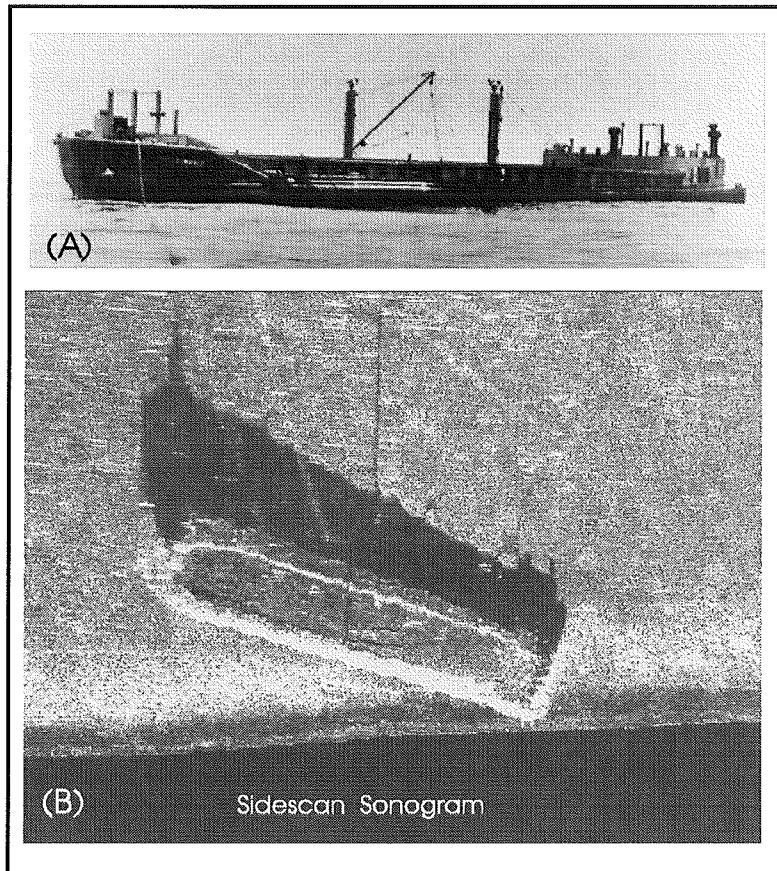


This document was produced  
by scanning the original publication.

Ce document est le produit d'une  
numérisation par balayage  
de la publication originale.



## Irving Whale Sediment Sampling Program 16-20 October, 1995



A report submitted to  
Transport Canada and Environment Canada

by  
D.R. Parrott  
Geological Survey of Canada (Atlantic)  
Box 1006, Dartmouth, NS Canada  
B2Y 4A2  
November, 1995

Geological Survey of Canada  
Open File Report No. 3250



Natural Resources  
Canada

Ressources naturelles  
Canada

---

**Table of Contents**

<b>Introduction</b>	<b>3</b>
<b>Background</b>	<b>3</b>
<b>The IRVING WHALE site</b>	<b>3</b>
<b>Navigation</b>	<b>7</b>
<b>Sampling Program - October 1995</b>	<b>7</b>
<b>Position of the Irving Whale</b>	<b>9</b>
<b>References</b>	<b>11</b>
<b>APPENDIX A</b>	<b>12</b>
<b>Survey Particulars</b>	<b>12</b>
<b>Personnel</b>	<b>12</b>
<b>Equipment Specifications and Performance</b>	<b>12</b>
BATHYMETRY	<b>12</b>
SAMPLING EQUIPMENT	<b>12</b>
NAVIGATION EQUIPMENT	<b>12</b>
<b>Summary of Activities</b>	<b>12</b>

## **Introduction**

On 7 September, 1970, the barge IRVING WHALE, carrying a cargo of No. 6 (Bunker C) fuel oil, sank in about 67 metres of water on the Magdalen Shelf, Gulf of St. Lawrence. Recent studies have shown that the system used on the barge to heat the fuel in the cargo tanks contained polychlorinated benzenes (PCBs), and that some contamination of seafloor sediments near the barge has occurred.

From 16-20 October 1995, a sediment sampling program was undertaken near the IRVING WHALE, as part of a joint project between the Geological Survey of Canada, Environment Canada and Transport Canada, to determine the extent of sediment contamination near the barge. The Geological Survey of Canada (Atlantic) assisted Environment Canada and Transport Canada, by providing expertise in obtaining undisturbed samples of seafloor sediments, and in the precise location of the samples. Sediment samples were taken near the barge, and at distances up to 30 kilometers to provide information on PCB levels.

