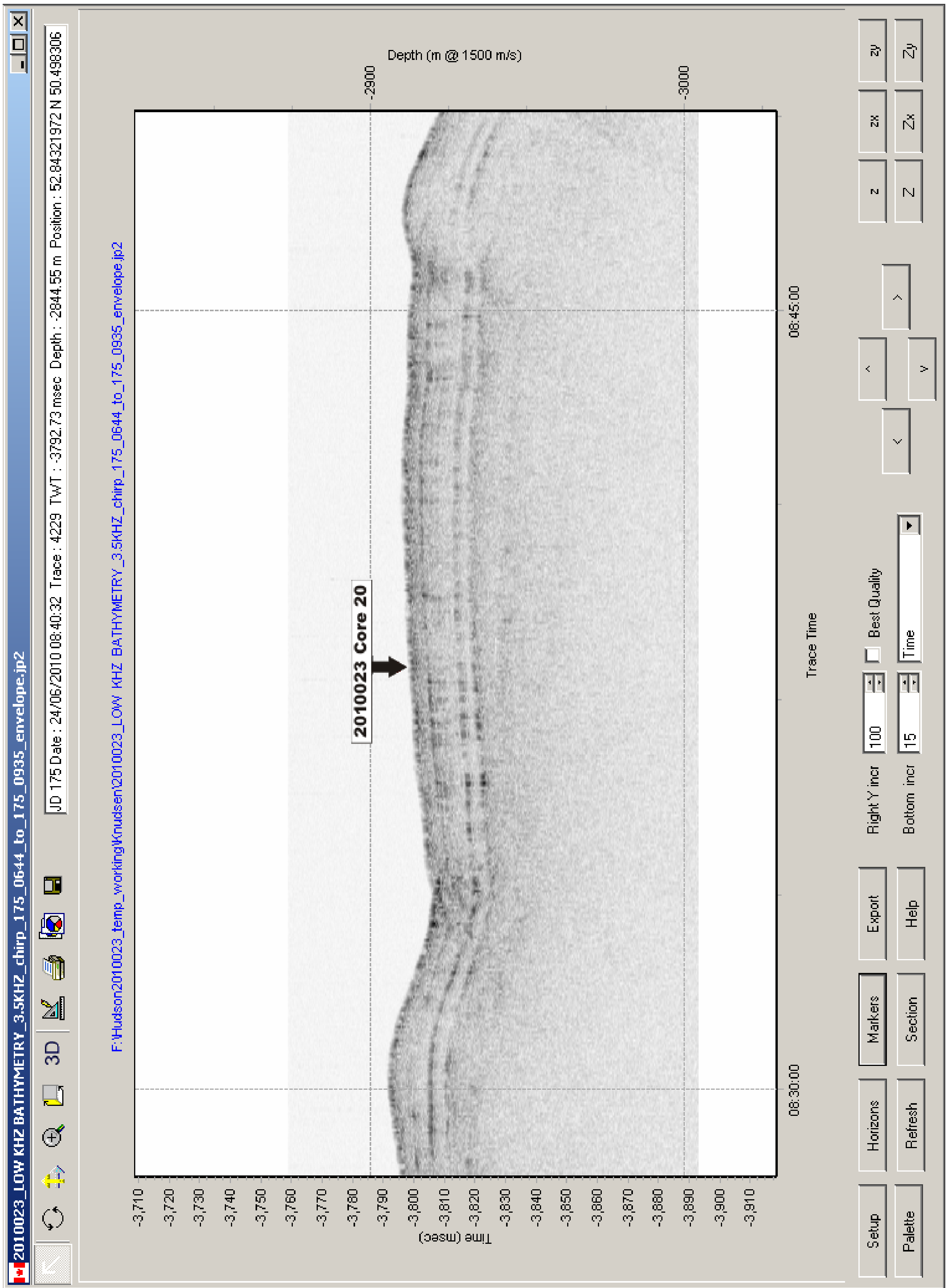

2010023 Core 16


2010023_LOW KHZ BATHYMETRY_3.5KHZ_chirp_173_2228_to_174_0859_envelope.jp2
JD 174 Date : 23/06/2010 07:15:24 Trace : 42770 TWT : -779.92 msec Depth : -584.94 m Position : 52.11440250 N 50.8689305
F:\Hudson2010023_temp_working\Knudsen\2010023_LOW KHZ BATHYMETRY_3.5KHZ_chirp_173_2228_to_174_0859_envelope.jp2
Time (msec)
Depth (m @ 1500 m/s)
Trace Time
06:00:00
07:00:00
08:00:00
2010023 Camera 017
Setup
Horizons
Markers
Export
Palette
Refresh
Section
Help
Right Y incr
100
Best Quality
Bottom incr
60
Time

