1988
FINAL FIELD REPORT

WESTERN ARCTIC SURVEYS
PACIFIC REGION

CSS JOHN P TULLY

BEAUFORT SEA
JULY 11 TO SEPTEMBER 25

B.M. LUSK, C.L.S.
HYDROGRAPHER-IN-CHARGE

CANADIAN HYDROGRAPHIC SERVICE
DEPARTMENT OF FISHERIES AND OCEANS
INSTITUTE OF OCEAN SCIENCES
SIDNEY, B.C.

Canada

1988

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BY

BARRY M. LUSK, CLS

INSTITUTE OF OCEAN SCIENCES

SIDNEY, BC

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ACKNOWLEDGEMENTS

For the fourth year in a row the JOHN P. TULLY journeyed to the Beaufort Sea. Hydrographic surveys were once again carried out and the existing 1981 deep draught corridor was extended to the south.

The success of the 1988 Hydrographic surveys is due to the efforts of everyone involved. I would like to thank the ship's complement for providing a very happy and productive work environment, Polar Continental Shelf for their logistics support, Okanagan Helicopters for their safe flying and the surveyors aboard for the long and difficult hours they spent aboard our launches.

The success of our efforts is due entirely to the people who participated and the superior tools with which we had to work. My thanks are extended to one and all.

B.M. Lusk, CLS
December 1988

FOREWORD

The CSS JOHN P. TULLY has now four Arctic seasons behind her and each of these seasons has proven interesting and informative.

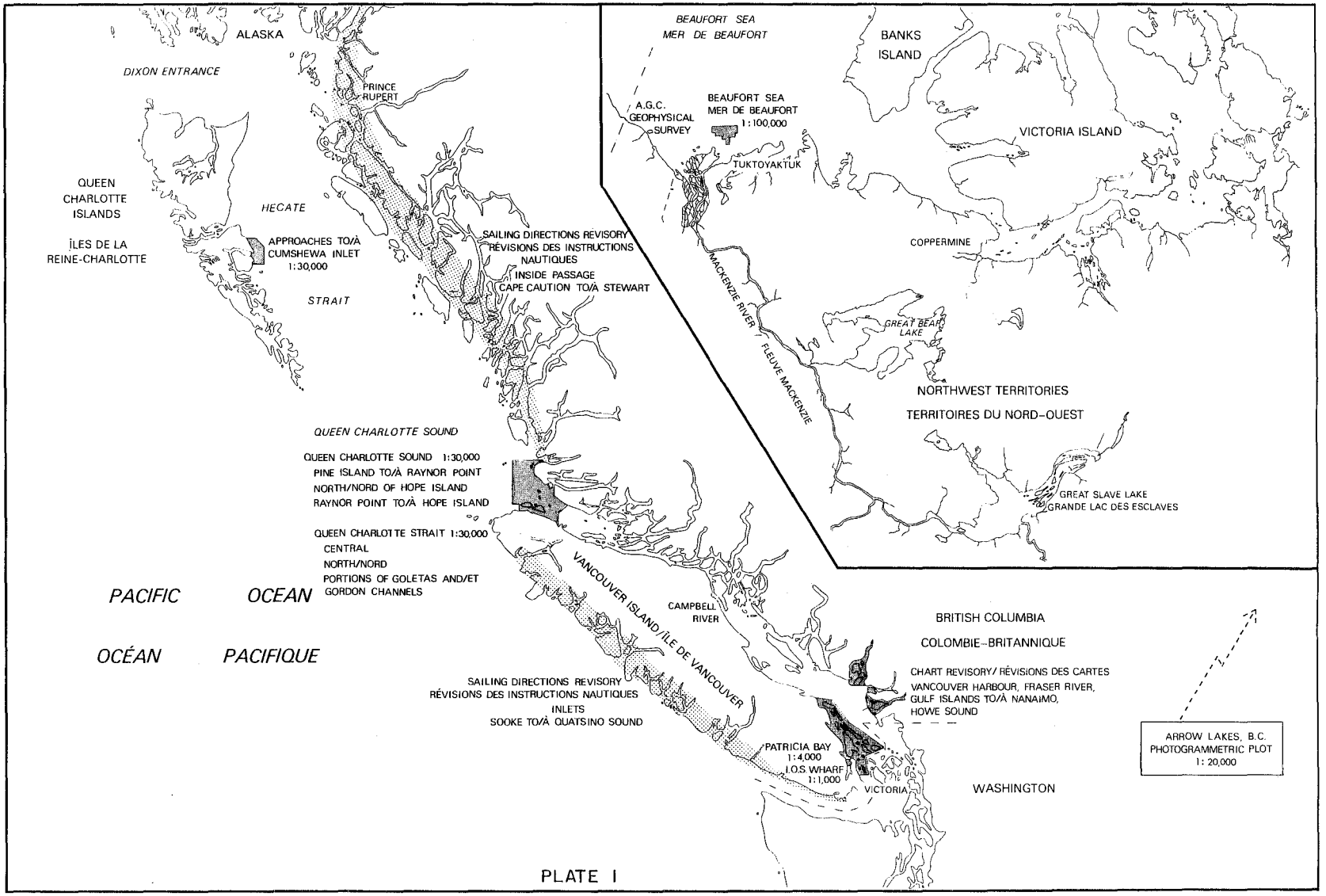
In February of 1988 plans were formulated to extend the hydrographic surveys of 1985 and 1986 north and west to the existing deep draught corridor. The survey area designated for 1988 was divided into two priority areas. Priority area 1 was a 24 kilometre wide corridor which extended from the existing (1981) corridor southeast into the Amauligak oil fields and Priority area 2 was an extension of this corridor to the east to marry in with the 1986 work.

These hydrographic surveys were a continuation of the surveys begun in 1985. Soundings were run at 100 metre line spacing and replaced previous Decca surveys of 500 and 1000 metre line spacing of earlier years. These surveys are intended to provide large scale bathymetric information for proposed pipeline routes from the Beaufort Sea oil fields to the vicinity of Richards Island as well as guarantee safe deep draught shipping in the area.

In 1985, just prior to the JOHN P. TULLY's maiden cruise, a proposed plan of surveys was conceived. It was our intention to re-sound three large areas which lay south of the existing corridor in each of three years. Each area had within its boundaries about 24,000 nm of sounding. See Plate #2. Our 1988 field season completed our three year period but has not, as yet, completed our intended sounding. More work in 1989 will be necessary.

The positioning system used in 1988 was the same system used in 1985 and 1986 and occupied the same sites ashore. The systems used were Cubic Westerns DM-54 ARGO, as our primary positioning system and the DEL NORTE 542 Trisponder system as our initial calibration system. See Plate #10 for shore station configuration and Plate #9 for overall system configuration.

The CSS JOHN P. TULLY's annual trip to the Arctic is truly a multidisciplinary effort and this year was no different. Numerous requests for assistance were received and we agreed to do the following. Magnetics information, on the journey north and south, was gathered for R. Currie of Pacific Geoscience Centre. Water samples, on the way north and south, were gathered for C.S. Wong of Ocean Chemistry. Ocean current drifters were placed in the Beaufort Sea for H. Melling of Ocean Physics and ocean depth information was gathered for General Bathymetric Charts of the Oceans. We also agreed to assist K. Kagaard of NOAA in Seattle, Washington in the recovery of three current metres that had been placed along Alaska's north slope. Unfortunately, ice conditions on the Tully's journey west on September 9 precluded a search for these meters.



Pacific Region 1988 Hydrographic Survey Program
Programme De Leves Hydrographique De La Région Du Pacifique

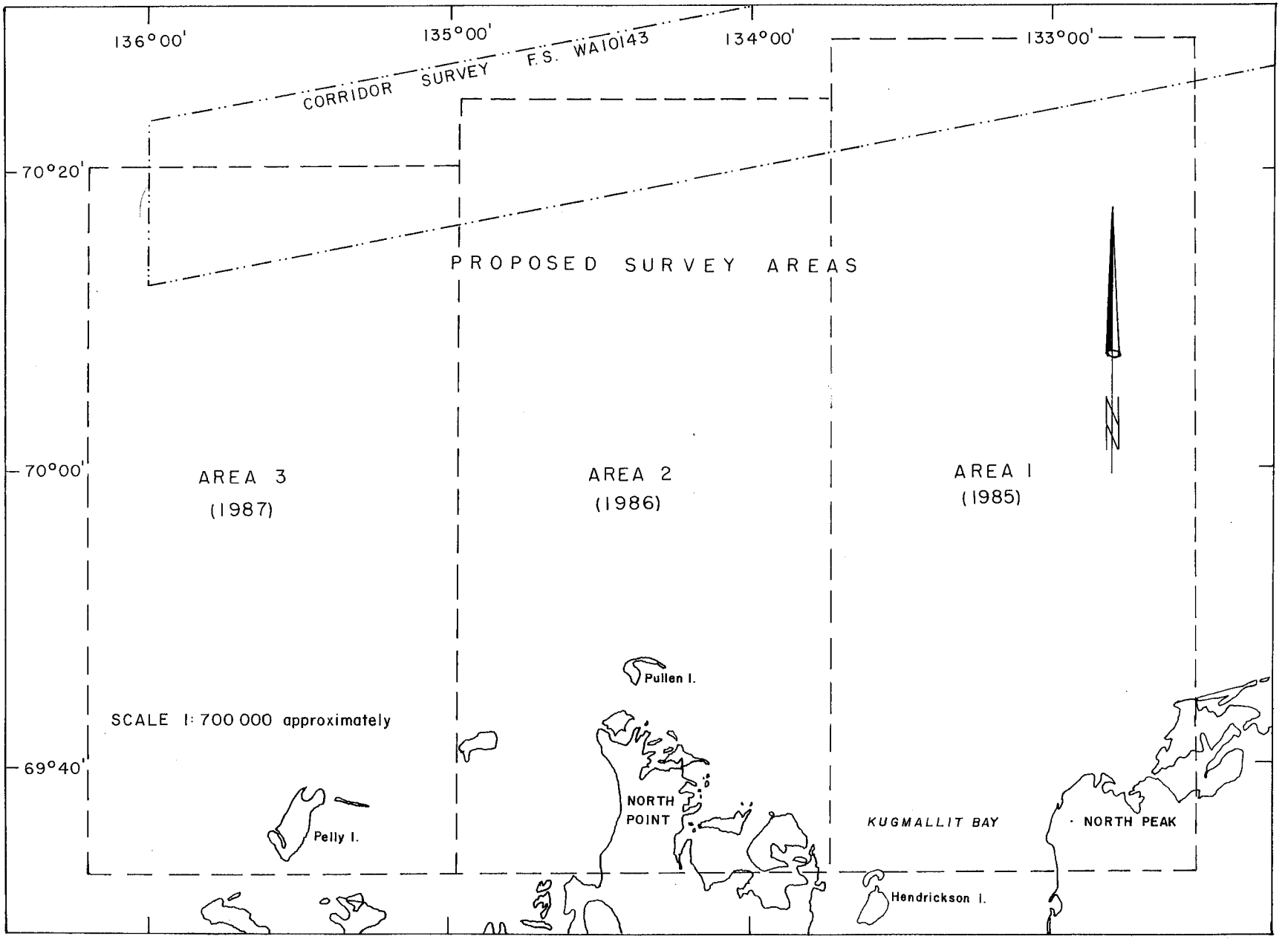

136°00'
135°00'
134°00'
133°00'
CORRIDOR SURVEY F.S. WA10143
70°20'
PROPOSED SURVEY AREAS
70°00'
AREA 3
(1987)
AREA 2
(1986)
AREA 1
(1985)
SCALE 1: 700 000 approximately
69°40'
Pullen I.
NORTH
POINT
Pelly I.
KUGMALLIT BAY
NORTH PEAK
Hendrickson I.

PLATE 2

The JOHN P. TULLY left IOS at 1800 on July 11 and reached the fairway buoy off Tuktoyaktuk at 1845 on August 3. Hydrography was completed on August 31 and Geophysics surveys were conducted until the ship left the Beaufort Sea on September 9. The ship arrived at IOS on September 25 after a successful passage south. Thus ended another winning survey season in the Arctic.