## **Background**

The barge IRVING WHALE was built in 1966 by the Saint John Shipbuilding and Dry Dock Company. It measures 82 metres long, 18.5 metres wide, and 5 metres deep. On 7 September, 1970, the IRVING WHALE was under tow by the tug IRVING MAPLE from Halifax, NS to Bathurst, NB. The barge sank, during a storm, in about 67 metres of water on the Magdalen Shelf, Gulf of St. Lawrence (Fig. 1). At the time of sinking the barge contained about 4200 tonnes of heated No. 6 fuel oil (Bunker C). The barge settled slowly by the stern, which allowed a substantial quantity of oil to escape through the tank vents.

Observations of the surficial geology were made during a salvage program in the summer of 1995 when divers used a water jet to excavate a trench under the barge. Attempts to raise the barge were halted in August 1995, as a result of a legal injunction filed by le Societe pour Vaincre la Pollution Inc.

## **The IRVING WHALE site**

The IRVING WHALE sank on a portion of the Magdalen Shelf, (Fig 1) which is interpreted to have been glaciated several times in the past, resulting in the deposition of glacial till, (ice-contact sediments), and glaciomarine (ice-proximal) sediments (Loring and Nota, 1973). During the most recent of these glaciations, at about 10-12 ka, sea level was lowered to about 62 to 70 metres below the present level, exposing much of the shelf (Piper et al., 1990).

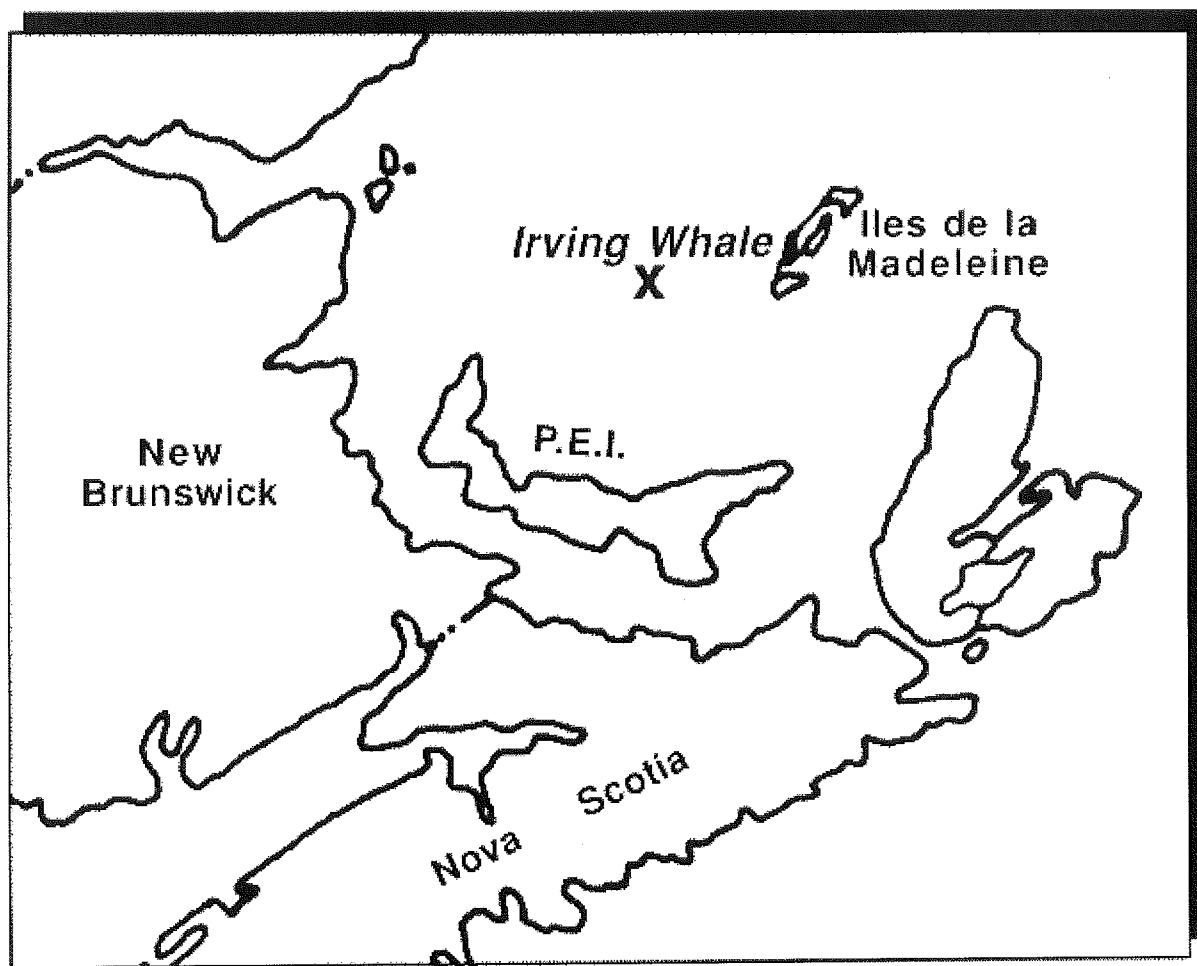


Figure 1 Gulf of St. Lawrence showing the location of the sunken barge IRVING WHALE.