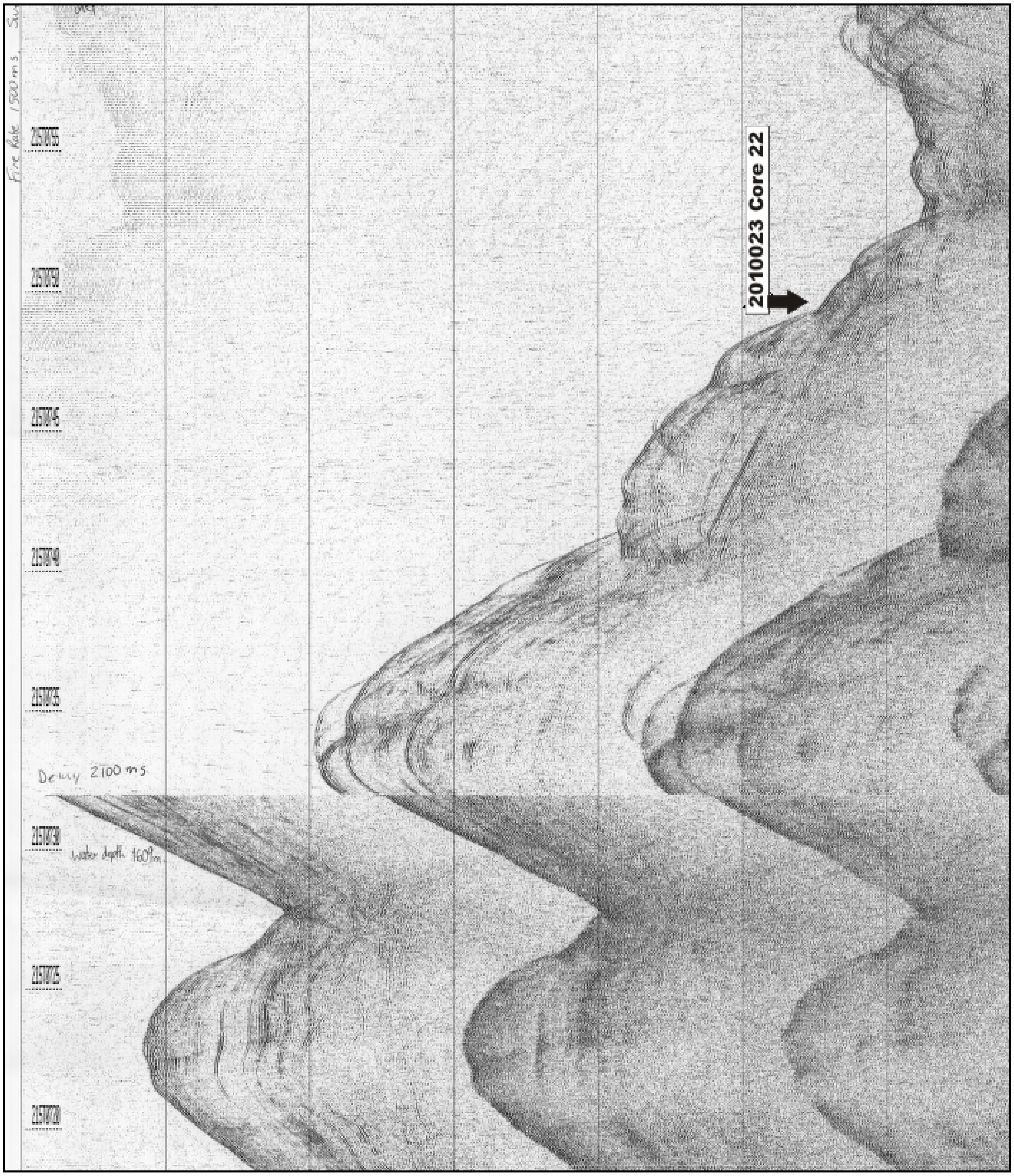

2010023_SEISMIC_HUNTEC_External_174_2206_to_175_0636_envelope.jp2
JD 175 Date : 24/06/2010 06:31:17 Trace : 17544 TWT : -3461.08 msec Depth : -2595.81 m Position : 5835361.00000000 N 530
F:\Hudson2010023_temp_working\Huntec\2010023_SEISMIC_HUNTEC_External_174_2206_to_175_0636_envelope.jp2
Depth (m @ 1500 m/s)
2010023 Core 18
Time (msec)
-3,400
-3,410
-3,420
-3,430
-3,440
-3,450
-3,460
-3,470
-3,480
-3,490
-3,500
-3,510
-3,520
-3,530
-3,540
-3,550
-3,560
-3,570
-3,580
-3,590
06:30:00
Trace Time
Setup
Palette
Horizons
Refresh
Markers
Section
Export
Help
Right Y incr
200
Bottom incr
30
Best Quality
Time
z
Z
zx
Zx
zy
Zy