PERSONNEL INVENTORY

1. Hydrographic - Field Staff & Electronics

Barry M. Lusk	H-I-C	July 11-Sept. 2
Mike V. Woods	2-I-C	July 14-Sept. 10
John B. Larkin	Processor	Aug. 3-Sept. 2
Peter T. Milner	Surveyor	July 14-Sept. 25
Doug Popejoy	Surveyor	July 14-Sept. 10
Carol Nowak	Surveyor	July 11-Sept. 2
Mike A. Ward	Surveyor	Aug. 3-Sept. 25
Knut Lyngberg	Surveyor	July 11-Sept. 2
John Miller	NOAA Surveyor	July 11-Aug. 31
Olen Vanderleeden	Student/Surveyor	July 11-Sept. 2
Bruce Balfe	Student/Surveyor	July 11-Sept. 2
Radim Zizka	Student/Surveyor	July 11-Sept. 2
Larry Dorosh	Electronics Technologist	July 14-Sept. 2
Gordon Worthing	Electronics Technologist	July 11-Aug. 16
Bob Muse	Electronics Technologist	Aug. 31-Sept. 25

2. Ship's Officers and Crew

John Anderson	Captain	July 11-Sept. 25
Alan Chamberlain	Ice Captain	July 11-Aug. 4
Alan Coombes	Chief Officer	July 11-Sept. 25
John Purdie	2nd Officer	July 11-Sept. 25
Dan Knoblauch	3rd Officer	July 11-Sept. 1
Gilles Carriere	3rd Officer	Sept. 1-Sept. 25
Phil Pereira	Chief Engineer	July 11-Sept. 25
Dave Purdie	2nd Engineer	July 11-Sept. 25
Brian Heesterman	3rd Engineer	July 11-Sept. 25
Alan McRae	Electrician	July 11-Sept. 25
Pat Murphy	Boatswain	July 11-Sept. 25
Steve Law	Seaman	July 11-Sept. 25
Ed Aucoin	Seaman	July 11-Sept. 25
Gerry Garneau	Seaman	July 11-Sept. 25
Simon Dockerill	Seaman	July 11-Sept. 25
Terry Ryder	Seaman	July 11-Aug. 11
Dan Graham	Seaman	Aug. 4-Sept. 1
Miles Fidler	Seaman	Aug. 4-Sept. 1
Don Kirkby	Seaman	Aug. 4-Sept. 25
Al Keene	Seaman	July 11-Sept. 25
John Ennis	Mechanic	Aug. 4-Sept. 1
Dennis Saker	Oiler	July 11-Sept. 25
Wayne Contois	Seaman	Aug. 16-Sept. 1
Pierre Begin	Chief Cook	July 11-Sept. 25
Don Boughton	2nd Cook	July 11-Sept. 25
Colin Bell	3rd Cook	July 11-Sept. 25
Paul Philip	Steward	July 11-Sept. 25
Tom Smart	Steward	July 11-Sept. 25

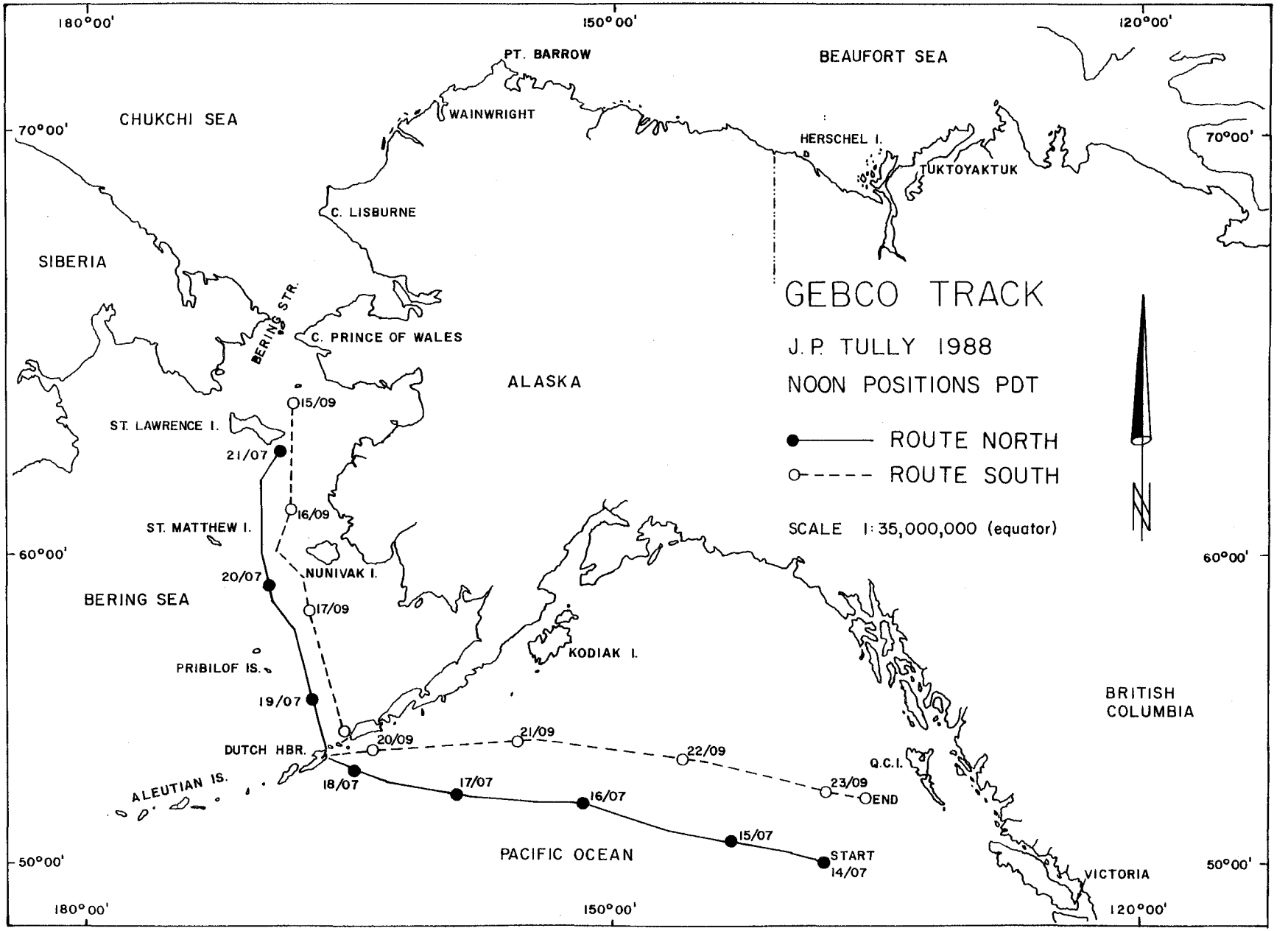

180°00'
150°00'
120°00'
70°00'
60°00'
50°00'
PT. BARROW
BEAUFORT SEA
CHUKCHI SEA
WAINWRIGHT
HERSCHEL I.
TUKTOYAKTUK
C. LISBURNE
SIBERIA
BERING STR.
C. PRINCE OF WALES
ALASKA
GEBCO TRACK
J.P. TULLY 1988
NOON POSITIONS PDT
ROUTE NORTH
ROUTE SOUTH
SCALE 1:35,000,000 (equator)
ST. LAWRENCE I.
ST. MATTHEW I.
NUNIVAK I.
BERING SEA
PRIBILOF IS.
KODIAK I.
BRITISH COLUMBIA
DUTCH HBR.
ALEUTIAN IS.
Q.C.I.
PACIFIC OCEAN
VICTORIA
15/09
21/07
16/09
20/07
17/09
19/07
20/09
21/09
22/09
23/09
END
18/07
17/07
16/07
15/07
START
14/07

PLATE 3

3. Helicopter Pilots - PCSP

Dave White	206B	
Earl Niell	206B	As required
Rick Beason	S-61	July 15-Sept. 9
Ross Bertram	212	

4. Polar Continental Shelf Project - Tuktoyaktuk

Frank Hunt	Expeditor	July 15-Aug. 28
Ed Chapman	Expeditor	Aug. 28-Sept. 9

EQUIPMENT INVENTORY

Beaufort Sea Survey

1. Ship

CSS JOHN P. TULLY, steel hulled, 69 metre hydrographic survey vessel, ice strengthened.

2. Launches

Tempest	10 m	NOAA design - diesel
Toronado	10 m	NOAA design - diesel
Surge	10 m	NOAA design - diesel
Storm	10 m	NOAA design - diesel

These launches are aluminum hulled, semi-displacement sounding launches capable of 17 knots @ 2500 rpm.

3. Helicopters

C-FAHQ and C-GUCX Associated Helicopters, Bell 206B Jet Rangers on charter to Polar Continental Shelf Project.

C-FOKP Okanagan Helicopters Ltd., Sikorsky S-61 on charter to Beaudril of Tuktoyaktuk.

C-FOKV Associated Helicopters Ltd., Bell 212 out of Inuvik.

4. Positioning Systems

ARGO DM54 medium frequency (1702 khz) electronic positioning system with four shore stations (two 70 foot Texas Towers and two 75 foot fibreglass whip antennas with propane thermal-electric generators); one range-range receiver and five hyperbolic receivers.

Trisponder 542 microwave positioning system with one master and four remote transponders.

Magnavox 1107 GPS Transit/GPS Navigator rented from Bytown Marine, Ottawa.

5. Echo Sounding Equipment

1 Raytheon DSF-6000, 24/100 khz, (ship) 1 Raytheon PTR, 12.5 khz, (ship) 5 Simrad Skipper 802, 50 khz, (launches) 6 Meyers Systems Inc. Model G-1097 Digitizers.

6. Data Loggers

5 Hydrographic Acquisition Loggers (HAL) recently retrofitted with Targa RAM Ports for data logging.

7. Processing System

1 PDP 11-34A Computer with three 10 Mb RL02 disc drives
1 Targa RAM/Bubble Reader
2 Kennedy 9000 9 track magnetic tape drives
1 Calcomp 1044 series plotter
5 VT100 terminals
2 Tektronics graphics terminals
2 LA120 printers

8. Launch Radios

5 Robertson VHF radios with sel call headphones and intercom
4 Icom handheld portables

Atlantic Geoscience Centre Geophysical Equipment

1 Klein 50 kHz 3-channel side scan sonar with winch, cable and towfish
1 3.5 kHz hull mounted sub-bottom profiler
1 HP85 computer, 4 EPC recorders, 2 analog data tape recorders
Syledis positioning system from Canadian Engineering Surveys

Oceanographic Equipment

Serial Ascii Interface Loop system (SAIL)
1 Magnetometer (PGC)
220 flasks for water samples (Ocean Chemistry)
8 drifter buoys (Ocean Physics)

Tidal Equipment

1 Low Powered Tide Gauge (LPTG)

CHRONOLOGY OF EVENTS

July 11	JOHN P. TULLY left IOS at 1830 local time.
July 12	Proceeded west through Juan de Fuca Strait. Noon position 48°-30'.4, 126°-28'.6
July 13	Began Magnetics and GEBCO at 0530 this morning. Noon position 48°-41'.1, 131°-30'.2
July 14	Continued Mag and GEBCO. Noon position 49°-58'.7, 136°-26'.2. ARGO party left Victoria for Tuktoyaktuk.
July 15	Continued Mag and GEBCO. Noon position 51°-04'.6, 143°-30'.9. ARGO party arrived in Tuktoyaktuk late in afternoon.
July 16	Continued Mag and GEBCO today and records are very good. Noon position 52°-30'.1, 150°-56'0. ARGO party carried out a reconnaissance of ARGO stations and readied equipment.
July 17	Continued Mag and GEBCO. Ship's noon position 52°-56'.7, 158°-50'.2. ARGO party readying equipment.
July 18	Discontinued Mag and GEBCO this morning. Arrived in Dutch Harbour and refuelled. ARGO equipment taken to Pelly Is., Pullen Is., in a.m. and to Warren Pt. and Relief in p.m. Used Sikorsky S61.
July 19	Continued Mag and GEBCO. Noon position 55°-19'.5, 167°-10'.3. ARGO tower and electronics assembled at Warren Point. ARGO equipment installed at Relief Islet. I.L.A. inspection carried out. Fibreglass antenna in good shape.
July 20	Continued Mag and GEBCO. Ship's noon position 59°-12'.0, 169°-40'.3. Tower erected at Warren Point. AGRO R.P.U. faulty.
July 21	Discontinued Mag and GEBCO today at St. Lawrence Is. Ship's noon position 62°-35'.3, 169°-05'.6. ARGO set up at Pullen Island. Fibreglass whip in good shape. ARGO turned on.
July 22	Circumnavigated Fairway Rock today. Noon position 66°-24'.1, 168°-20'.5. ARGO team at Tuktoyaktuk. Strong northwest winds.

July 23	Ship continued north and east. Ship's noon position 69°-21'.2, 165°-36'.2. ARGO team held up due to weather.
July 24	Ship proceeding towards Wainwright. Heavy ice. Ship's noon position 70°-29'.6, 162°-24'.8. No helicopter available at Tuktoyaktuk.
July 25	Ship stopped in ice off Wainwright. Tower erected at Pelly Island and ARGO turned on. All ARGO work completed.
July 26	Ship drifted in 10/10 ice. Ship's position off Wainwright. First H.F. contact made with Tuktoyaktuk. Frequency used 8294.2 & 12429.2 MHz.
July 27	Ship drifting in ice. Drift speed 40 n.m. per day. Ship's noon position 71°-02'.3, 158°-20'.0. Removed DECCA tower at Baillie Island. CHS whip antenna has been pushed over.
July 28	Ship drifting in ice. Ship's noon position 71°-02'.3, 158°-20'.0. ARGO team waiting in Tuktoyaktuk. Kept busy with maintenance jobs around PCSP.
July 29	Ship attempted some movement behind the C.C.G. Martha L. Black. Very slow going in heavy ice. Ship's noon position 71°-20'.2, 157°-05'.1. ARGO team waits.
July 30	Ship in heavy ice. Noon position 71°-33'.1, 156°-17'.4. ARGO team waits.
July 31	Ship broke free from very heavy ice north of Point Barrow this morning. Noon position 71°-06'.5, 153°-45'.7. ARGO team waits.
August 1	Ship proceeded east across the north slope of Alaska making good progress in 4/10 to 5/10 ice. ARGO team waits.
August 2	Ship continued east past Barter Island. ARGO team waits.
August 3	Ship arrived off of Tuktoyaktuk at 1845 this evening. Wind blowing 40 knots.
August 4	Winds still very strong. Sea rough. Postponed transfer of personnel until seas calmer. Completed personnel transfer later in the day. Set up positioning system on remaining Trisponder sites. Began calibration and continued into a.m.