The surficial sediments in the area consist of sands and gravels, partially derived by reworking of pre-existing glacial sediments during a sea level transgression to its present level from the low stand during the last glaciation (Josenhans et al., 1990). The sediments have been modified during these changes in sea level, which subjected the marine areas to beach-zone reworking of the glacial sediments. During the low stand of sea level, beach-zone reworking removed fine material from the deposits and produced sandy and gravelly deposits (basal transgressive lag). The following rise in sea level left littoral (sub-marine beach related) sandy, shelly and gravelly deposits. Modern wave and tidally generated currents continue to winnow and transport sediments in this area. Previous sampling programs have shown the presence of localized deposits of fine-grained sandy mud (Loring and Nota, 1973). The regional surficial geology is shown in Figure 2.

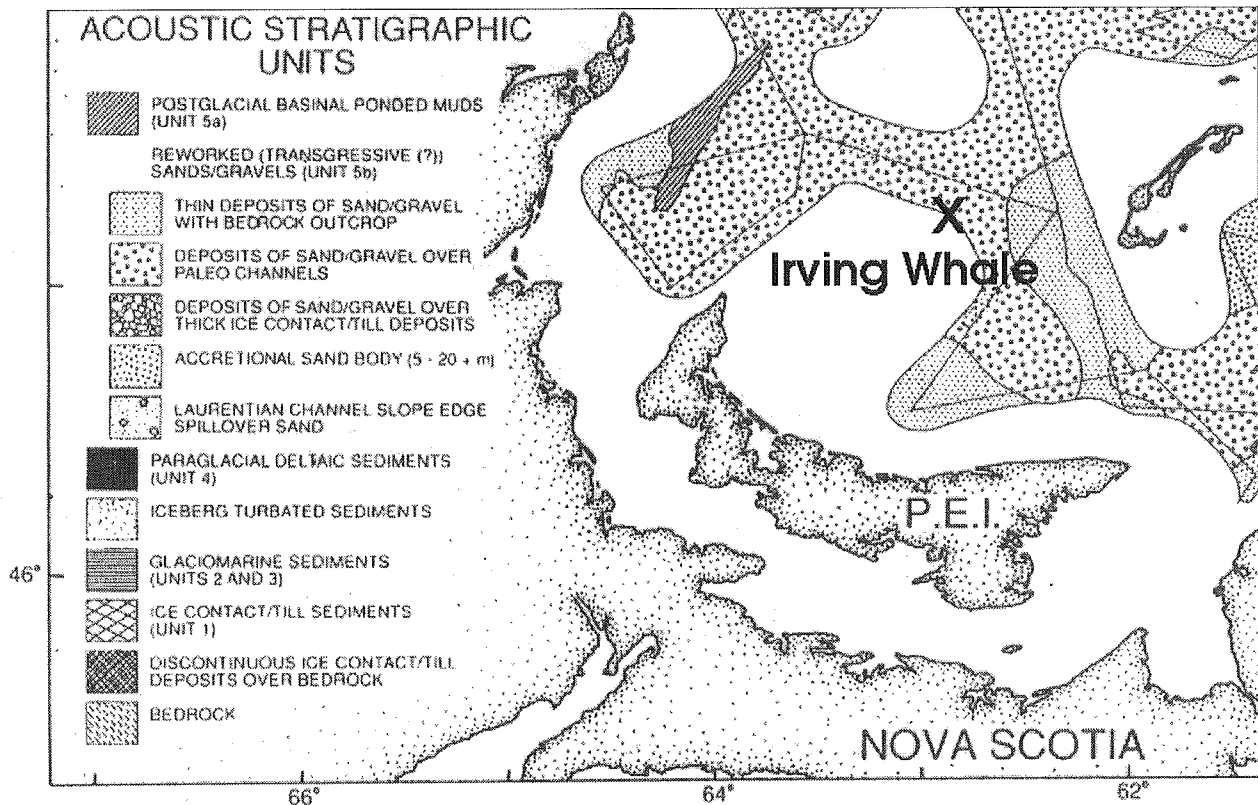


Figure 2. Regional surficial geology of the Gulf of St. Lawrence near the location of the sunken barge IRVING WHALE. The location of the IRVING WHALE is indicated by the 'X'. Modified after Josenhans et al, 1990.