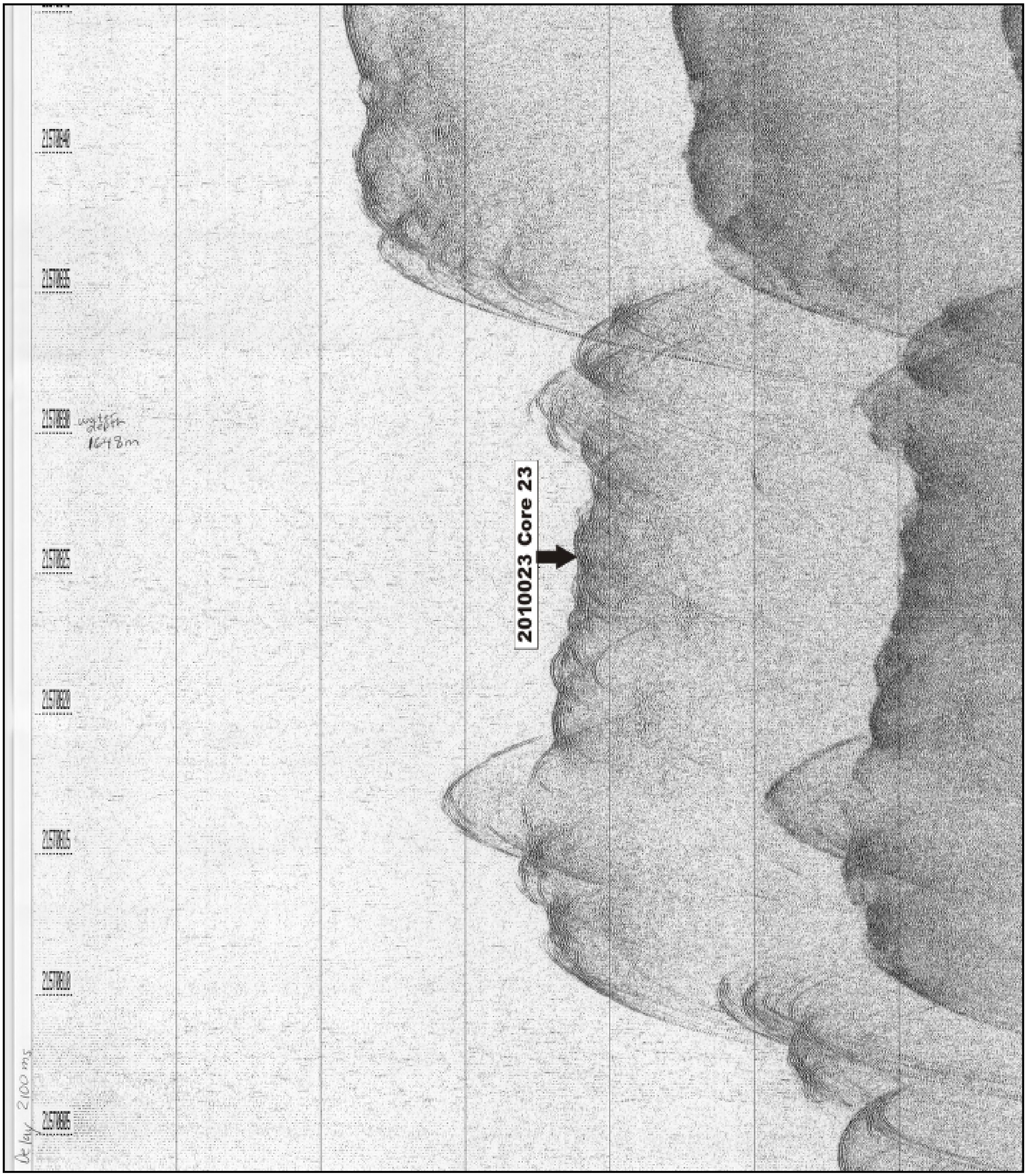


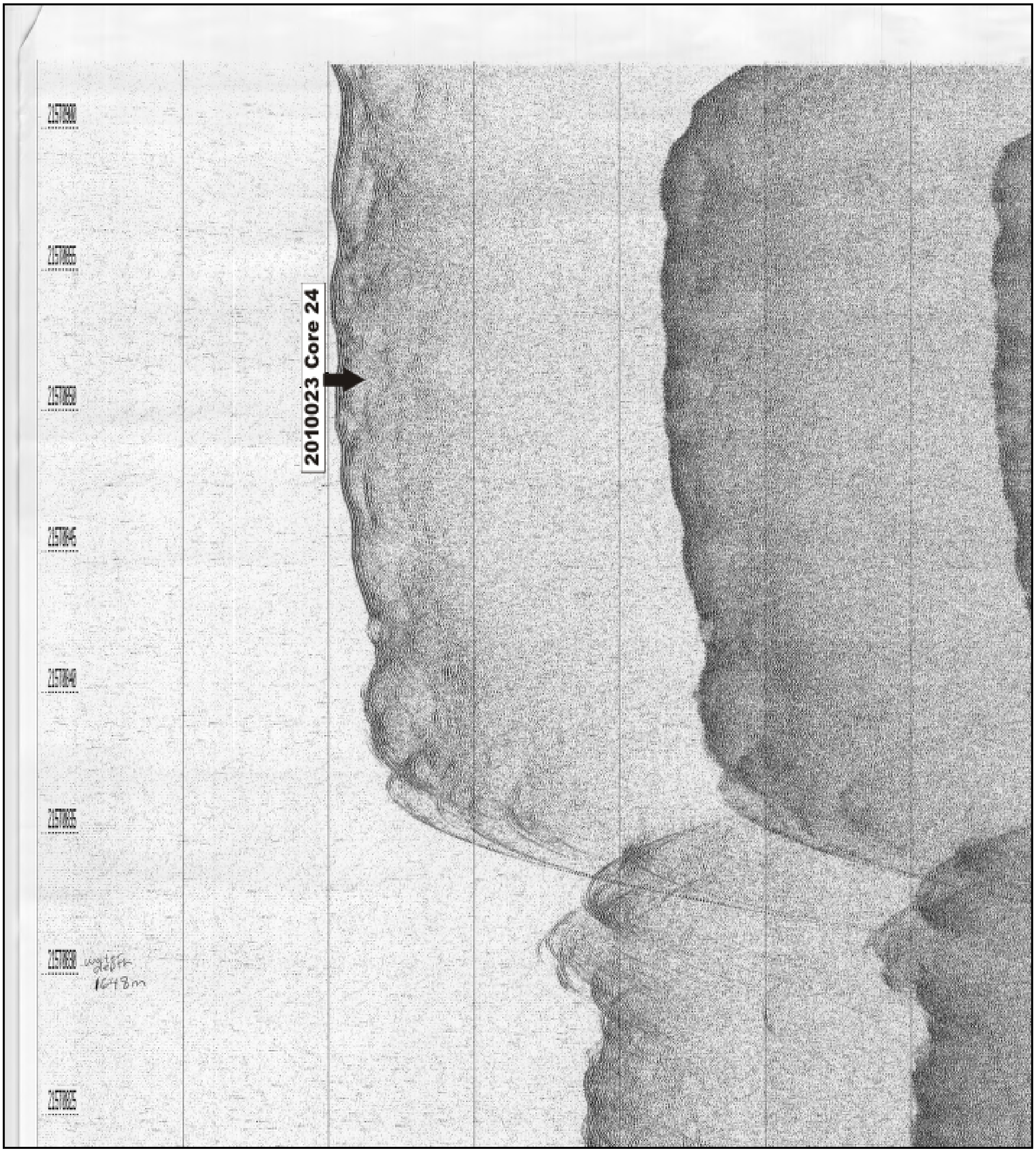
2010023_SEISMIC_HUNTEC_External_174_2206_to_175_0636_envelope.jp2
JD 175 Date : 24/06/2010 05:59:58 Trace : 16607 TWT : -3371.46 msec Depth : -2528.60 m Position : 5830841.00000000 N 529
F:\Hudson2010023_temp_working\Huntec\2010023_SEISMIC_HUNTEC_External_174_2206_to_175_0636_envelope.jp2
Depth (m @ 1500 m/s)
2010023 Core 19
Time (msec)
-3,300
-3,310
-3,320
-3,330
-3,340
-3,350
-3,360
-3,370
-3,380
-3,390
-3,400
-3,410
-3,420
-3,430
-3,440
-3,450
-3,460
-3,470
-3,480
-3,490
06:00:00
Trace Time
Setup
Horizons
Markers
Export
Palette
Refresh
Section
Help
Right Y incr
200
Bottom incr
10
Best Quality
Time
z
zx
zy
Z
Zx
Zy