August 5	Continued calibration of ship and launches.
August 6	Began launch sounding.
August 7	Continued launch sounding. All surveyors up to speed. Launch and ship operations now 24 hours per day.
August 8	Launches away at 0400. Recalled launches at 1000 because of high winds. Ship sounding commenced. Dr. W. Doubleday and Mr. A. O'Connor arrived today.
August 9	Winds high. No launch sounding. Ship sounding continued.
August 10	Launches placed in water at 0730 this morning. Doubleday and O'Connor left by helicopter this a.m. Drifters launched today for Dr. Humfrey Melling. Work day changed to 0800 to 2400.
August 11	Winds very high this morning and no launches put into water until 2000. Ship sounding during interval. Drifters launched.
August 12	Launches away first thing and then recalled during 1200 to 1600 shift. Ship sounding commenced.
August 13	Ship sounding continued. Helicopter to ship with groceries. M. Woods ashore to get tides. Launches placed in water for last shift of the day.
August 14	Launch sounding all day today.
August 15	Launch sounding all day. "Surge" developed a cracked manifold and "Storm" was used in her place. Some time lost to exchange of equipment.
August 16	Launch sounding continued. R. Sandilands arrived today. Ship sounding during the evening.
August 17	Launch sounding continued.
August 18	Launch sounding continued. Survey area enveloped in fog. Helicopter unable to fly.
August 19	R. Sandilands off to Tuktoyaktuk today. No launch sounding today, winds very high. Ship sounding continued.
August 20	No launch sounding, winds very high. Ship continued sounding.

August 21	No launches away at 0800 this morning. Seas still rough. Launches put into the water for 1200 shift. Launch sounding continued till 2400.
August 22	Launch sounding all day today.
August 23	Launch sounding 0800-2400. Ship sounding 2400-0800.
August 24	Some data lost on RAM cartridges yesterday. Launches continue sounding.
August 25	Launches continued sounding. We are now rebooting the HAL's each morning to prevent data loss.
August 26	No launches over the side this morning as winds were high. Ship sounding continued. Launched drifters today.
August 27	No launches over the side this morning. Launches put in the water at 2000 for one shift. Ship sounding.
August 28	Launches over the side first thing and then recalled at 2000. Winds high. Ship sounding.
August 29	Very thick fog. Launches out all day doing splits and exams. Helicopter scheduled but could not fly.
August 30	Winds high, no launch sounding. Ship sounding all day.
August 31	Launch sounding today. Completed sounding at 2000. Ship proceeded to the fairway buoy off Tuktoyaktuk. Drifters launched on passage to Tuktoyaktuk.
September 1	Transfer of personnel and change of Tully operation. ARGO team moved ashore to PCSP. All others flew home.
September 2	Three man ARGO team set up operations at PCSP. Relief Point ARGO dismantled; Warren Point ARGO turned off; Tuft Point and North Peak Trisponder equipment retrieved.
September 3	Pelly Island ARGO dismantled, tower taken down. Warren Point ARGO tower taken down and returned to Tuktoyaktuk.
September 4	All equipment removed from Warren Point. Area inspected by Inuvialuit Land Administration.

September 5	Tide gauge at Tuktoyaktuk removed. Fog prevented S61 flight.
September 6	No helicopter available.
September 7	Okanagan 212 helicopter chartered from Inuvik. All equipment at Pelly and Pullen Islands recovered in a.m. Relief Island gear recovered in p.m.
September 8	Cleaned up equipment and completed inventory of equipment.
September 9	ARGO equipment ferried out to Tully for transportation to IOS. Tully partially completed AGC project. Tully departs the Arctic.
September 10	ARGO crew arrives home.
September 25	JOHN P. TULLY arrives at IOS. GEBCO and Magnetics gathered on journey south.

PLANNING, PREPARATION AND OPERATIONS

1. Planning - Beaufort Surveys

Field sheet and plotting sheets

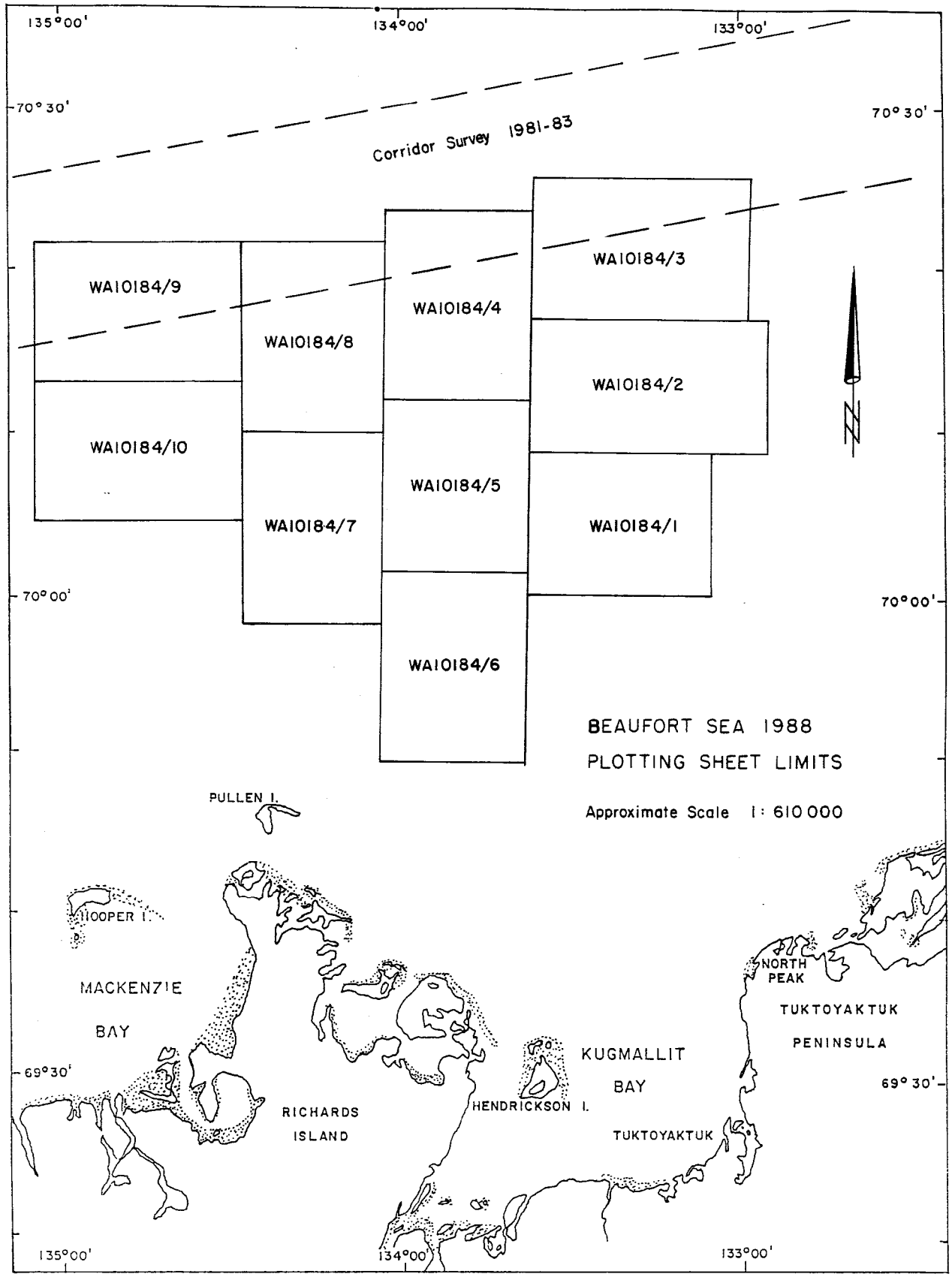
WA10184	Beaufort Sea Sureys	1:100,000	
WA10184/1	Plotting Sheet	1:20,000	
WA10184/2	Plotting Sheet	1:20,000	
WA10184/3	Plotting Sheet	1:20,000	
WA10184/4	Plotting Sheet	1:20,000	
WA10184/5	Plotting Sheet	1:20,000	(See Plate #4)
WA10184/6	Plotting Sheet	1:20,000	
WA10184/7	Plotting Sheet	1:20,000	
WA10184/8	Plotting Sheet	1:20,000	
WA10184/9	Plotting Sheet	1:20,000	
WA10184/10	Plotting Sheet	1:20,000	

Plans were formulated in 1985 to resurvey that area of the Beaufort Sea that lay south of the existing corridor. This area was divided into 3 equal portions of about 25,000 n.m. of linear sounding and designated "one" for each of the next three seasons (See Plate #2). As may be expected we have not kept to this very ambitious plan. This has been due to a number of reasons not the least of which has been weather and ice.

Our plan for the 1988 season was to extend the corridor south in the vicinity of the Amauligak oil field and to the east to marry into the survey boundaries of the 1986 and 1985 surveys. No hydrography was conducted in 1987.

The scale of the surveys would be the same as all the recent surveys, 1:20,000 which translates into a line separation of 100 metres on the main lines. Our positioning system, ARGO DM54, was to be set up on the same sites as we used in 1985 and 1986 and most of the same towers, guy wires and ground mats would be reused.

No field sheets were pre-graduated or prepared beforehand. No lattices were required nor prepared. No pre-survey meetings were held to designate tasks. We kept it simple. We had done it many times before and we knew what we were doing. We merely identified the survey area, loaded our equipment aboard the ship and journeyed to the Beaufort Sea.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134°00'
133°00'
70°30'
Corridor Survey 1981-83
WA10184/9
WA10184/8
WA10184/4
WA10184/3
WA10184/2
WA10184/10
WA10184/7
WA10184/5
WA10184/1
WA10184/6
70°00'
BEAUFORT SEA 1988
PLOTTING SHEET LIMITS
Approximate Scale 1: 610 000
PULLEN I.
COOPER I.
MACKENZIE
BAY
69°30'
RICHARDS
ISLAND
HENDRICKSON I.
KUGMALLIT
BAY
TUKTOYAKTUK
NORTH
PEAK
TUKTOYAKTUK
PENINSULA

PLATE 4

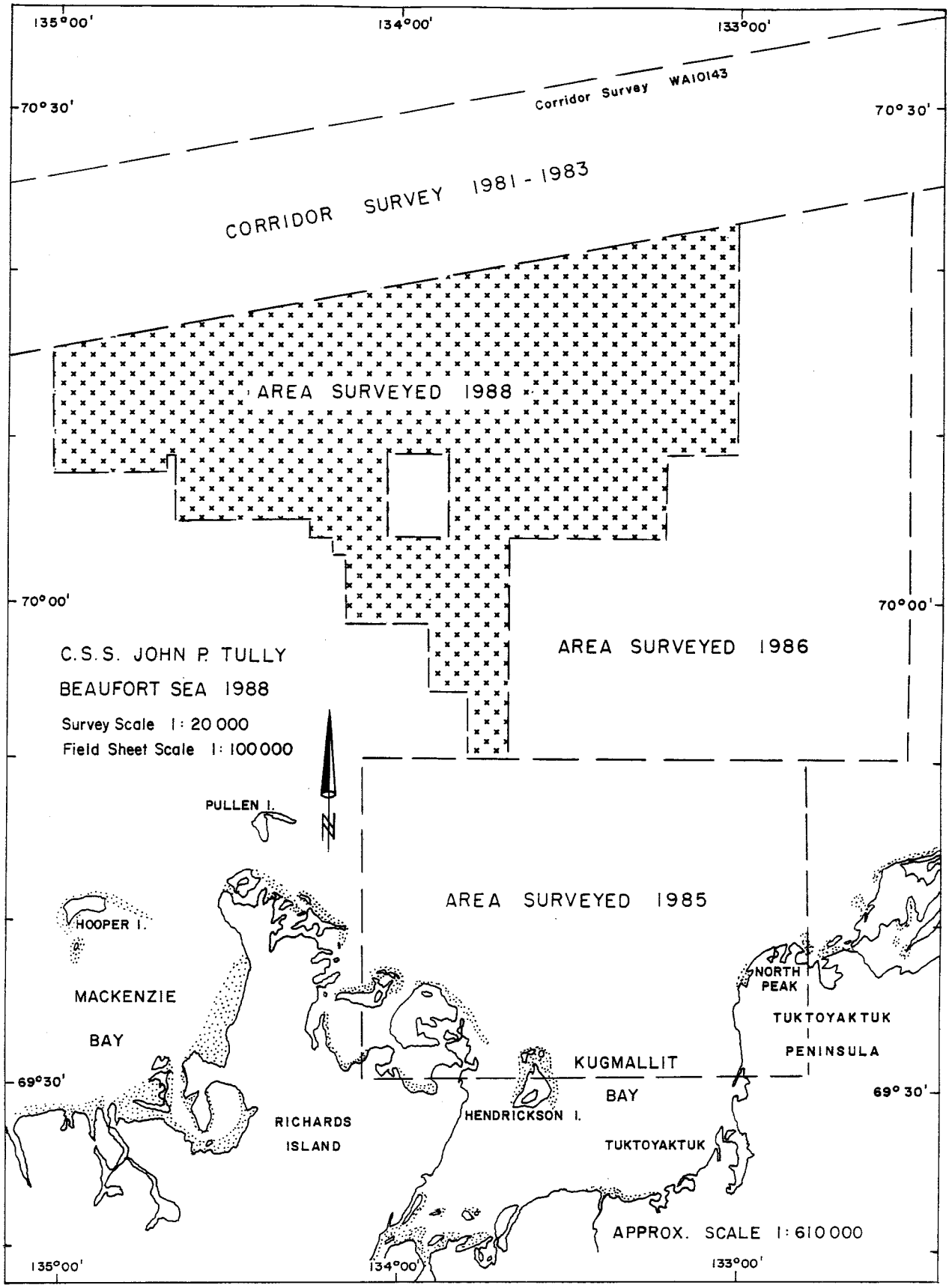

135°00'
134°00'
133°00'
70°30'
Corridor Survey WA10143
CORRIDOR SURVEY 1981 - 1983
AREA SURVEYED 1988
70°00'
C.S.S. JOHN P. TULLY
BEAUFORT SEA 1988
Survey Scale 1 : 20 000
Field Sheet Scale 1 : 100000
AREA SURVEYED 1986
PULLEN I.
AREA SURVEYED 1985
HOOPER I.
MACKENZIE
BAY
NORTH
PEAK
TUKTOYAKTUK
PENINSULA
KUGMALLIT
BAY
69°30'
RICHARDS
ISLAND
HENDRICKSON I.
TUKTOYAKTUK
APPROX. SCALE 1:610000