The IRVING WHALE is presently located on the seafloor in about 67 metres water depth in an area of moderately undulating seafloor. Interpretation of the sidescan sonar data (Parrott, 1994) indicates the presence of a predominantly sandy seafloor, with patches of gravel and boulders. A photograph of the barge is shown with a sidescan sonar image of the barge and surrounding seafloor in Figure 3. The presence of the gravel deposit and boulders has been confirmed by observations from the Department of National Defense manned submersibles SDL-1 and PISCES, deployed from the CFAV CORMORANT.

While using a water jet to excavate a trench under the barge, divers observed that the near surface sediments appeared to be composed of layers of sandstone interbedded with fine sediment. Small pieces of sandstone within a layer were dislodged with the water jet, however pieces larger than about 0.3 metre had to be removed by hand. The presence of a hard substrate near the surface caused problems sampling the seafloor sediments with a vanVeen grab sampler in 1994 and with a Shipek sampler in 1995. In both cases, only small amounts of sand/gravel sediment were obtained, indicating that the surficial sediments may occur as a thin veneer over the hard substrate.

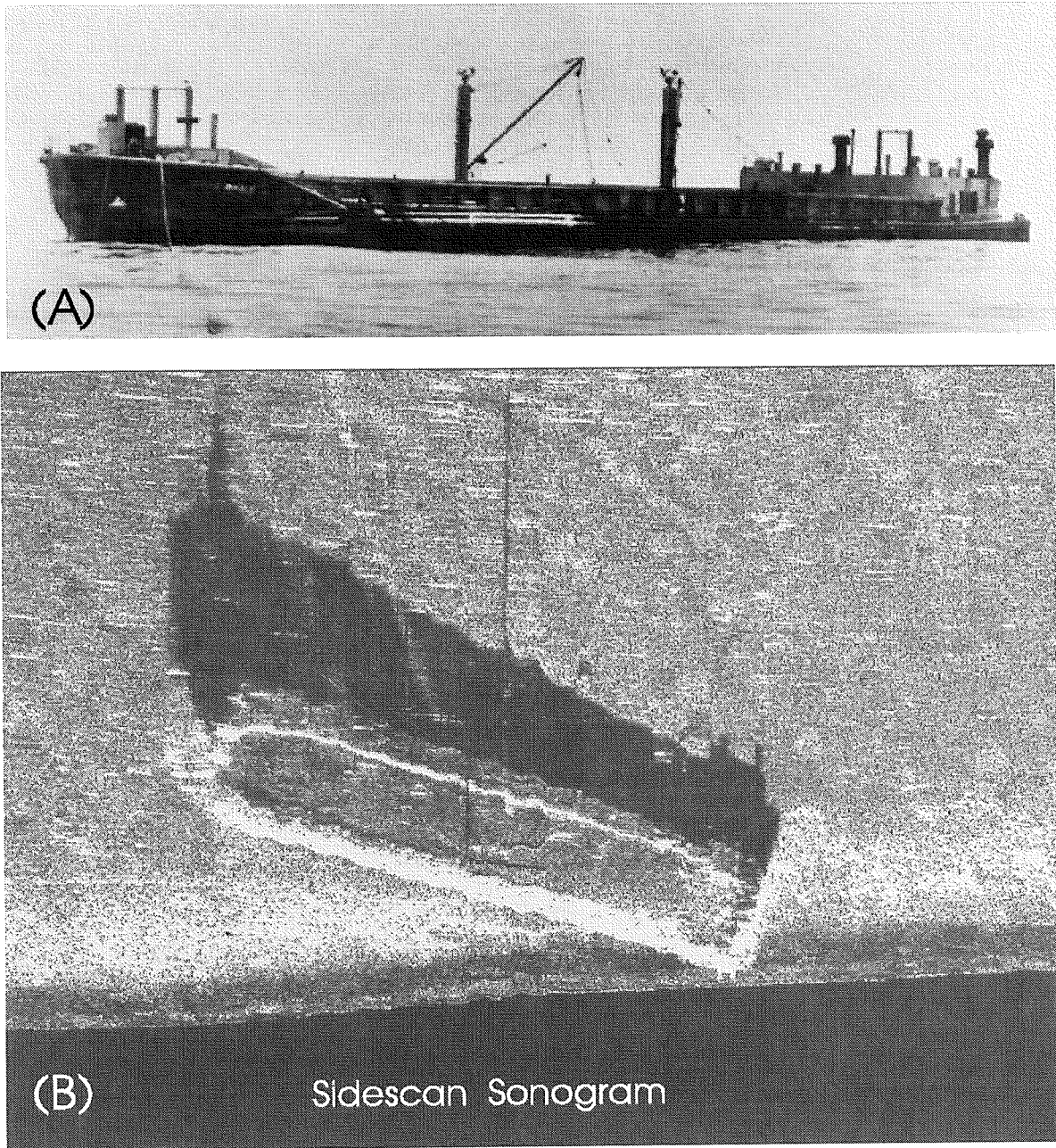


Figure 3 Photo (A) of the barge IRVING WHALE and a sidescan sonar image (B) of the barge, processed from 120 kHz data collected in 1994 with a Simrad MS992 sidescan sonar system. The sidescan sonar image shows hoses and debris on the deck of the barge. The acoustic shadow (shown as the large dark patch behind the barge) shows the various derricks, bollards, and pipes on the barge which can be seen in the photo.

## **Navigation**

Positions were determined with a Global Position System with real time Differential corrections (D-GPS) and displayed using AGCNav, a navigation display and logging program specifically developed for marine geoscientific surveying. It accepts input from a range of navigation devices, most notably a GPS or Differential GPS receiver. It also accepts data from an acoustic tow fish positioning system and several other sensors. It produces a versatile display of the ship and towed bodies in real time. AGCNav runs on a single IBM compatible computer.

## **Sampling Program - October 1995**

From 16-20 October 1995, a sediment sampling program was undertaken near the IRVING WHALE, as part of a joint project between the Geological Survey of Canada, Environment Canada and Transport Canada. Observations of the barge and surrounding seafloor were made using the Department of National Defense manned submersible PISCES IV, deployed from the CFAV CORMORANT. During the dive, a single push-core sample was taken in soft sediment that had been deposited close to the barge.

Sediment samples were taken with a Shipek grab sampler to provide an assessment of sediment contamination in the area. Samples were taken in a grid, 100 m, 500 m, and 1000 m from the barge. Additional samples were taken 3 km and 5 km northeast of the barge to establish background levels of PCB concentrations. Many of the sampling attempts produced small amounts of fine-grained sand. Duplicate samples were taken at these location to obtain a sufficient quantity of sediment. The locations of the samples relative to the barge, are shown in Figure 4 and reported in Table 1.