2010023_LOW KHZ BATHYMETRY_3.5KHZ_chirp_175_0644_to_175_0935_envelope.jp2
JD 175 Date : 24/06/2010 08:40:32 Trace : 4229 TWT : -3792.73 msec Depth : -2844.55 m Position : 52.84321972 N 50.498306
F:\Hudson2010023_temp_working\Knudsen\2010023_LOW KHZ BATHYMETRY_3.5KHZ_chirp_175_0644_to_175_0935_envelope.jp2
Depth (m @ 1500 m/s)
-2900
-3000
2010023 Core 20
Time (msec)
-3,710
-3,720
-3,730
-3,740
-3,750
-3,760
-3,770
-3,780
-3,790
-3,800
-3,810
-3,820
-3,830
-3,840
-3,850
-3,860
-3,870
-3,880
-3,890
-3,900
-3,910
08:30:00
08:45:00
Trace Time
Setup
Horizons
Markers
Export
Palette
Refresh
Section
Help
Right Y incr
100
Bottom incr
15
Best Quality
Time
z
zx
zy
Z
Zx
Zy

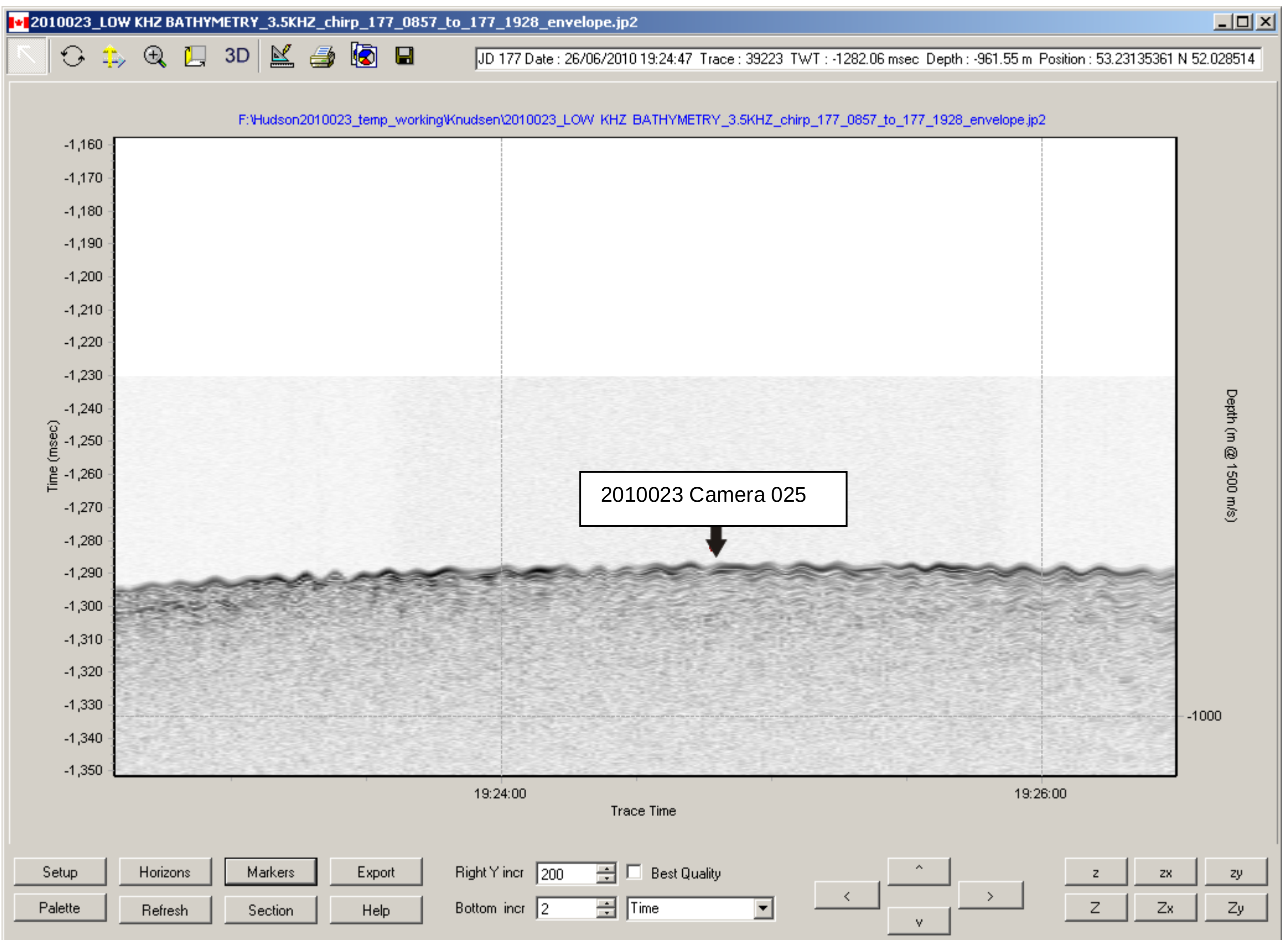

2010023_SEISMIC_HUNTEC_External_175_2137_to_176_0759_envelope.jp2
JD 176 Date : 25/06/2010 05:18:00 Trace : 18478 TWT : -4306.92 msec Depth : -3230.19 m Position : 5920669.00000000 N 517
F:\Hudson2010023_temp_working\Huntec\2010023_SEISMIC_HUNTEC_External_175_2137_to_176_0759_envelope.jp2
Depth (m @ 1500 m/s)
-3600
2010023 Core 21
Time (msec)
Trace Time
05:15:00
Setup
Palette
Horizons
Refresh
Markers
Section
Export
Help
Right Y incr
200
Bottom incr
15
Best Quality
Time