PLATE 5

2. Preparations

Preparations, especially when modern survey teams are so heavily into electronics, are an ongoing process and every free moment during the fall and winter is spent servicing equipment. Other detailed preparations are listed below:

a) Argo and Trisponder equipment was recalibrated and timed.

b) Sounders and radios were serviced during the winter and placed in our sounding launches in June in anticipation of our cruise.

c) We ordered propane and batteries from two firms in Inuvik and had them transported over the ice road to Tuktoyaktuk. We initiated the rental of a G.P.S. receiver.

d) Serviced all our Tower gear, like ropes, anchors, gin poles, etc. and boxed it all up for transport to Tuktoyaktuk.

e) Applied for and were granted licences to erect our Argo system on Warren Point. Application was made through the Inuvialiut Land Administration in Tuktoyaktuk.

f) Arranged with Dr. Knut Aargaard of NOAA for the recovery of three moorings in the Arctic Ocean.

g) Discussed at length the proposed DIAND organized Beaufort Surveys which ultimately were cancelled for lack of funding.

h) Began discussions with a substitute group from Atlantic Geoscience Centre who wished to use the "TULLY" for a Repetitive Ice Scour Mapping Survey.

i) Ordered and received 8 barrels of JETB fuel for refuelling helicopters aboard the "TULLY."

j) Interviewed 5 students at BCIT who were applying for term positions aboard the "TULLY" and who would be employed as launch surveyors. Three were ultimately hired.

k) Wrote out and circulated abbreviated job descriptions and performance level anticipations to all surveyors assigned to "TULLY."

l) Discussed nature of the survey and anticipated travel schedules with Capt. J. Anderson of the CSS JOHN P. TULLY.

m) Ordered and received chart folios.

n) Pre-determined launch schedule routines and designated surveyors to each shift.

o) Arranged for the modification of our Hydrographic Automated Loggers to retrofit Targa logging ports. Contracted out.

p) Re-wrote the logging software in our Hal loggers to reflect required improvements and changes. Contracted out.

The above points substantially cover the planning required to carry out our hydrographic surveys in the Beaufort Sea.

3. Operations

The JOHN P. TULLY left the wharf at IOS on July 11 and proceeded south and west out Juan de Fuca Strait. On July 13 we streamed the Magnetometer and began our GEBCO sounding (See Plate # 3). There were eight surveyors aboard that consisted of three students and five seasoned surveyors plus one electronic technician. Watches were organized and two surveyors stood the six hour watches.

The ship proceeded towards Dutch Harbour and arrived there on July 19 to take on fuel. Eight hours later she left and proceeded north through the Bering Sea. GEBCO and magnetics were suspended on July 21 as we passed to the east of St. Lawrence Island.

The ship saw the first ice of the year on July 23 as King Neptune came aboard and the ice became more and more dense as we neared Wainwright. On July 26 the ship was enclosed by 10/10 ice and remained locked in the ice as the drift of the ice pack fortunately moved us in our intended direction. The ship remained in the ice, along with the Canadian Coast Guard ice breaker Martha L. Black until July 31 when the pressure on the ice slackened and we broke free east of Point Barrow. In tandem, the two vessels travelled east towards Tuktoyaktuk through ice of various concentrations with many open water leads. The JOHN P. TULLY arrived off the fairway buoy north of Tuktoyaktuk on the evening of August 3.

High winds on the morning of August 4 prevented us from getting our advance party out of Tuktoyaktuk to the ship but by the afternoon the winds had calmed and our surveyors and seamen were airlifted aboard. The helicopter, supplied to us from Polar Continental Shelf, was immediately used to complete the installation of our shore positioning systems and by evening of this date we were in operation.

Calibration of our Argo DM51 system was carried out on the evening of August 4 and continued well into the early hours of the morning. Launch calibration began on the morning of August 5 and by noon of that day everything was in order.

Launch and ship sounding began in earnest and continued through to August 31. During this period the launches were scheduled to sound 16 hours per day and the ship was scheduled to sound the

remaining 8 hours. Launch shifts during the first week began at 0400 each day and concluded at 2000 but because of the darkness that we experienced on the early shift it was decided to begin our launch schedule at 0800 and conclude at midnight. This continued for our remaining period of the survey.

During our 27 days of sounding operations we experienced unusually high winds which curtailed our launch work on 12 of the days in the area. Five of these 12 days no launches were put in the water at all. During these weather days the ship was used to gather the sounding information.

Except for the weather problems our sounding operations progressed smoothly. The launches worked very well and minor problems were quickly fixed by our able launch mechanic. A launch failure report has been written and appears at the bottom of this page.

Daily launch miles average 728 km per day throughout the survey but good weather days produced much more. Our best days sounding occurred on August 25 when our launches sounded 1396 km. Our best 5 day period was between August 14 to August 18 when 5946 km of sounding were collected and, of course, the winds were light. Other statistics on launch and ship sounding performance are available on pages 16 to 20.

LAUNCH STATISTICS

Launch	Diesel Consumed	Oil Consumed	Hours Run
Storm	8,620 litres	31 litres	178 hours
Surge	4,963 litres	19.5 litres	98 hours
Tempest	13,667 litres	49.5 litres	272 hours
Tornado	13,990 litres	51.0 litres	263 hours

Total Fuel Consumed - 41,240 litres
Average Consumption Per Hour - 50.85 litres

In 1985 and then again in 1986 the reader's attention was drawn to the fact that all 4 of our launches travel at different speeds. This may not appear to be a very important factor but it is. M. Woods' report of 1986 explains the situation very well and the reasons for similar launch speeds is a subject well worth pursuing. Once again in 1988 these differing launch speeds made scheduling sounding shifts awkward to say the least.

To pursue this subject one step further. The more speed we can get out of our launches the more effective is our effort. Considering our limited season, the offshore area of our surveys, our dependency on good weather and the amount of money expended, speed is of the essence. Perhaps even at the expense of an engine or two.

Summary of Launch Downtime and Frequency of Recurring Problems

August 6	Tornado: 24 volt system unplugged and batteries went dead during the night.
	Continuing problem experienced in 1985 and 1986. Solution: screw in connectors.
	Surge lost power as exhaust escaped into engine room and clogging air filters.
	Continuing problem experienced in 1985 and 1986. Solution: probably unavoidable, change exhaust manifold. Surge seems susceptible to this problem.
August 8	Tornado: Solenoid failed and engine would not start. This is a recurring and easily repaired assuming the availability of spare parts.
	Tornado: loss of steering fluid. This is an occasional problem with all launches.
	Tornado: Broken antenna. This is caused by the antennas that are mounted on the port side of the launches banging against the ship in rough weather. M. Woods suggested in his 1986 report that these antennas be mounted in the centre of the launch.
August 15	Surge continues to operate poorly. Exhaust leak and air filters clogging up. Changed to launch Storm.
August 16	Battery charging power supply unplugged, Argo and Hal dead in morning. This is a continuing problem. Solution: screw in connectors.
	Storm losing revs. Exhaust leak clogging up air filters. This is a recurring problem.
August 17	Storm lost windshield wiper. Recurring problem with blades and wiper motors. Solution: better quality, more spares.
August 18	Tempest: windshield wiper repairs. Storm: windshield wiper repairs. Recurring problem each year.
August 21	Tempest: windshield wiper repairs.

August 24 — Tornado: blown water hose. Occasional problem with all launches. Tornado: alternator failure, no sweat spare aboard.

August 31 — Tempest: turbo caught fire, launch rescue by Storm. This occasionally happens. Solution: spare installed.

After reviewing the past three years performance of our launches, a number of recurring problems become evident. They are listed below.

1. Wiper blades and motors cause problems.
2. Leaking exhaust and plugged air filters cause problems.
3. Broken antennas.
4. Uncomfortable coxswain seats and too large and badly positioned steering wheels cause excessive coxswain fatigue.
5. Battery charging leads become disconnected.

SUMMARY OF SURVEY DOWNTIME AND FREQUENCY OF RECURRING PROBLEMS WITH ELECTRONIC EQUIPMENT

August 5 — Surge: no data on RAM. All Hals slow, 4-5 sec. update rate on Navigation screens.

August 6 — Tornado: Skipper sounder leaving blanks.

August 7 — Tornado: launch positions jumping but variance did not go up.

August 8 — Ship: Hal reset after navigation screen went fuzzy. Navigation screen also has missing digits and misspelled words.

Transmitting on 2142 and 4982 makes the hyperbolic lane count blink on and off.

No data on RAM. Hal crashed when trying to use EOL command.

August 10 — Surge: Skipper sounder stopped working.

August 11 — Tornado: RAM automatically dismounted. Surge: replaced radio.

Tempest: replaced bolts on CRT box.

Ship: ranges on Argo disappeared momentarily, also loss of signal lights flashed on.

August 12	Tornado: new Hal software not working. RAMs automatically dismounted. Old software substituted for new.
	Ship: put cursor on estimated easting screen 3 hit return puts estimated easting to zero. It should default to previous value.
August 13	Tempest: no ranges from Trisponder, suspected water problem.
August 14	All launches have water in their Trisponder antennas.
August 15	Storm: changed radio. Storm: no communication between surveyor and coxswain, broken headset.
August 17	Tempest: Hal froze on execute new data and would not reset until we unplugged Transterm and tried again.
	Storm: CDU blanking out but no lane jumps. Replaced CDU. Tornado: Trisponder not working.
August 18	Storm: RAM logged garbage only.
August 20	Ship: all loss-of-signal lights on Argo, several seconds. No ranges on Hal.
August 21	Tempest: losing tracking on digitizer.
August 22	Tempest: no fix mark on sounder. Fixed by changing BNC 1 to BNC 2. Tempest: Hal froze up, would not reset. Storm: No data logged on RAM.
August 23	Tornado: Trisponder not working. Tempest: No data logged on RAM. Tornado: No data logged on RAM.
August 24	Storm: Trisponder not working. Tornado: lane jump.
August 28	Tempest: Hal froze, reset button didn't work, turned Hal off then on again - it worked. Tempest: Cross track distance doesn't agree with distance off line.
August 29	Tempest: Trisponder does not work. Tornado: Radio transmit button stuck.
August 31	Tornado: lane jump - variance 200.

None of these problems, except perhaps the loss of data on the RAMs caused us a serious loss of time. Each fault mentioned above was soon fixed by substituting a working piece of equipment

by our electronics technologists aboard. However, a serious look at these recurring problems during the winter may reduce the frequency of problems in the future. A wish-list for Hal repairs will be the subject of a separate report.

APPENDIX 1

ICE REPORT

Ice along the north coast of Alaska was very heavy this year and remained in close to the shore throughout the summer. Strong south winds, which usually occur during July and August, never materialized. The predominant wind was from the northeast and northwest throughout the month of August which of course keeps the ice edge in tight to the beach. Ice in the Beaufort Sea remained north of 70°30' throughout our surveys even though those same strong NE and NW winds should have driven it south. However, our survey areas were free of ice and caused us no problem.

Of concern to the ship was the poor ice conditions along the Alaska coast on its journey to the west at the end of the season. Much apprehension and concern for a safe unescorted exit from the Arctic provided the impetus for the ship to leave early.

This early exit reduced by half the amount of time promised to Mr. S. Blasco of Atlantic Geoscience Centre and as a result he completed only half of his intended work.

Steve Blasco's survey commenced on September 1 and was to conclude on September 15. Fourteen days during this period were to be used to measure the Repetitive Ice Scours that can be found on the floor of the Beaufort Sea between Baillie Island and Herschel Island. Unfortunately, the ship's early departure prevented this survey from being completed.

Please refer to Plates 6 and 7 which show the ice conditions in the Beaufort Sea and west to Point Barrow in early and late August.