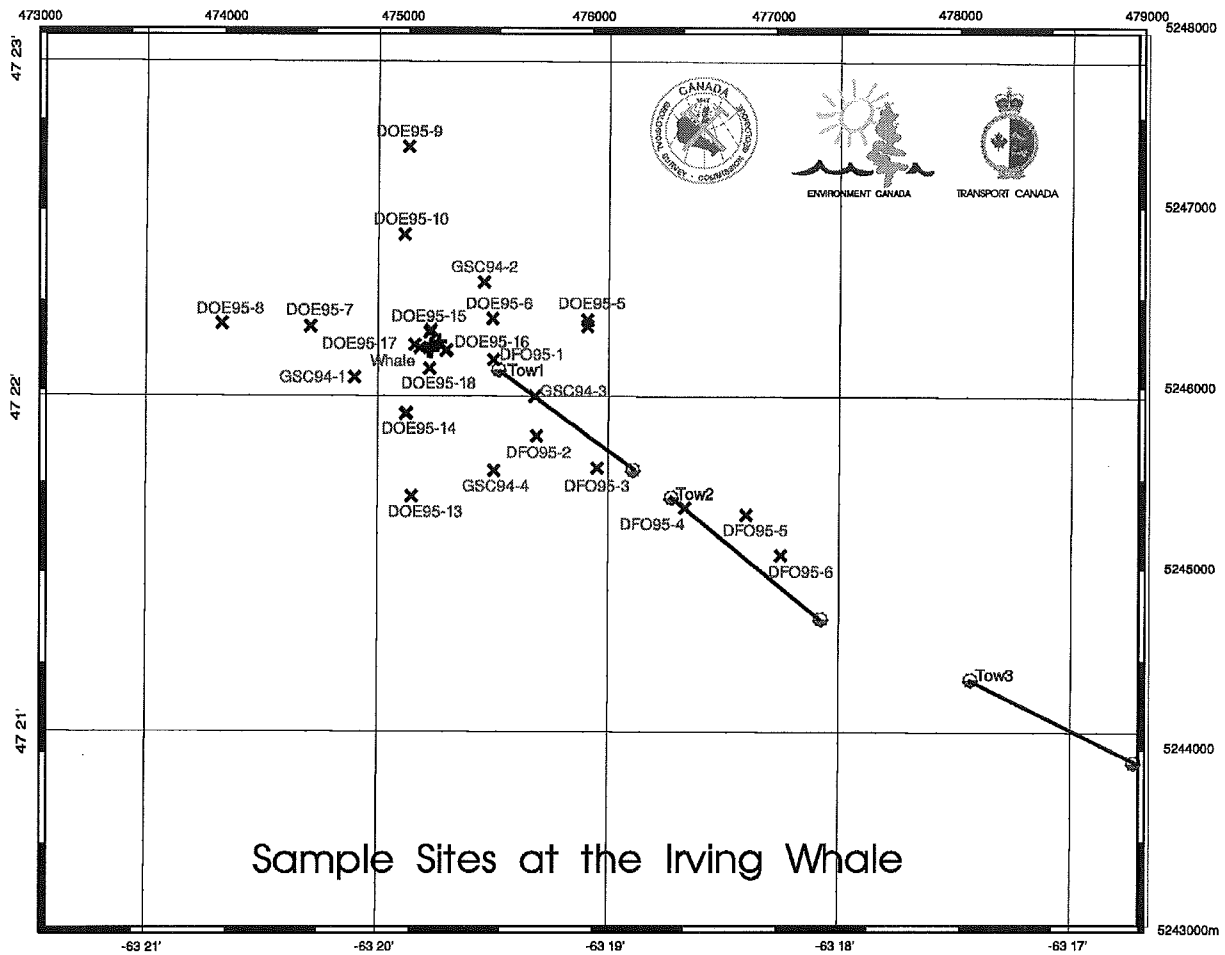


Figure 4. Sediment sample positions relative to the newly determined position of the barge Irving Whale. Samples taken during the 1995 program from the CCGS Simon Fraser are designated 'DOE95-1' etc. Duplicate samples were taken in several locations. Samples from the 1994 GSC sampling program are designated 'GSC94-1'. Benthic tows are designated 'Tow1' and samples taken during a 1995 sampling program from the vessel Opilio are designated 'DFO95-1'.

The Shipek grab sampler was deployed using the crane on the helicopter deck of the CCGS Simon Fraser. The sampler was lowered to the seafloor by hand and recovered using the capstan on the rear quarter-deck. Samples were stored in Hexane rinsed glass jars.



Sample1	47.339245	-63.278604	4 km SE of barge
Sample2a	47.404333	-63.275308	5 km NE of barge
Sample2b	47.405997	-63.273803	5 km NE of barge
Sample3	47.434123	-63.232342	10 km NE of barge
Sample5a	47.370595	-63.318171	1 km E of barge
Sample5b	47.370292	-63.318161	
Sample6	47.370658	-63.325106	0.5 km E of barge
Sample7	47.370263	-63.338413	0.5 km W of barge
Sample8	47.370408	-63.344858	1 km W of barge
Sample9	47.379325	-63.331279	1 km N of barge
Sample10a	47.37492	-63.331576	0.5 km N of barge
Sample11	47.13681	-63.564725	31 km SW of barge
Sample12a	47.246738	-63.457265	17 km SW of barge
Sample12b	47.246843	-63.457287	
Sample13	47.361737	-63.331008	1 km S of barge
Sample14a	47.365938	-63.331383	0.5 km S of barge
Sample14b	47.365893	-63.331437	