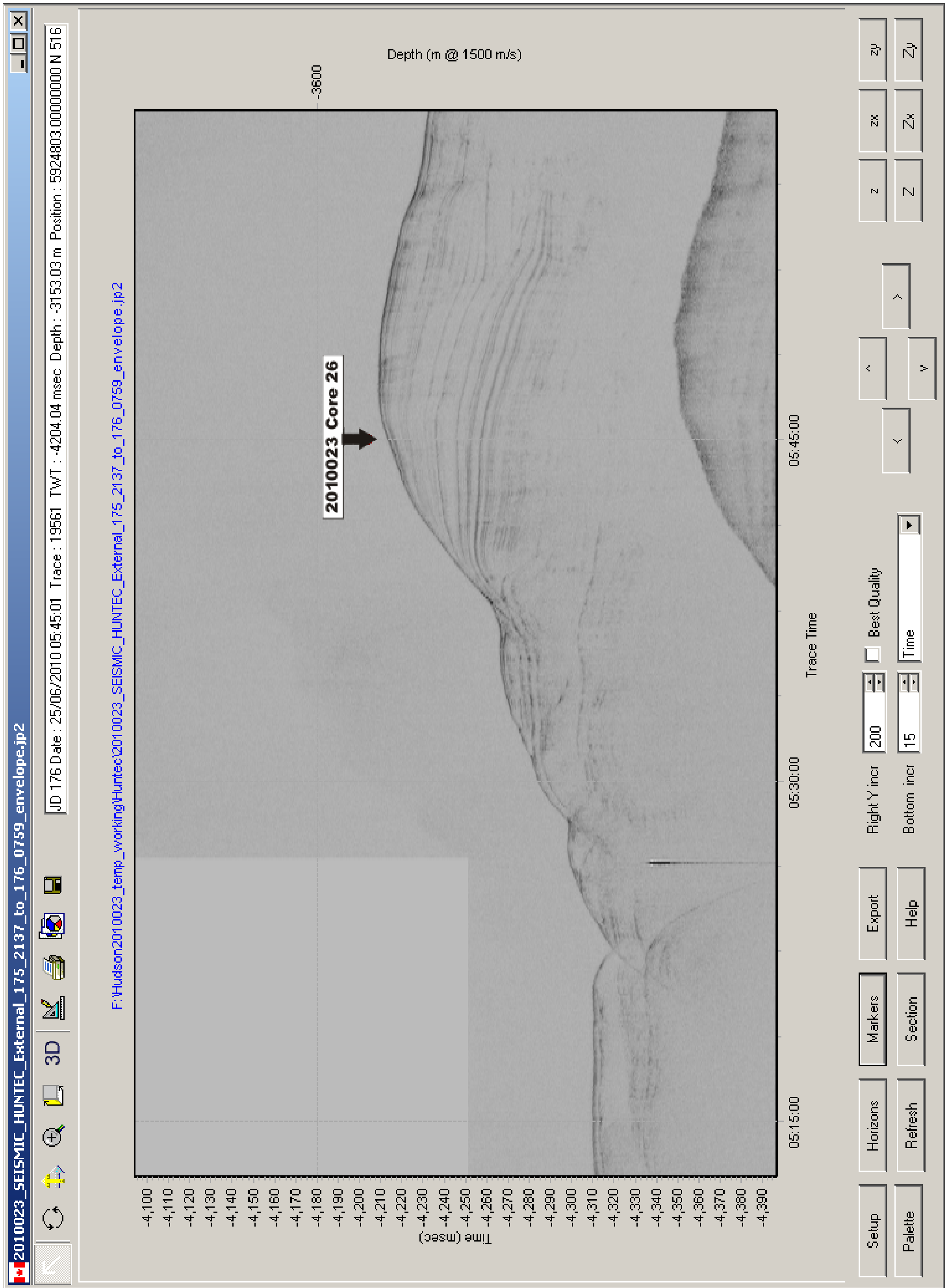

2010023 Core 22
Delay 2100 ms


2010023 Core 23

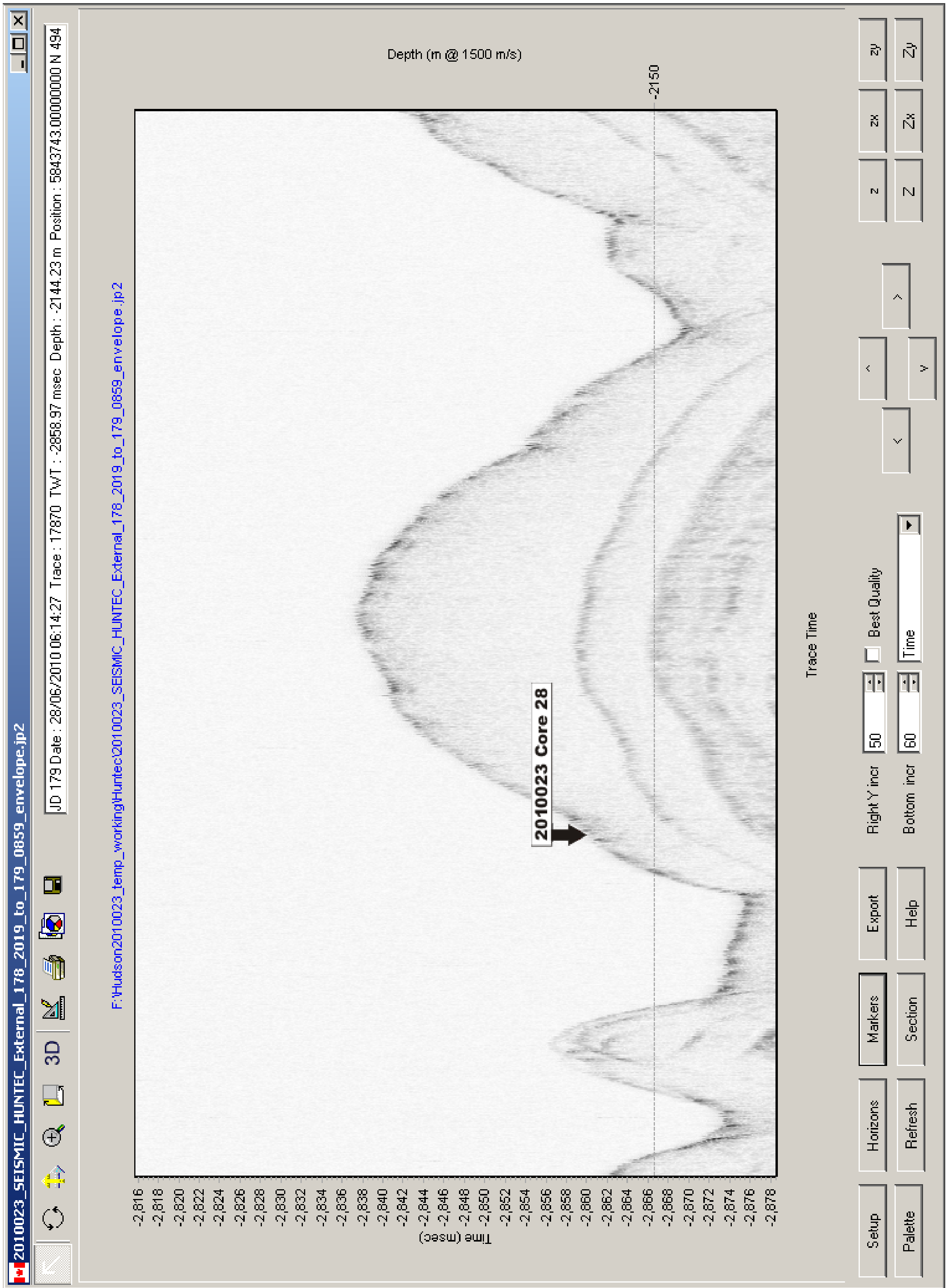


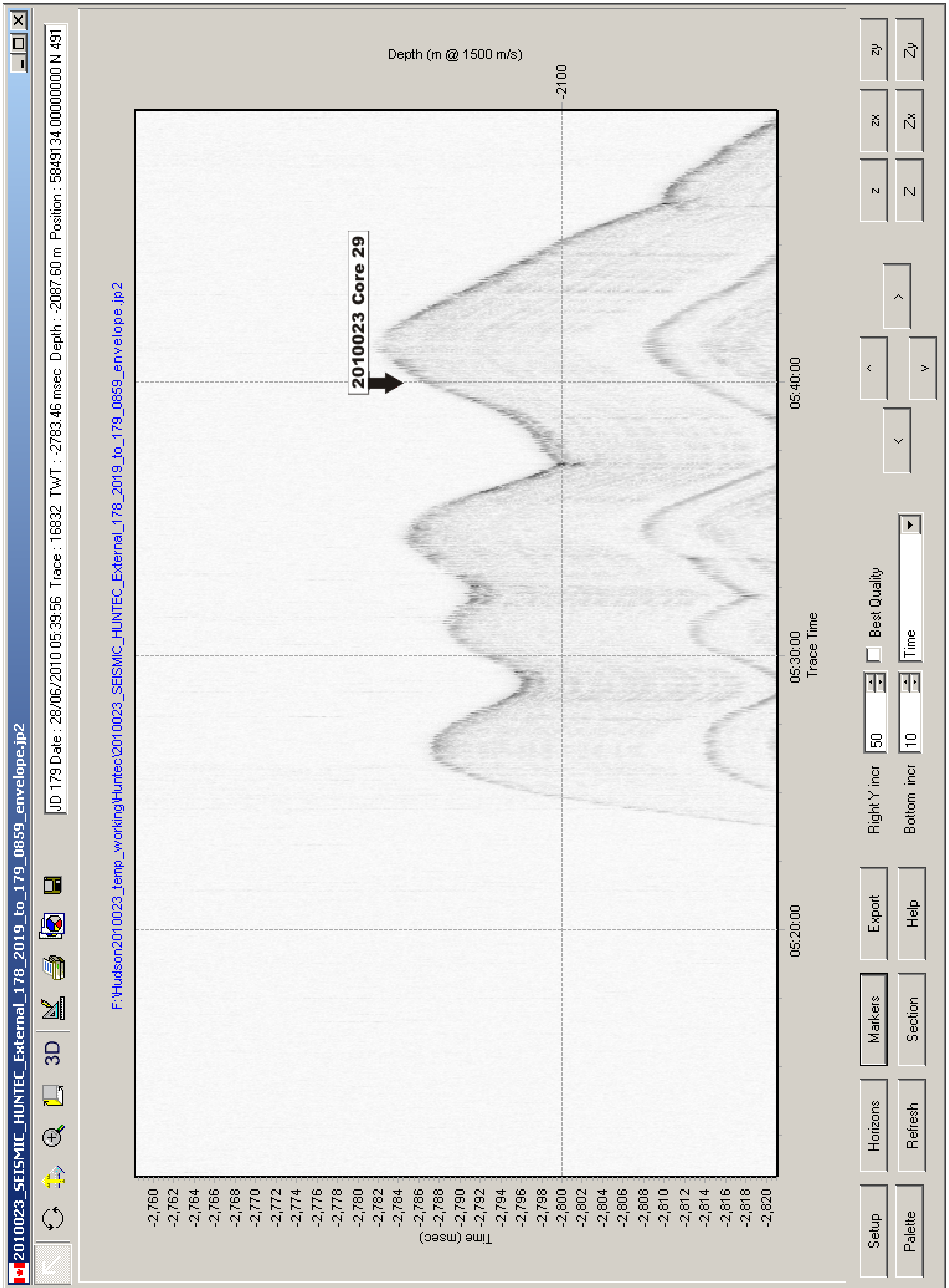
2010023 Core 24

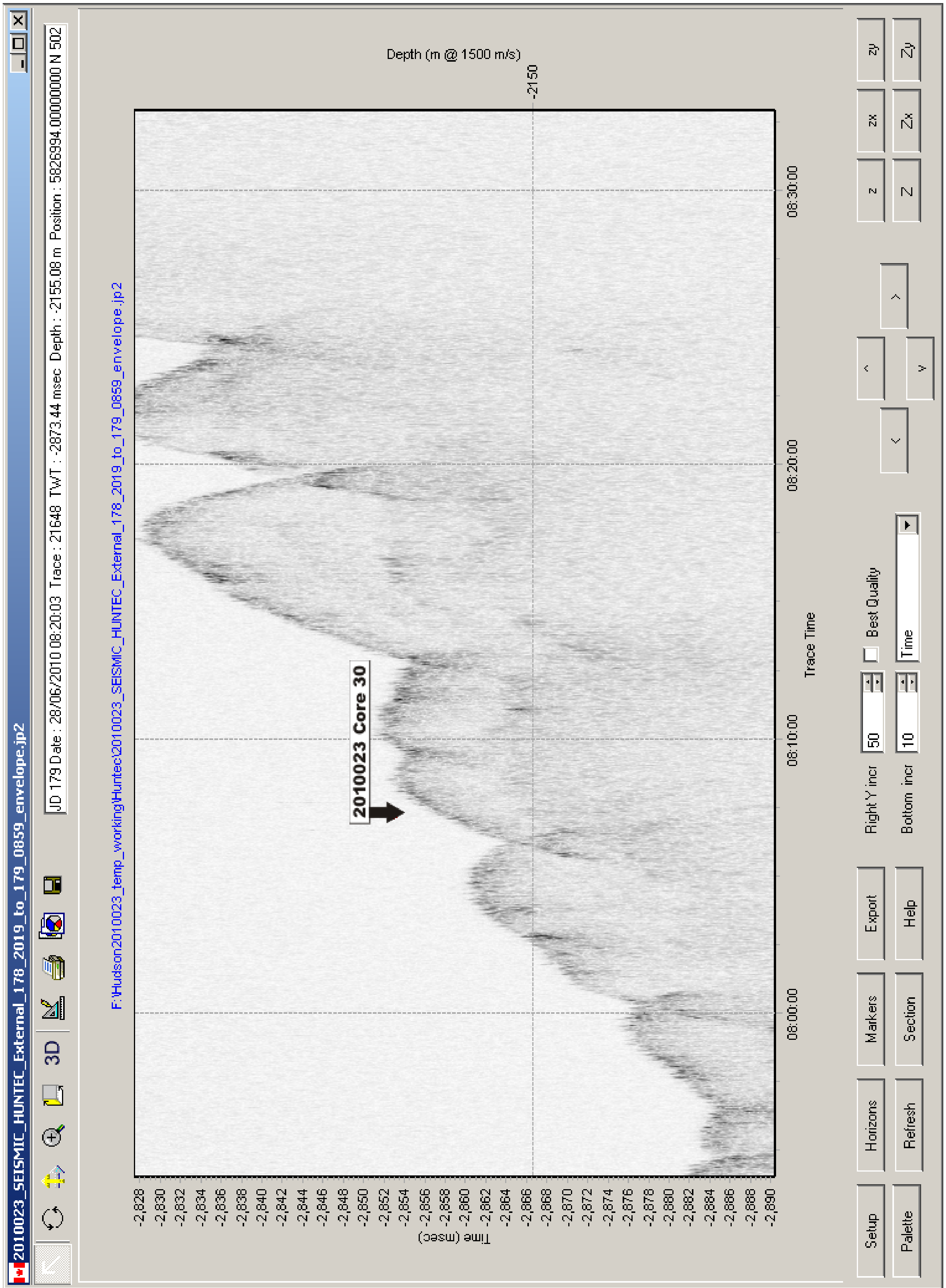

2010023_LOW KHZ BATHYMETRY_3.5KHZ_chirp_177_0857_to_177_1928_envelope.jp2
JD 177 Date : 26/06/2010 19:24:47 Trace : 39223 TWT : -1282.06 msec Depth : -961.55 m Position : 53.23135361 N 52.028514
F:\Hudson2010023_temp_working\Knudsen\2010023_LOW KHZ BATHYMETRY_3.5KHZ_chirp_177_0857_to_177_1928_envelope.jp2
2010023 Camera 025
Time (msec)
Depth (m @ 1500 m/s)
-1000
19:24:00
19:26:00
Trace Time
Setup
Horizons
Markers
Export
Palette
Refresh
Section
Help
Right Y incr
200
Best Quality
Bottom incr
2
Time