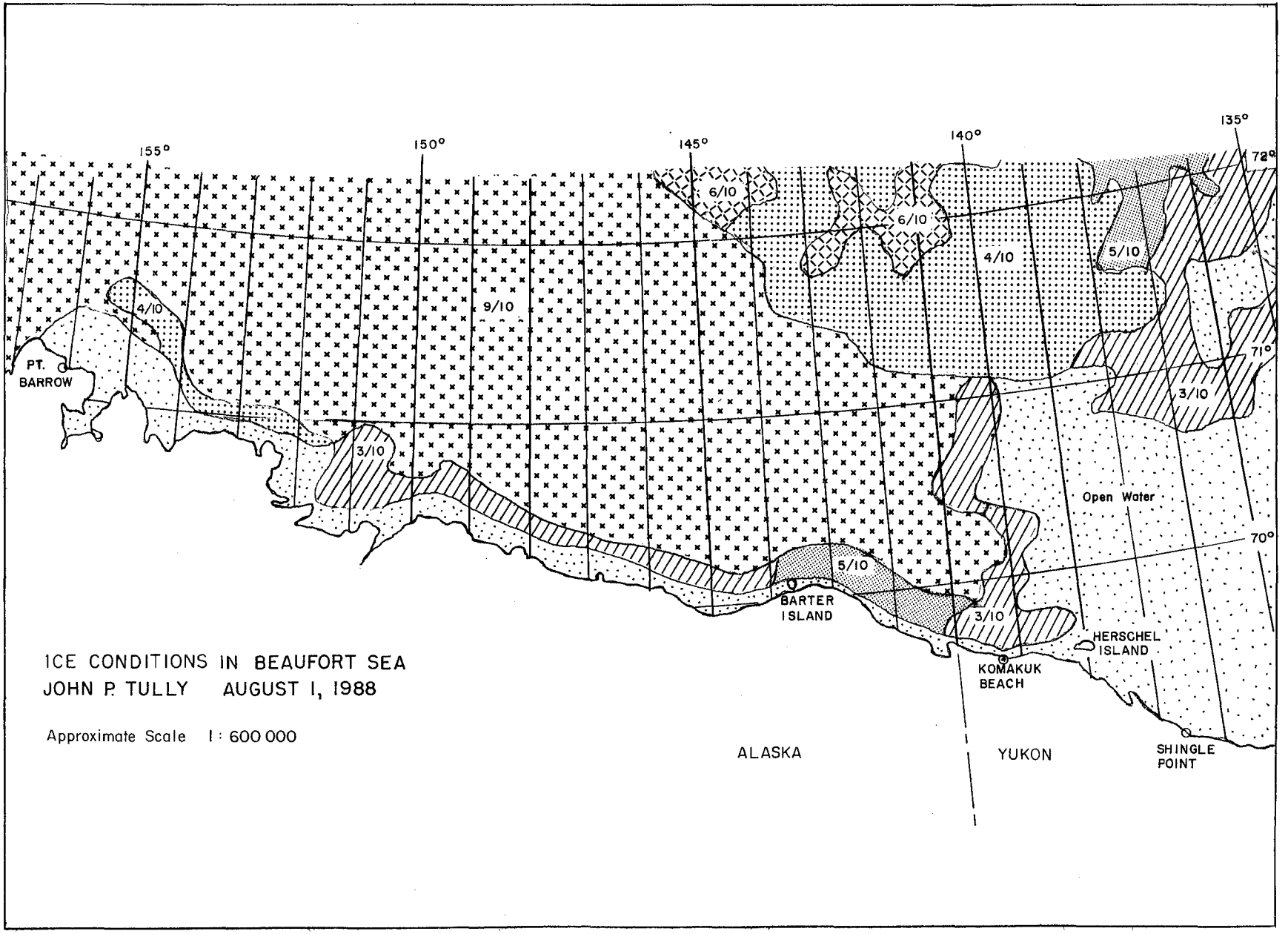

155°
150°
145°
140°
135°
72°
71°
70°
6/10
6/10
4/10
5/10
9/10
4/10
3/10
3/10
5/10
3/10
Open Water
PT. BARROW
BARTER ISLAND
HERSCHEL ISLAND
KOMAKUK BEACH
SHINGLE POINT
ALASKA
YUKON
ICE CONDITIONS IN BEAUFORT SEA
JOHN P. TULLY AUGUST 1, 1988
Approximate Scale 1 : 600 000

PLATE 6

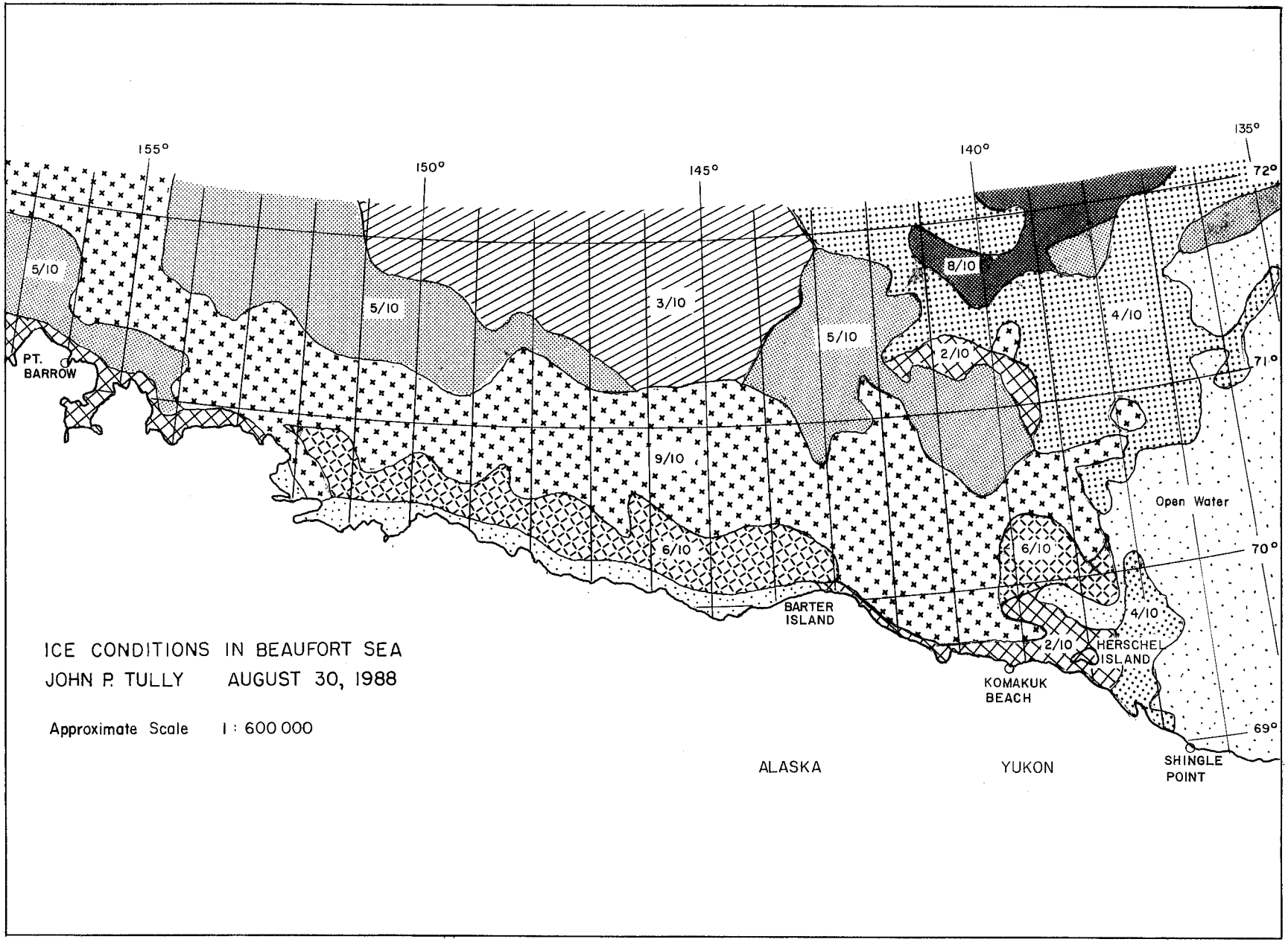

155°
150°
145°
140°
135°
72°
71°
70°
69°
5/10
5/10
3/10
5/10
8/10
4/10
2/10
9/10
6/10
6/10
4/10
2/10
PT. BARROW
BARTER ISLAND
HERSCHEL ISLAND
KOMAKUK BEACH
SHINGLE POINT
Open Water
ALASKA
YUKON
ICE CONDITIONS IN BEAUFORT SEA
JOHN P. TULLY AUGUST 30, 1988
Approximate Scale 1 : 600 000

PLATE 7

APPENDIX 2

1988 CONTROL AND POSITIONING SYSTEM CALIBRATION

M. Woods, 2-I-C

1. Preparations

The primary positioning system chosen for the 1988 Beaufort Sea Hydrographic program was, once again, the CHS ARGO-DM54 Medium Frequency system. The area to be surveyed (Plate #5) was adequately covered by the same ARGO chain used in 1985 and 1986, therefore there was no requirement to establish any new horizontal control ashore, provided that the old stations could be recovered, and that all the equipment arrive safely in Tuk prior to July 10. All the towers, ground mat, gin pole, guy ropes, sand bags, etc. were already in storage at Polar Shelf. The ARGO RPU and ALU units were shipped by truck in March. Forty bottles of propane, eight Cat batteries and 40 litres of acid were delivered from Inuvik in April. The four Thermal Electric Generators (TEGS) used in Queen Charlotte Strait in the spring, were shipped by air in June, along with sleeping bags, boots, cruiser suits, tools and the Harris Radio.

2. Shore Operations - July 14 to August 4

The shore party (Woods, Milner, Popejoy and Dorosh) left Pat Bay on July 14 and arrived at Polar Shelf, Tuktoyaktuk on July 15 at 16:00. On July 16, Popejoy and Dorosh spent the day opening crates, charging batteries and checking equipment, while Woods and Milner recovered all the stations, revised the station descriptions and checked the condition of the fibreglass whip antennas which were still up at Relief and Pullen Islands. Arrangements were made to use Okanagan's Sikorsky S-61 which was in Tuk, on contract to Beaudril, and the equipment for all four stations was trucked over to Beaudril's pad on the 16th. The S-61 can carry 5000 pounds internally, allowing all the gear for two stations (4900 pounds) to be carried in one load. Milner and Dorosh took everything out to Pelly and Pullen in the morning of July 18th; Woods and Popejoy flew to Warren Point and Relief Island in the afternoon, using only 2.6 hours flying time. On the 19th the tower at Warren Point was put together, but not erected due to high winds, and the station at Relief Island was completely assembled using the whip antenna that has been up since 1983 and is still in good shape. Since Warren Point is on ILA lands, a bear monitor from the ILA was hired during construction to fulfill the permit requirements. It's a good thing that no bears appeared - I wouldn't like to see one killed unnecessarily and the bear monitor only had a .22 rifle with him.

The wind dropped by noon on the 20th allowing the tower to be raised at Warren Point. Upon firing up the system, the RPU or ALU was found to be defective. No spares were available until

the ship arrived and since Warren was the master station, which had to be on to establish timing of the chain, the electronics were replaced by those at Pullen Island. The rationale of this decision was that Pullen had to be visited upon arrival of the ship for installation of Trisponder and if ARGO did not work properly at Pullen, the ship could still work using just the other three stations. This shift of equipment was made on the 21st, at which time the TEGS were fired up at Warren and Relief.

Bad weather and a full helicopter schedule defeated further flying for the next three days, but the time in camp was well spent assisting Dave English install the LPTG at the new Tuk gauge house, installing the Harris radio, watching football games on T.V. and repairing a large patch of felt paper that had blown off the roof of the mess hall. On July 25th, the tower was put up on Pelly Island, the TEG turned on and the antenna tuned in. All the important tasks were now complete, nothing more could be done at the stations until the ship arrived.

Over the next few days time was spent repairing equipment, tidying up the storage locker, taking inventory, helping to fix a leaky gas tank in the GMC truck, keeping in touch with the Tully via the Harris Radio and watching more football. One day was spent taking down the old 150 foot Decca Tower at Baillie Island. This was done at the request of EMR since CHS was the last government agency to use it and we were going to take it down in 1983. At that time Dome asked us to leave it up for them to use, on the understanding that they would take it down when finished. We do not know if Dome (now AMOCO) is finished with it yet, but EMR have had to maintain a license and a NOTAM on it every year. With the advent of GPS and the use of TEXAS towers for today's equipment it is better to be down. The only drawback is that the tower is in the Geodetic data bank and always was a useful backsight. A new description of the site and its monumentation has been forwarded to Nautical Geodesy.

When the ship arrived off the Tuk fairway buoy on the evening of July 3, it was too rough to get aboard. More waiting by the shore party! Finally at noon on the 4th we began ferrying people and baggage aboard and one helicopter was sent out to put Trisponder beacons on Tuft Point, North Peak and Pullen Island. While at Pullen the spare RPU and ALU were hooked up, the TEG fired up and the last ARGO station was tuned in.

3. Calibration

The ship's Range-Range ARGO unit was first calibrated by taking a series of Trisponder fixes at six stations across the south end of the survey area. Delta ranges were set to zero during these measurements. At each station the calibration program in the HP-85 (CAL88) was used to compute the ship's position from the Trisponder ranges, compute the required ARGO ranges for that position and compare the observed ranges to the computed ranges. At least 5 comparisons were made at each station and a mean delta

range correction computed for each station. The mean from these six stations was then used to compute an average set of delta ranges for the whole area.

The ship's hyperbolic receiver was then calibrated using the Buoy Fix routine in the ARGO monitor program. This routine computes hyperbolic lane count at any observed bearing and distance directly astern of the Range-Range antenna, by entering the ship's gyro heading and the distance to the second antenna. The ship's hyperbolic antenna is 3.35 metres astern of the Range-Range antenna.

The launch's hyperbolic receivers were also calibrated using the Buoy Fix routine. Each boat was positioned astern of the ship by lining up the fore and after masts, and the distance between the ship's ARGO antenna and the launch was measured by the Trisponder system with short range beacons. A series of five or six comparisons between observed and calculated lane count supplied the delta ranges to be used in the launches.

Throughout the course of the survey, calibration of the ship's Range-Range ARGO was checked whenever the ship was in range of the Trisponder chain and the launches were checked by the Buoy Fix routine before and after every shift.