Sample15a	47.369977	-63.329712	0.1 km N of barge
Sample15b	47.3701	-63.329607	
Sample16a	47.369038	-63.32851	0.1 km E of barge
Sample16b	47.369083	-63.328449	
Sample17a	47.369342	-63.330789	0.1 km W of barge
Sample17b	47.369187	-63.330407	
Sample18	47.368137	-63.329707	0.1 km S of barge
Sample19	47.432798	-63.312096	7.5 km NE of barge
Sample20	47.460965	-63.270457	10 km NE of barge

Table 1 Positions for sediment samples collected during the October 1995 program from CCGS Simon Fraser

### Position of the Irving Whale

During the sampling program an accurate position for the barge was determined with a Global Positioning System using real-time Differential corrections (D-GPS). As the CCGS Simon Fraser passed over the barge, the barge was detected on the ship's echosounder and the position noted from the navigation system. The vessel was equipped with a Honeywell ELAC echo-sounder operating at 30 kHz, with a 16° beamwidth (between -3dB points). The wide beamwidth of the transducer, produced a footprint of about 20 metres in the 65 metre water depths present at the Irving Whale site, resulting in large side echoes from the barge (Figure 5). A strong reflection can be seen from the top of the rail and the deck of the barge. A weaker echo can be seen between the deck of the barge and the seafloor, and may be related to the amount of oil

remaining in the tanks. The multiple echo shown below the barge is probably caused by internal reflections within the barge.