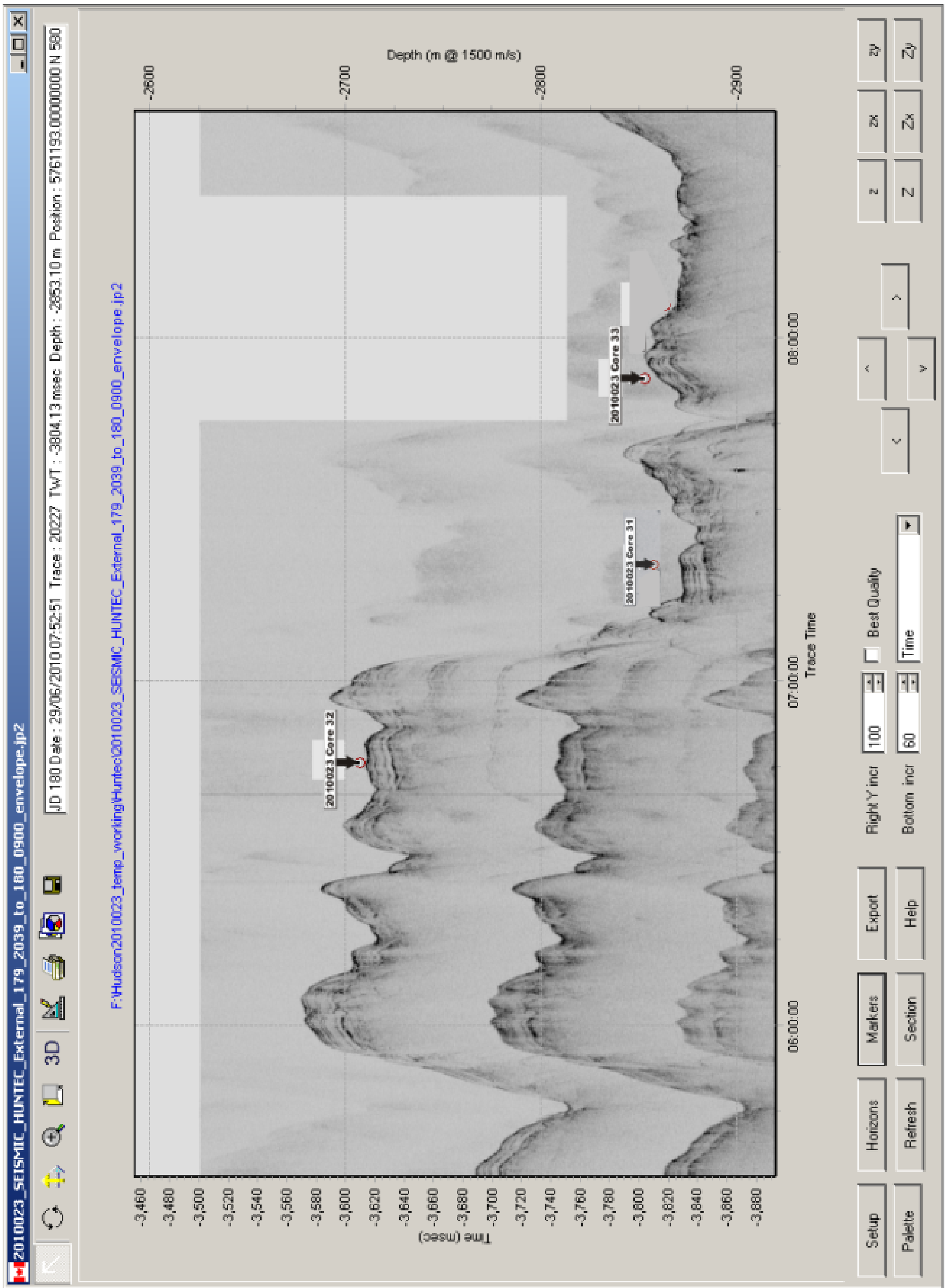

2010023_SEISMIC_HUNTEC_External_175_2137_to_176_0759_envelope.jp2
JD 176 Date : 25/06/2010 05:45:01 Trace : 19561 TWT : -4204.04 msec Depth : -3153.03 m Position : 5924803.00000000 N 516
F:\Hudson2010023_temp_working\Huntec\2010023_SEISMIC_HUNTEC_External_175_2137_to_176_0759_envelope.jp2
Depth (m @ 1500 m/s)
-3600
2010023 Core 26
Time (msec)
-4,100
-4,110
-4,120
-4,130
-4,140
-4,150
-4,160
-4,170
-4,180
-4,190
-4,200
-4,210
-4,220
-4,230
-4,240
-4,250
-4,260
-4,270
-4,280
-4,290
-4,300
-4,310
-4,320
-4,330
-4,340
-4,350
-4,360
-4,370
-4,380
-4,390
05:15:00
05:30:00
05:45:00
Trace Time
Setup
Palette
Horizons
Refresh
Markers
Section
Export
Help
Right Y incr
200
Bottom incr
15
Best Quality
Time
z
Z
zx
Zx
zy
Zy


2010023_SEISMIC_HUNTEC_External_178_0058_to_178_0900_envelope.jp2
JD 178 Date : 27/06/2010 01:56:22 Trace : 2307 TWT : -2573.62 msec Depth : -1930.22 m Position : 5921912.00000000 N 4485
F:\Hudson2010023_temp_working\Huntec\2010023_SEISMIC_HUNTEC_External_178_0058_to_178_0900_envelope.jp2
Depth (m @ 1500 m/s)
-1800
-2000
2010023 Core 27
Time (msec)
Trace Time
01:30:00
02:00:00
02:30:00
Setup
Palette
Horizons
Refresh
Markers
Section
Export
Help
Right Y incr
Bottom incr
Best Quality
Time
z
zx
zy
Z
Zx
Zy


2010023_SEISMIC_HUNTEC_External_178_2019_to_179_0859_envelope.jp2
JD 179 Date : 28/06/2010 06:14:27 Trace : 17870 TWT : -2858.97 msec Depth : -2144.23 m Position : 5843743.00000000 N 494
F:\Hudson2010023_temp_working\Huntec\2010023_SEISMIC_HUNTEC_External_178_2019_to_179_0859_envelope.jp2
Depth (m @ 1500 m/s)
-2150
2010023 Core 28
Time (msec)
Trace Time


2010023_SEISMIC_HUNTEC_External_178_2019_to_179_0859_envelope.jp2
JD 179 Date : 28/06/2010 05:39:56 Trace : 16832 TWT : -2783.46 msec Depth : -2087.60 m Position : 5849134.00000000 N 491
F:\Hudson2010023_temp_working\Huntec\2010023_SEISMIC_HUNTEC_External_178_2019_to_179_0859_envelope.jp2
Depth (m @ 1500 m/s)
-2100
2010023 Core 29
Time (msec)
-2,760
-2,762
-2,764
-2,766
-2,768
-2,770
-2,772
-2,774
-2,776
-2,778
-2,780
-2,782
-2,784
-2,786
-2,788
-2,790
-2,792
-2,794
-2,796
-2,798
-2,800
-2,802
-2,804
-2,806
-2,808
-2,810
-2,812
-2,814
-2,816
-2,818
-2,820
05:20:00
05:30:00
05:40:00
Trace Time
Setup
Horizons
Markers
Export
Right Y incr
50
Best Quality
Palette
Refresh
Section
Help
Bottom incr
10
Time
z
zx
zy
Z
Zx
Zy


2010023_SEISMIC_HUNTEC_External_178_2019_to_179_0859_envelope.jp2
JD 179 Date : 28/06/2010 08:20:03 Trace : 21648 TWT : -2873.44 msec Depth : -2155.08 m Position : 5826994.00000000 N 502
F:\Hudson2010023_temp_working\Huntec\2010023_SEISMIC_HUNTEC_External_178_2019_to_179_0859_envelope.jp2
Depth (m @ 1500 m/s)
-2150
2010023 Core 30
Time (msec)
-2,828
-2,830
-2,832
-2,834
-2,836
-2,838
-2,840
-2,842
-2,844
-2,846
-2,848
-2,850
-2,852
-2,854
-2,856
-2,858
-2,860
-2,862
-2,864
-2,866
-2,868
-2,870
-2,872
-2,874
-2,876
-2,878
-2,880
-2,882
-2,884
-2,886
-2,888
-2,890
08:00:00
08:10:00
08:20:00
08:30:00
Trace Time
Setup
Horizons
Markers
Export
Palette
Refresh
Section
Help
Right Y incr
50
Bottom incr
10
Best Quality
Time
z
zx
zy
Z
Zx
Zy


2010023_SEISMIC_HUNTEC_External_179_2039_to_180_0900_envelope.jp2
JD 180 Date : 29/06/2010 07:52:51 Trace : 20227 TWT : -3804.13 msec Depth : -2853.10 m Position : 5761193.0000000 N 580
F:\Hudson2010023_temp_working\Huntec\2010023_SEISMIC_HUNTEC_External_179_2039_to_180_0900_envelope.jp2
Depth (m @ 1500 m/s)
Time (msec)
Trace Time
2010023 Core 32
2010023 Core 31
2010023 Core 33
06:00:00
07:00:00
08:00:00
Setup
Palette
Horizons
Refresh
Markers
Section
Export
Help
Right Y incr
Bottom incr
Best Quality
Time