The Magnavox 1107 GPS receiver was used on a daily basis to check for ARGO lane jumps. Initially the 1107 was set to output positions on NAD'27, but the first comparisons to ARGO showed differences of about 100 metres. Not knowing exactly what was going on with the internal conversion routines, the 1107 was reset to output positions on WGS'72 and all observed positions were converted to NAD'27 on the PDP-11 computer. The Algorithm used to compute these datum transformations was taken from UNB lecture notes #16 (E.J. Krakiwsky and D.E. Wells). The average offsets for the area were interpolated from the Geoid maps in Surveying Offshore Canada Lands, Third Edition 1982, (Energy Mines and Resources) and from the published offsets for geodetic stations Tuk Doppler and Sachs Harbour. Offsets used: X=15, Y=-155, Z=-175. The procedure for checking ARGO involved:

- Setting the ARGO clock the same as the GPS clock
- Simultaneously printing out ARGO fixes on the HP-85 and GPS on its own printer
- Converting GPS NAD'72 to NAD'27
- Converting the GPS position to ARGO lane count
- Comparing the computed position and lane count with the ARGO HP-85 output

Care was taken to note the number of satellites and the GDOP at the time of GPS fix to give some confidence to the fixes. The average difference between ARGO and GPS was 10 metres in Northing and 11 metres in Easting, with GPS plotting 15 metres northeast of ARGO (See Appendix 3). Average lane count differences were all less than 0.3 lanes (27 metres) and were usually 0.1 to 0.2

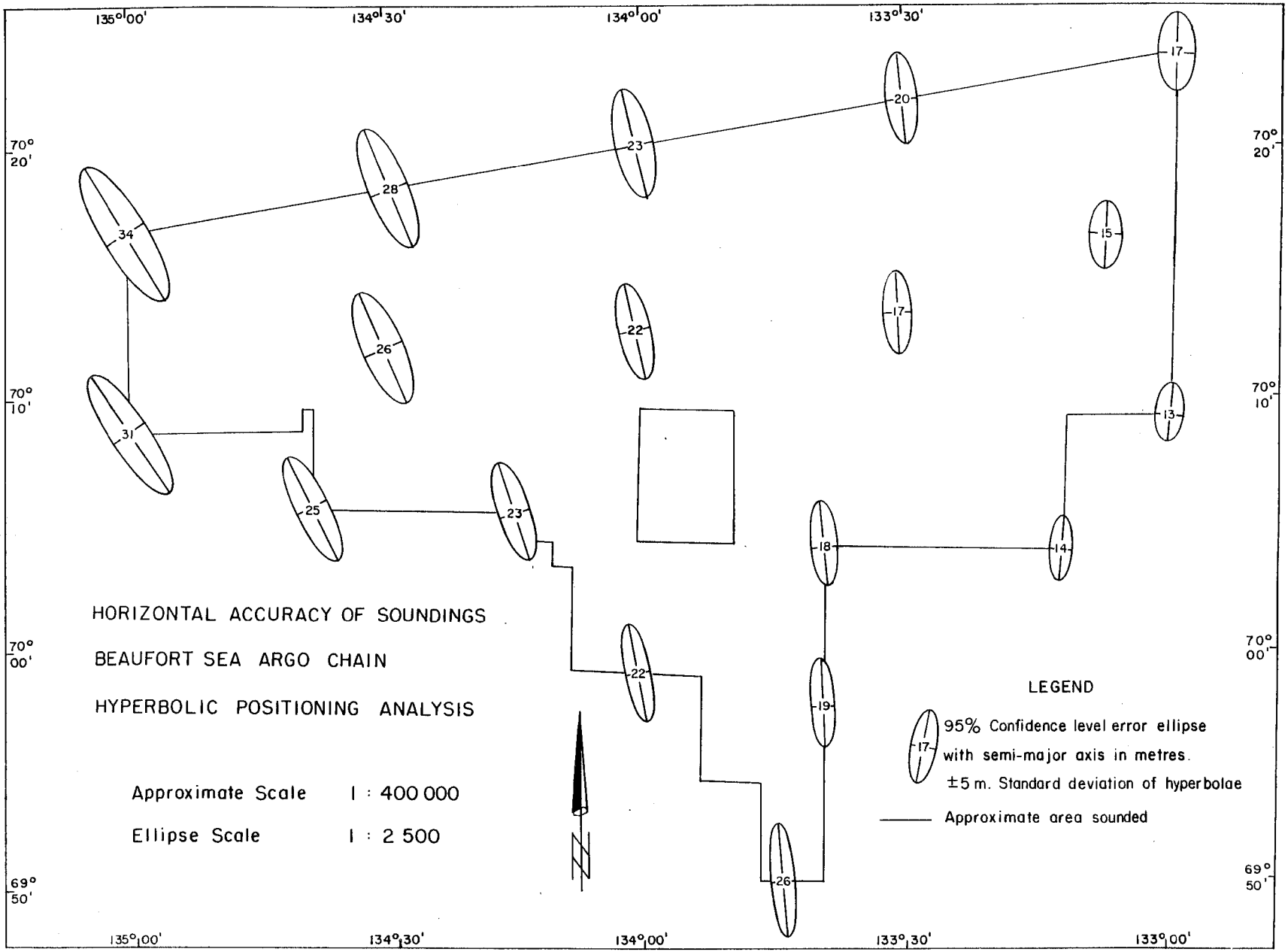

135°00'
134°30'
134°00'
133°30'
133°00'
70° 20'
70° 10'
70° 00'
69° 50'
HORIZONTAL ACCURACY OF SOUNDINGS
BEAUFORT SEA ARGO CHAIN
HYPERBOLIC POSITIONING ANALYSIS
Approximate Scale 1 : 400 000
Ellipse Scale 1 : 2 500
LEGEND
95% Confidence level error ellipse
with semi-major axis in metres.
±5 m. Standard deviation of hyperbolae
Approximate area sounded

PLATE 8

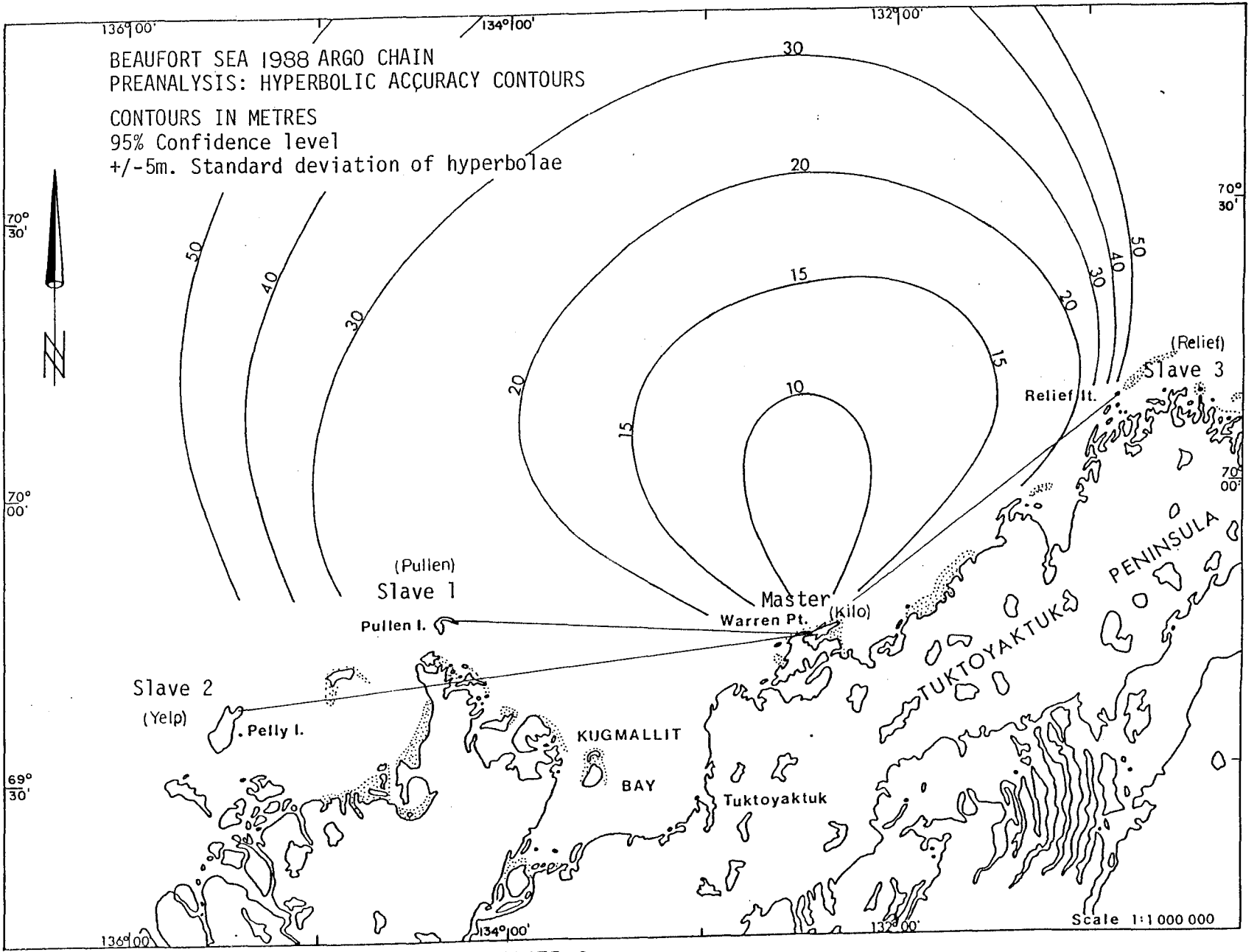

BEAUFORT SEA 1988 ARGO CHAIN
PREANALYSIS: HYPERBOLIC ACCURACY CONTOURS
CONTOURS IN METRES
95% Confidence level
+/-5m. Standard deviation of hyperbolae
136°00'
134°00'
132°00'
70° 30'
70° 00'
69° 30'
30
20
15
10
50
40
30
20
15
(Relief)
Slave 3
Relief It.
(Pullen)
Slave 1
Master
(Kilo)
Warren Pt.
Pullen I.
Slave 2
(Yelp)
Pelly I.
KUGMALLIT
BAY
Tuktoyaktuk
TUKTOYAKTUK
PENINSULA
Scale 1:1 000 000

PLATE 9

lanes (9 to 18 metres) provided that four satellites were in view with a GDOP of four or less.

Non-differential GPS is considered accurate to ±25 metres; not good enough to calibrate ARGO but certainly adequate for lane jump detection. The errors associated with our simple method of comparison include:

- Antenna separation (1.25 m) was not accounted for.
- Error in the offsets used to convert WGS'72 to NAD'27. Precise offsets offshore are simply unknown.
- Errors in clocks and non-simultaneous fixes (± sec) minimized by taking fixes while the ship was drifting.
- Argo and GPS both resolve positions to ±0.001 minutes in latitude and longitude, therefore an error of ±2 metres exists in position computation alone.

Taking these errors into consideration leads one to believe that stand-alone GPS is quite likely better than ±25 metres, given good satellite geometry.

The ARGO system this year performed flawlessly. There were no lane jumps on the ship's receivers and only the odd one in the launches. The shore towers were well installed, with good ground mats and well tuned antennas. Also weather conditions were fairly stable, generally overcast and damp, which reduces propagation errors.

4. Demobilization - September 1 to 10

On September 1 the majority of the hydrographers left the ship and flew south as Steve Blasco's geophysical crew moved aboard. Woods and Popejoy set up camp at Polar Shelf and began preparations for ARGO takedown. On the 2nd, Relief Island, Warren Point and Pullen Island ARGO sites were dismantled and the propane bottles drained. The tower was left up at Warren Point until later. All ARGO gear was left neatly on the Tundra, to be picked up later, in a larger helicopter. The Trisponder beacons, batteries and solar panels were retrieved from Tuft Point, North Peak and Pullen Island. The Trisponder beacon at Pullen Island was missing; just the batteries and solar panel remained. It was later discovered that the MOT crew from the NAHIDIK had removed it, claiming interference with the racon.

The towers at Pelly Island and Warren Point were taken down on the 3rd. Dave White, our 206-B pilot, was a big help at both sites as three people are needed to take a tower down easily. The tower, gin pole and ground mat were left in place at Pelly Island, but due to the ILA rules, everything at Warren had to be dismantled. The gear was removed from Warren Point with the 206, three sling loads in all, and on the last trip, Jane Bicknell of the ILA came out to do the final inspection and found all in order.

On September 5, the tide gauge was removed and shipped back to IOS, and in the afternoon, the S-61 was available for retrieval of the ARGO equipment. Unfortunately, upon arrival at Relief Island, dense fog rolled in preventing landing and the trip was aborted. The big Sikorsky was unavailable for the next few days so a 212 was chartered from Okanagan Helicopters in Inuvik. Bad weather prevented flying on the 6th, but on the 7th, operating between snow showers and some fog, the equipment was brought back from Pelly and Pullen in the morning and the last of it from Relief in the afternoon. The 212 is a good machine for this type of work as two TEGS, the batteries and the electronic units can it inside while the propane bottles are carried in the sling. Also during this period Larry Dorosh left the ship on the evening of September 4, supervised the takedown of the Harris radio, cleaned up the solar panels and equipment from Warren Point before leaving home on the evening of the 6th.

The TEGS were cleaned up, the locker tidied up and inventory taken on the 8th. On the 9th, the ARGO units were ferried back to the Tully and the shore party flew south, overnighting in Edmonton and arriving home at noon on the 10th. The TEGS, Harris radio, two sets of solar panels, batteries and tower equipment were all left in Tuk for next season. The white whip antennas are still up at Pullen and Relief, complete with ground mat, and the tower and ground mat are on the tundra at Pelly. However, if next season's work is further to the west, the chain will have to be moved as geometry is getting poor at the western extremity of this season's work (See Plates #8 and #9).