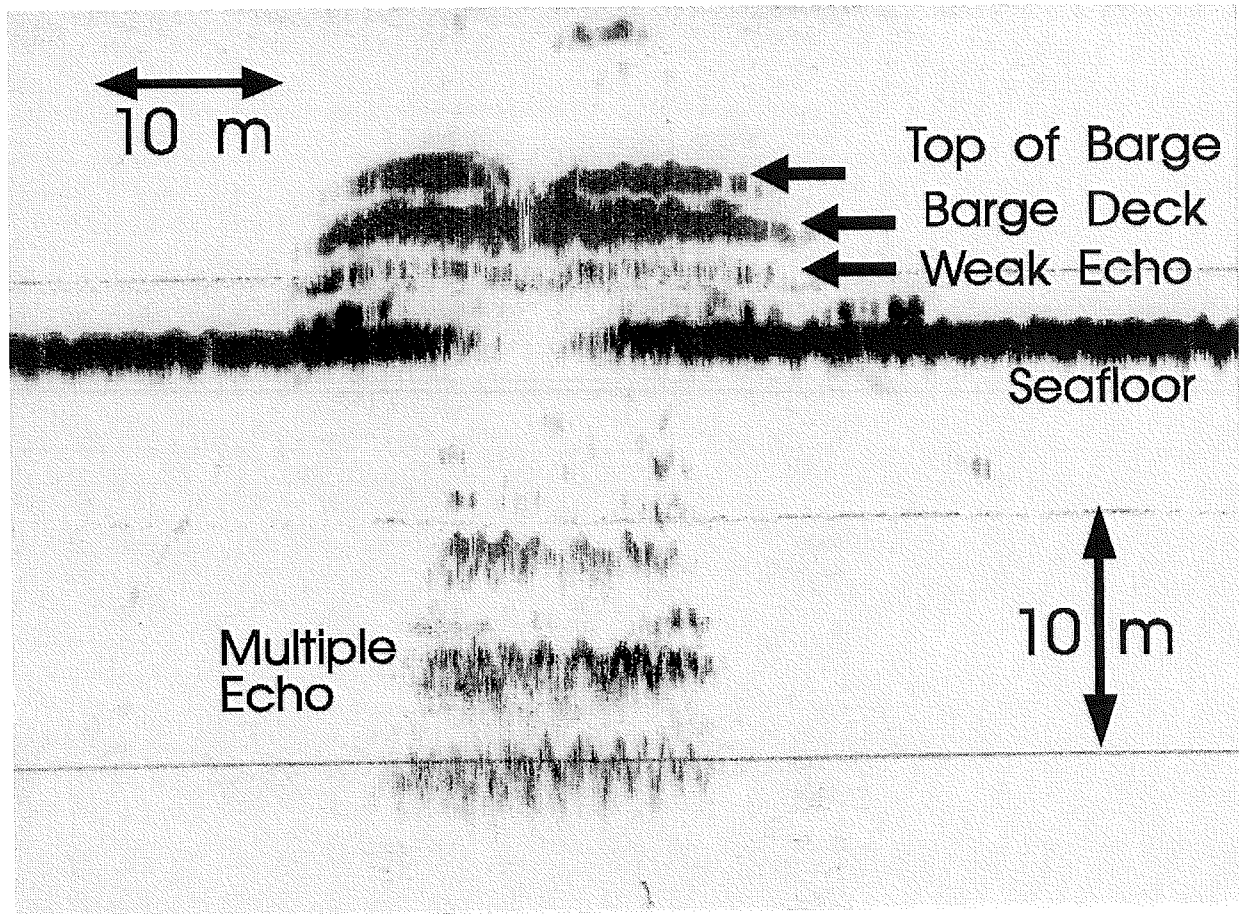


Figure 5 Echo sounding transect over the barge Irving Whale made during the October 1995 sampling program on the CCGS Simon Fraser. The echo from the top of the side rails and the floor of the barge can clearly be seen. A weaker echo is present between the deck of the barge and the seafloor.

Seven separate determinations of the position were made, as shown in Table 2 and compared to the location determined by the Canadian Hydrographic Service during a 1994 multibeam bathymetry survey of the barge. All seven positions from this survey plotted within the perimeter of the barge determined from the 1994 multibeam bathymetry data.

The position of the barge (calculated as the average of the seven positions), using the NAD83 reference datum is:

47° 22.1513' N

63° 19.7721' W

LORAN-C time/difference readings taken at the same time as the D-GPS are:

14822.69	on chain	5930-X
30153.46	on chain	5930-Y

Previous Position	47.370333	-63.331333
Whale1	47.369298	-63.329557
Whale2	47.369190	-63.329599
Whale3	47.369107	-63.329582
Whale4	47.369008	-63.329626
Whale5	47.369458	-63.329043
Whale6	47.369226	-63.329558
Whale7	47.369027	-63.329776

Table 2 Position of the barge Irving Whale determined using D-GPS during the October 1995 sampling program from the CCGS Simon Fraser. The previous position shown is approximately 200 metres northwest of the position determined during this survey. These positions are shown in Figure 4.

## References

Josenhans, H., Zevenhuizen, J., and MacLean, B. Preliminary seismostratigraphic interpretations from the Gulf of St. Lawrence; *in* Current Research, Part B, Geological Survey of Canada, Paper 90-1B, p.59-75, 1990.

Loring, D.H and Nota, D.J.G. Morphology and sediments of the Gulf of St. Lawrence: Fisheries Research Board of Canada Bulletin 182. 1973.

Parrott, D.R Irving Whale sidescan sonar survey. Unpublished GSC report submitted to Transport Canada and Environment Canada. Oct 1994

Piper, D.J.W., Mudie, P.J., Fader, G.B., Josenhans, H.W., MacLean, B. and Vilks, G., Quaternary Geology, Chapter 10 *in* Geology of the Continental margin of Eastern Canada, M.J. Keen, , and G.L. Williams, (ed.); Geological Survey of Canada, Geology of Canada, no. 2; .475-607 (also Geological Society of America, The Geology of North America, v. I-1), 1990.

## Appendix A

### Survey Particulars

Name of Vessel: CCGS Simon Fraser  
Dates of Survey: 16-20 October 1995  
Area of Operation: Gulf of St. Lawrence

### Personnel

<u>Geological Survey of Canada</u>	<u>Transport Canada</u>	<u>Environment Canada</u>
Russell Parrott	Will Vickery	Sinclair Dewis

### Equipment Specifications and Performance

#### BATHYMETRY

Bathymetry data were collected by using the ship's Honeywell ELAC 30 kHz echo sounder.

#### SAMPLING EQUIPMENT

Samples of the surficial sediment in the area were obtained using a Shipek grab sampler deployed from the starboard side of the vessel.

#### NAVIGATION EQUIPMENT

Navigation was by a differential Global Positioning System. Real Time differential corrections were obtained from the Coast Guard beacons at Port aux Basques, Newfoundland. Data was logged using AGCNav. Accuracy of the navigation was about 4 m.

### Summary of Activities

Monday 16 October 1995 - Mobilization

The sampling gear and navigation system were loaded into the GSC vehicle. R. Parrott (GSC) and W. Vickery (CGC) drove from Dartmouth to Charlottetown, PEI and joined the vessel CCGS Simon Fraser. The gear was loaded onto the vessel, and preliminary arrangements made for equipment deployment. Due to weather conditions, the vessel remained in Charlottetown.

Tuesday 17 October - Mobilize and test gear

The navigation system (AGCNav) was installed on the bridge where it would be visible by the helmsman, and accessible to the officer of the watch. The Shipek grab was installed, and tested at the dockside. The ship sailed at about 15:30 and headed to the Irving Whale site. Final adjustments were made to the core samplers, with new gaskets and tubes fitted.

Wednesday 18 October - Standby for Cormorant and sampling

The vessel arrived at the site at about 08:00. W. Vickery (CGC) and S. Dewis (EC) were transferred to the Cormorant, where W. Vickery made a submersible dive on the barge Irving

Whale. A single sample was taken near the barge during the submersible operations. Several samples were taken about 5-10 km from the site to provide background samples. Additional samples were taken about 1 km from the barge before operations stopped at 17:00 due to bad weather conditions. The vessel proceeded to anchor for the night.

Thursday 19 October - Sediment sampling near the barge

W. Vickery was transferred to shore to return to Dartmouth. The vessel steamed back to the site. Samples were taken en route, and near the barge. Additional samples were taken NE of the barge. A new position was determined for the barge using D-GPS. Sampling was completed at 21:00.

Friday 20 October 1995 - Return to Dartmouth

R. Parrott and S. Dewis transferred to shore at Alberton with all equipment and samples. A Coast Guard driver transported personnel and gear back to Charlottetown where the gear and samplers were loaded into vehicles and driven to Dartmouth.