APPENDIX 3

ARGO - GPS COMPARISONS

CENTRAL MERIDIAN 135

STATION	NORTHING	EASTING	△N	△E	SATS	HDOP
A2201850	7773158.64	545400.49				
G2201850	7773166.32	545420.73	- 7.68	-20.24	6,9,11,12	4
A2201900	7773118.78	545358.76				
G2201900	7773126.57	545379.64	- 7.79	-20.88	6,9,11,12	4
A2201910	7773075.10	545311.40				
G2201910	7773084.46	545330.34	- 9.36	-18.94	6,9,11,12	3
A2201950	7773499.44	545525.12				
G2201950	7773510.80	545544.67	-11.36	-19.55	6,11,12,13	3
A2281950	7794844.89	523968.35				
G2281950	7794848.82	523976.80	- 3.93	- 8.45	6,11,12,13	3
A2282100	7794792.14	526281.18				
G2282100	7794799.76	526297.00	- 7.62	-15.82	(4)	3
A2282130	7794439.73	523252.41				
G2282130	7794447.44	523263.97	- 7.71	-11.96	(4)	3
A2282140	7794554.22	523542.83				
G2282140	7794560.10	523557.54	- 5.88	-14.71	(4)	3
A2291840	7794360.99	551433.43				
G2291840	7794378.32	551438.31	-17.33	- 4.88	(4)	3
A2291850	7794335.52	551789.23				
G2291850	7794341.79	551794.97	- 6.29	- 5.74	(4)	3
A2291920	7794110.37	551781.11				
G2291920	7794124.24	551792.95	-13.87	-11.84	(4)	3
A2291930	7794330.42	551397.02				
G2291930	7794342.18	551397.63	-11.76	- 0.61	(4)	3
A2291950	7794288.41	551596.01				
G2291950	7794300.96	551606.66	-12.55	-10.65	(4)	3
A2321840	7797033.75	517981.30				
G2321840	7797047.20	517993.63	-13.45	-12.33	3,6,12,11	3
A2321930	7798726.91	518189.85				
G2321930	7798743.89	518189.87	-16.98	- 0.02	6,12,11,13	3

A2351830	7792940.36	537043.86				
G2351830	7792949.25	537049.61	- 8.89	- 5.75	6,12,11	3
A2351930	7793486.02	533219.68				
G2351930	7793500.67	533225.57	-14.65	- 5.89	3,12,11,13	3
A2352100	7793580.94	533098.85				
G2352100	7793591.95	533110.46	-11.01	-11.51	3,12,11,13	3
A2352200	7793624.74	533299.41				
G2352200	7793641.26	533306.52	-16.52	- 7.11	3,12,11,13	3
A2361900	7794376.17	564147.35				
G2361900	7794383.83	564157.45	- 7.66	-10.10	6,12,11,13	4
A2361930	7794300.63	564305.43				
G2361930	7794310.24	564318.61	- 9.61	-13.18	6,12,11,13	3
A2362100	7794528.77	564217.92				
G2362100	7794531.08	564236.34	- 2.31	-18.42	3,12,11,13	4
A2362200	7794299.27	564587.85				
G2362200	7794316.27	564599.55	-17.00	-11.70	3,12,11,13	3

MEAN $\triangle$N = -9.96 METRES, MEAN $\triangle$E = -10.90 METRES

STANDARD DEVIATION N = 4.49, E = 6.01

GPS IS CONSISTENTLY 14.77 METRES N.E. OF ARGO

NOTE: STATION NAMES CONSIST OF EITHER 'A' OR 'G' FOR ARGO OR GPS FOLLOWED BY JULIAN DAY AND TIME OF FIX.

ERROR SOURCES:

1. ANTENNA SEPARATION (1.25 M)
2. ERROR IN OFFSETS, WGS '72 TO NAD '27. THESE OFFSETS ARE NOT KNOWN EXACTLY FOR OFFSHORE POSITIONS.
3. ERROR IN TIMING ($\pm$ 1 SEC. BETWEEN FIXES) MINIMIZED BY TAKING FIXES WITH THE SHIP DRIFTING.
4. ARGO AND GPS BOTH RESOLVE POSITIONS TO THE NEAREST 0.001 MINUTE OF LAT. AND LONG., THEREFORE THERE IS $\pm$2 METRES IN POSITION DETERMINATION.

APPENDIX 4

FIELD REPORT STATISTICS: MONTHLY ..... FINAL FIELD .....

YEAR: 1988 FROM July 11, 1988 TO September 25, 1988

ESTABLISHMENT: Hydrographic Serv. HYDROGRAPHER-IN-CHARGE: B.M. Lusk, July 11-Sept. 1
P. Milner, Sept. 2-Sept. 25

Project Name	Project Number	Project Number	Project Number	Project Number	Total
1. GEBCO-MAGNETICS North Bound	7710/88				
2. HYDROGRAPHY Beaufort Sea		7710/88			
3. GEBCO-MAGNETICS South Bound			7710/88		
4.					
No. of Personnel (person days = PD)					
Hydrographers/(3 persons work 30 days = 3/90)	5/120	10/270	3/48		18/438
Scientists					
Students	3/72	3/81			6/153
Electronic Technicians	1/24	1.5/50	1/16		3.5/90
Ships Officers and Crew	22/528	26/702	22/352		70/1582
Helicopter Personnel		1/2			1/2
No. of Vehicles					
Ships	1	1	1		1
Launches		4			4
Land Vehicles					
Aircraft (specify type)		1			1
Hours flown - Transport Canada					
Hours flown - Contract		127			127
Work Record					
Total days in field	24	27	16		67
Total days actual field work	16	27	16		59
Total person days worked (staff)	31/744	41.5/1105	26/416		98.5/2265
Days lost (weather) ship/launch					
Days lost, other causes (specify) Ice	8				8
Sounding Kilometres					
Launch		19660			19660
Ship		4730			4730
GEBCO	3470		3052		6522
Spot (through ice)					
Total Sounding	3470	24390	3052		30912
Reconnaissance (track)					
Area Sounded (sq. km)		1472.8			1472.8
Shoals Examined by:					
Ship					
Launch		6			6
Other (specify)					
Total Examination		6			6
Navigational Aids Positioned					
Fixed Aids (including ranges)					
Floating Aids					
Conspicuous Objects					

Project Name	Project Number	Project Number	Project Number	Project Number	Total
1. GEBCO-MAGNETICS North Bound	7710/88				
2. HYDROGRAPHY Beaufort Sea		7710/88			
3. GEBCO-MAGNETICS North Bound			7710/88		
4.					
Control Stations					
New stations built					
Stations recovered and rebuilt		4			4
Tower stations built		4			4
Total stations built		8			8
No. of stations occupied					
No. of stations permanently marked					
Measured, km -- distances					
- Elevations					
- Heights					
Clearances					
Tide and Current Data					
Tide gauges established/recovered (e.g. 2/1)		1			1
Tide staffs established					
Bench marks established					
Old bench marks checked out		3			3
Current meters stationed/recovered (e.g. 5/4)					
Oceanography/Geoscience					
No. of Oceanographic Stations					
Gravity Profile - Surveyed (km)					
Gravity Profile - Track (km)					
Seismic Profile - Surveyed (km)					
Side Scan Profile - Surveyed (km)					
No. Gravity Stations					
Magnetic Profile - Surveyed (km)					
Magnetic Profile - Track (km)	3470		3052		6522
No. of Water Samples	17		10		27
Bottom Samples, Numbers of:					
Grab - cores e.g. 10-2					
Armed Lead		6			6
Samples retained					
Miscellaneous Items					
Wharves Surveyed					
Shorelining (km)					
Rocks and other obstructions fixed					
No. of Electronic Positioning Sites (Hi-fix Six, Argo, etc.)		4			4
No. Calibrations - Positioning Systems		Cont.			Continuous
Low Water Line (km)					

Note: Items that are not applicable indicate with a N/A.

APPENDIX 5

ELECTRONIC FIELD REPORT

G. Worthing

After hectic last minute preparations the JOHN P. TULLY finally sailed "North to Alaska" at 1830, Monday, July 11.

Primary duties during the cruise up involved support for the GEBCO line and preparation of the ship for the upcoming survey.

Time spent supporting the GEBCO line was minimal as the Raytheon sounder system and the Magnetometer functioned normally. Had to construct a pulse stretcher circuit so that fix marks out of HAL could be used to put 5-minute marks on sounder chart paper. This temporary arrangement should be replaced with a permanent installation when ship time is available. Some bread-boarding supplies would be handy to have on board for future cruises.

I spent quite a bit of time with the Magnavox satellite receiver. Suspected problems with the unit and its outputs to SAIL were found not to be problems but normal operational conditions. Once we have our own unit confusion caused by unfamiliarity should cease.

Another time consuming task involved setting up a modem line using the ship's existing phone wiring. The actual wiring did not take too long to trace out but getting it to work was another matter. The root of my problems was the Black Box "non-powered" Short Haul Modem. This unit receives its power from the device it is connected to. It would work with some VT-100's but not with others. Needless to say this initially caused me great confusion. As I ended up powering it with a separate power supply I would suggest we stick to line-powered modems in the future.

Numerous other tasks and problems kept me busy during the entire trip up, even while we were stuck in the ice pack for 5 days. This included time spent looking into problems on the Tully bridge.

Larry Dorosh and others arrived on board on August 4 and his field report covers from that date onwards.

I enjoyed this trip thanks to great people and great scenery (and I love 24 hour sunlight!). Also proud to say that I have been transformed from a lowly tadpole to a respected shellback!!!

I departed the ship on August 16 and arrived at home sweet home on August 17.

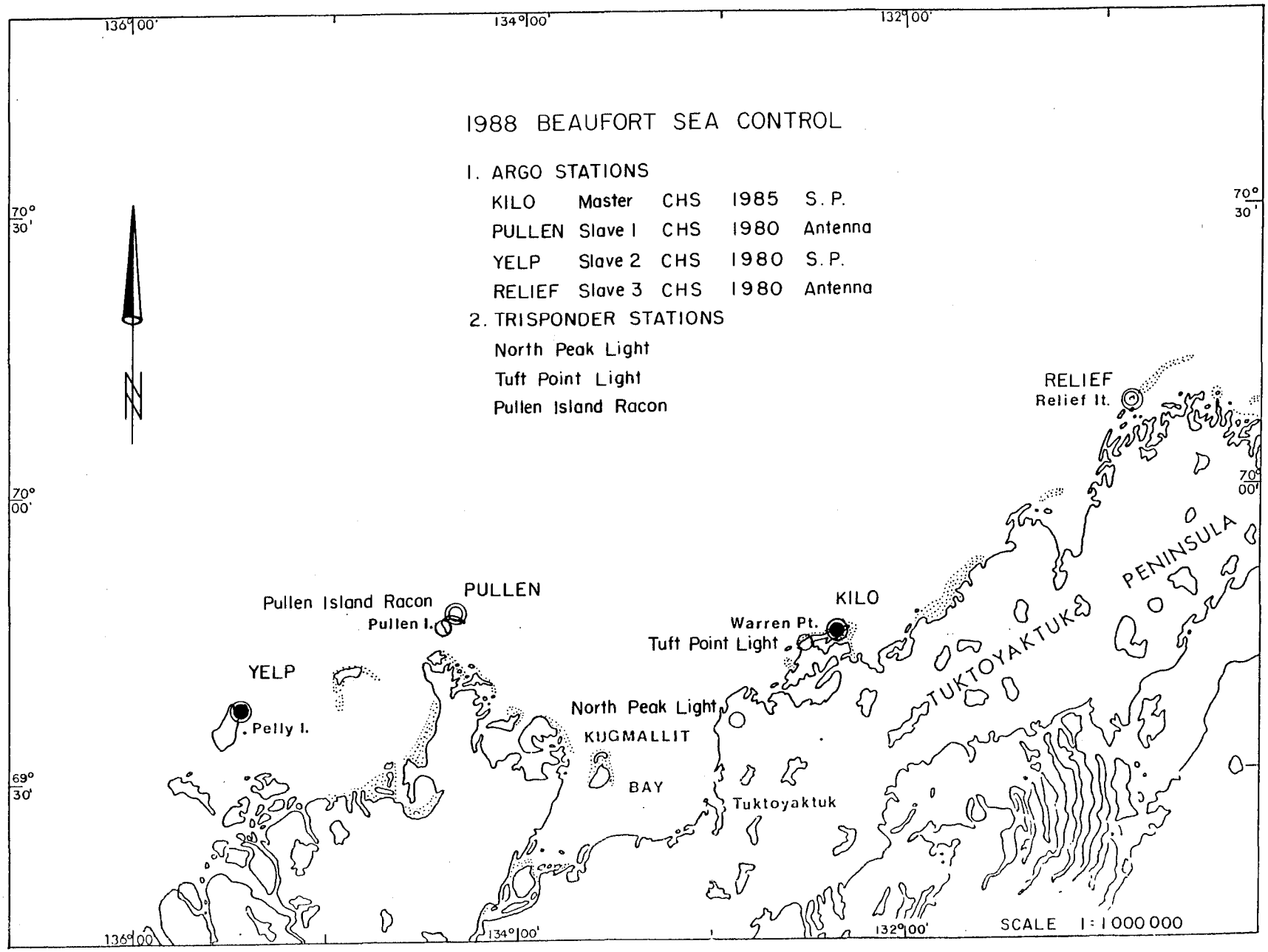

1988 BEAUFORT SEA CONTROL
1. ARGO STATIONS
KILO Master CHS 1985 S.P.
PULLEN Slave 1 CHS 1980 Antenna
YELP Slave 2 CHS 1980 S.P.
RELIEF Slave 3 CHS 1980 Antenna
2. TRISPONDER STATIONS
North Peak Light
Tuft Point Light
Pullen Island Racon
136°00'
134°00'
132°00'
70° 30'
70° 00'
69° 30'
RELIEF
Relief It.
PULLEN
Pullen Island Racon
Pullen I.
KILO
Warren Pt.
Tuft Point Light
YELP
Pelly I.
North Peak Light
KUGMALLIT
BAY
Tuktoyaktuk
TUKTOYAKTUK
PENINSULA
SCALE 1:1 000 000

PLATE 10

TECHNICAL FIELD REPORT

August 1 to September 7, 1988

L. Dorosh

3.5 days waiting for Tully - side trip to Beaudrill, dinner invitation by Hugh Stewart, Mike's acquaintance.

On board Tully on 4th, Trisponders were put ashore and Pullen Argo put on the air - calibration that night.

SSX beacons installed first thing on the 5th, then a few problems in start up: an Argo preamp failed, a CDU had no RS232 output, and minor headset problems (corroded coxswain station). A trial with one launch running the new HAL software was a failure - later was discovered that the labels were swapped causing VT100 software to be loaded.

There were several problems with the new software, the worst being the logging RANDOMLY DISMOUNTED SEVERAL CARTRIDGES (Transterm software) also with on cartridge after EOL & DISMOUNT HAL said "LOGGING ON & DISMOUNTED." With the VT100 on one occasion HAL logged up to 91 blocks and stopped writing to the Targa even though the logging as still ON and the MEDIUM MOUNTED.

One launch had the charger plug come loose from the yellow receptacle box and had run the batteries down overnight. Should be permanently wired to box in the future! Used green tape for now.

The Topaz U.P.S. batteries were damaged on route (not secured), Gordon and I jury rigged some Gel Cell batteries to get it going. A separate circuit should be provided to the Topaz as its breaker was overloaded by other loads one night.

Chased our tails looking for a fault with the DZ-11 port #4 on the PDP-11. Turned out the port was configured for handshaking just prior to the Tully sailing and J. Larkin was not made aware of this. Those that make any last minute changes should record them by at least leaving a note.

The RAM cartridges were found lying around in the launches after the day's survey and were subject to abuse and elements. Recommend a pouch or protective box be devised to protect them in these conditions.

The replacement (New Type) VHF antenna mounting brackets have a different bolt pattern and the Torando had its mount drilled to accept the new bracket.

We had a visit by A.D. O'Connor and Bill Doubleday (Acting ADM). I was requested to give Bill a run down on the launch electronics

including theory of Argo operation. He asked if there were any improvements that can be made and I suggested heave compensation, annotation of sounder and positioning by differential GPS telemetry.

HAL #3 was troublesome and would crash occasionally, seemed to be caused by the Dynamic RAM board (no spares). It would reboot after many tries (M. Woods says No Scroll got it working).

Found a defective RAM cartridge (#928806004 sent back to IOS). The batteries were dead. It is possible to check the battery by removing the plate at the PC connector end and metering (POS.) at both batteries separately with the ground available at every second pin on the PC connector.

The power supply for the VHF's on the launches are too difficult to replace (the unit in the Tempest failed and could not be changed quickly) therefore a better mounting scheme should be devised.

The short range Trisponder beacons on the launches were subject to water getting into the antennae and had to be swapped out occasionally to dry. New gaskets and intact antenna fibreglass shells will help in the future (possibly a plastic bag over the beacon too!).

The Magnavox 1107 GPS/TRANSIT was interfaced to SAIL via the new buffer made by Revlis (very impressive). I worked on the SAIL program and cleaned up a few things (renamed software sailtyv9.bas). Also connected the 1107 to a Decwriter 100 for a 5 minute hardcopy of position.

PGC's Magnetometer had a severed cable that was apparently caused by choosing the wrong button on the winch while the sensor was tied down at the rail. Repaired by reconnecting the cable at the sensor. Recommend PGC relabel winch controller and include instructions to ensure winch be not operated while sensor is tied down.

A problem with RAM's logging junk sporadically (5 different cartridges) was seemingly cured by reloading HAL's software each day or by starting logging from screen #1 not #4 as previously.

I wired a transterm in parallel with the Targa RS232 to try to catch whether the data was given to the Targa properly but was unable to observe any problems over several days of logging on a test HAL setup. Later I tried catching bad RAM's on a launch on board the ship with no luck. However, this monitoring of Targa data should be made available in all units for maintenance checks as it can show any problems with the data. Example: discovered that there is no flushing of the data when logging is turned off.

Argo operated very well with few lane jumps possibly a result of careful maintenance calibration by A. Thomson.

Repaired several things for the ship: the radio distribution preamplifier was muting from the ship board Argo range transmission - installed back to back diode clamp at input, the aft deck video system - got the Panasonic monitor 5370 working as well as two video cameras, and tried to find problem with missing log input to Sat/nav 3200 - found the signal getting into interface card but unable to continue as no schematics.

Helped Steve Blasco's group, AGC, set up; assist CES with Syledis by obtaining calibration factor for our antenna and cable (42.86), install RGB monitors in main lab (using sounder patch panel and a forth line from the wet lab thanks to Al McCrae) and bridge (co-ax up through deckhead in chartroom to beneath the new color sounder), and rig up as in every year a relay to supply fix marks to all recorders (driven from CES system). Also tried to receive FAX ice maps from Beaudrill but was unsuccessful as signal quality and level was poor (telephone lines from Tuk south poor?).

Updated the instructions for fax operations on the Tully, see attached.

Helped demobilize the shore equipment for two days, organize and store equipment in Room 4 in new warehouse. The Harris radio and thermal electric generators were left at Polar Base.

ELECTRONIC FIELD REPORT

B. Muse

My phase of JOHN P. TULLY's Arctic activities began on August 31 with my departure to join the ship in the Beaufort Sea. I arrived in Tuktoyaktuk on September 1 after a flight that should have taken just 14 hours, stretched into 31 hours and an overnight in Inuvik. I arrived onboard the ship at about 1400 September 1 and began a three day turnover with Larry.

The first nine days were as standby support for Steve Blasco and his AGC/CSR/CSE Ice Scouring Project. Hydrography was also involved, monitoring the DSF6000 to give him backup support. The LSR1807 was used as backup to the 3.5 Khz sounder. An intermittent fault on the LSR caused 2 1/2 days of headache but the problem was rectified and no further problems developed. The DSF6000 had stylus belt problems that were easily overcome and it too performed well. One of the biggest problems and most frustrating for me was the operation of the the SAIL system. Problems have been documented and turned over to the SAILSMAN with a view to correcting either my interpretation or some things that may have been overlooked. The major problem was to get the depth from the LSR to the SAIL datalogger. Magnetometer problems caused some problems in the form of bad connections and the breaking of the mag cable due to the way the mag winch was labeled. This has been brought to the attention of PGC technicians.

The way home was frought with little danger from the ice and only slight discomfort from the extremely low, low pressure storm that slowed us down in the Bering Sea just before going into Dutch Harbour Alaska to fuel the ship. The weather from Dutch Harbour to Pat Bay was very good with a following sea and light winds. This made the journey very comfortable and we arrived home on the 25th of September.

APPENDIX 6

GEOPHYSICAL CRUISE

P. Milner

On September 1, Steve Blasco and a staff of seven technicians mobilized via helicopter from PCSP to J.P. TULLY in conjunction with the demobilization of CHS survey staff. Mr. Blasco was there to conduct a repetitive ice scour mapping survey to determine rescouring rates and attributes of ice scours.

The area of operation was from approximately 130°W to Herschel Island and between six and eighty metres of water. In this area, the ship ran lines of various lengths and directions, at a speed of about four knots. These lines were to cover ground where data had been obtained in previous years.

A Klein side scan sonar system was employed, as well as 100 kHz, 12 kHz and 3.5 kHz sounders. The positioning system used was Syledis, which proved to be accurate and reliable for most of the area, although deteriorated markedly in the north-east corner of the survey area due to being out of range of one station.

The operation shut down and demobilized on September 9, several days earlier than expected. This was due to concern over ice conditions on the north coast of Alaska and around Point Barrow.

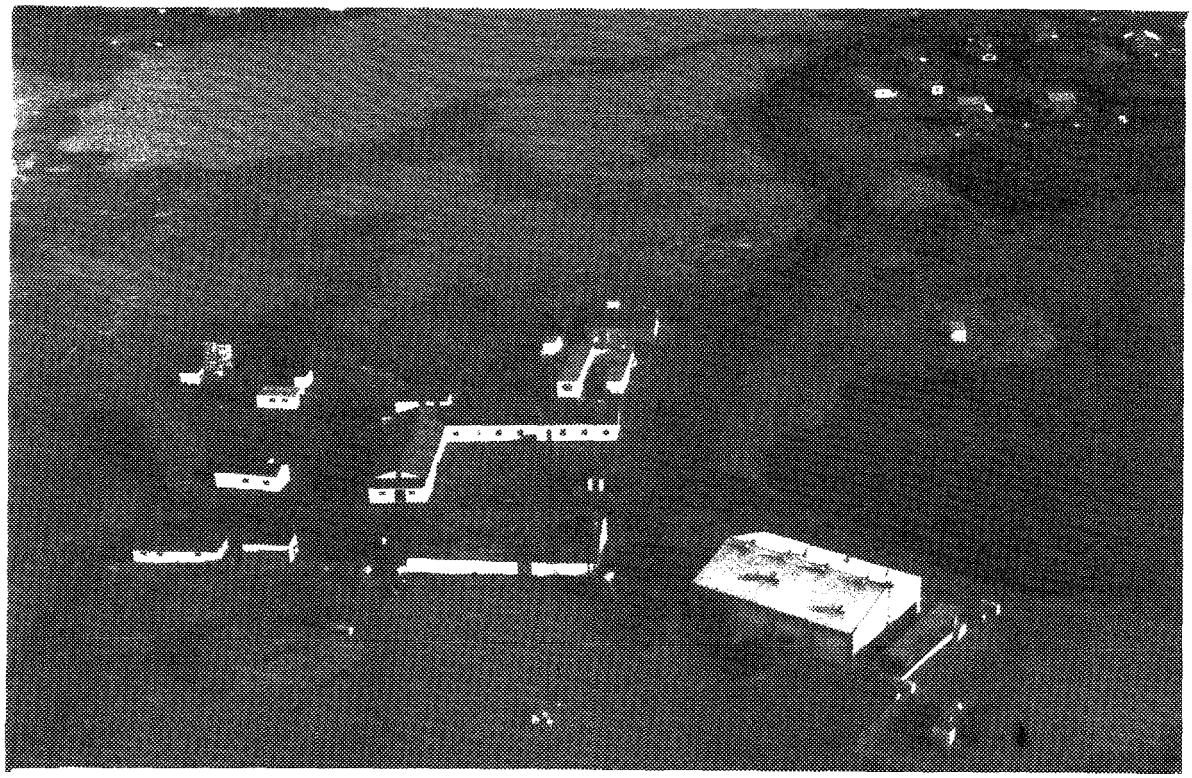
On September 10 the ship spent three hours conducting a search for a large ice scour north of Herschel Island at the request of Steve Blasco. This scour was found and positioned by GPS. At 11:00 MDT the ship resumed its westward trek out of the Beaufort.

The ice actually encountered on the way out was surprisingly light, with about a day spent in heavier ice in which the ship would only make four to five knots. By 18:00 PDT, September 13, the ship was west of Wainwright in virtually ice free water.

The southbound GEBCO line was started at 15:00 PDT, September 15, about fifty miles north of St. Lawrence Island. At 12:30, September 18, the GEBCO line was abandoned due to foul weather and the ship headed for Dutch Harbour later that afternoon. The ship took on fuel in Dutch Harbour, and at 02:00, September 20, left for the Gulf of Alaska crossing. The GEBCO line commenced at 09:00 September 20, and ended at 20:00 September 23 about 189 miles west of Cape St. James. The total mileage was 600 for the Bering Sea leg and 1050 for the Gulf of Alaska leg. J.P. TULLY arrived at IOS at 16:00, September 25.

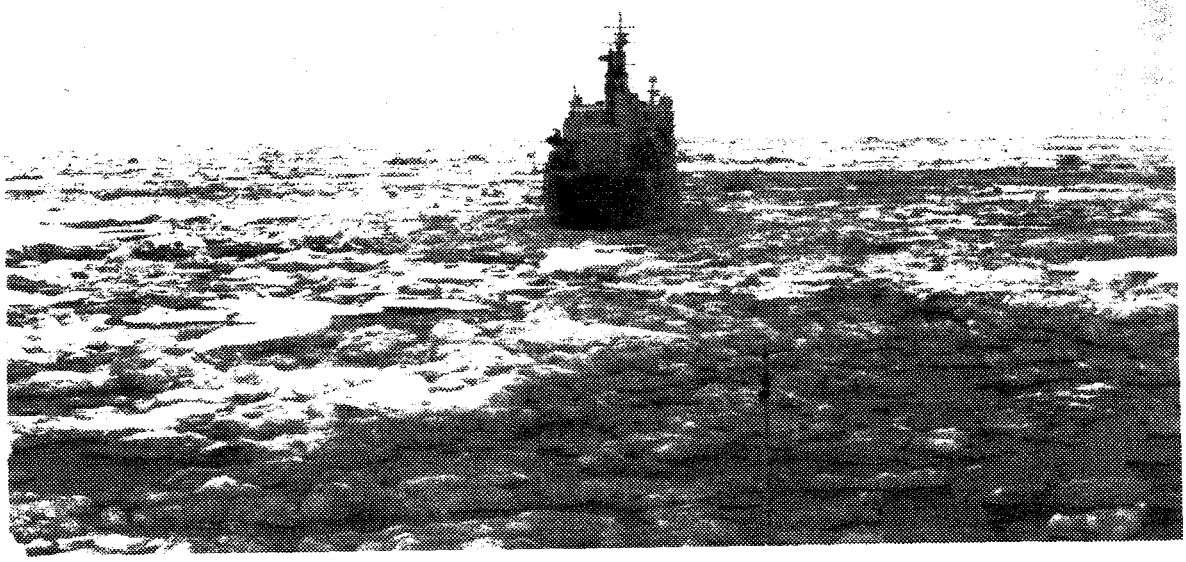
The Raytheon 12 kHz sounder worked well for the entire GEBCO line. The magnetometer became very noisy just north of the Aleutians. This proved to be caused by water in the cable connection. The magnetometer tow cable was snapped by accident,

caused by a winch with poorly marked controls. The cable was repaired while the ship was in Dutch Harbour. All data was logged on floppy disc by the SAIL system. The SAIL software is still awkward to use and caused several minor problems. Some further work on SAIL is required for it to be a straightforward, trouble-free logging system.

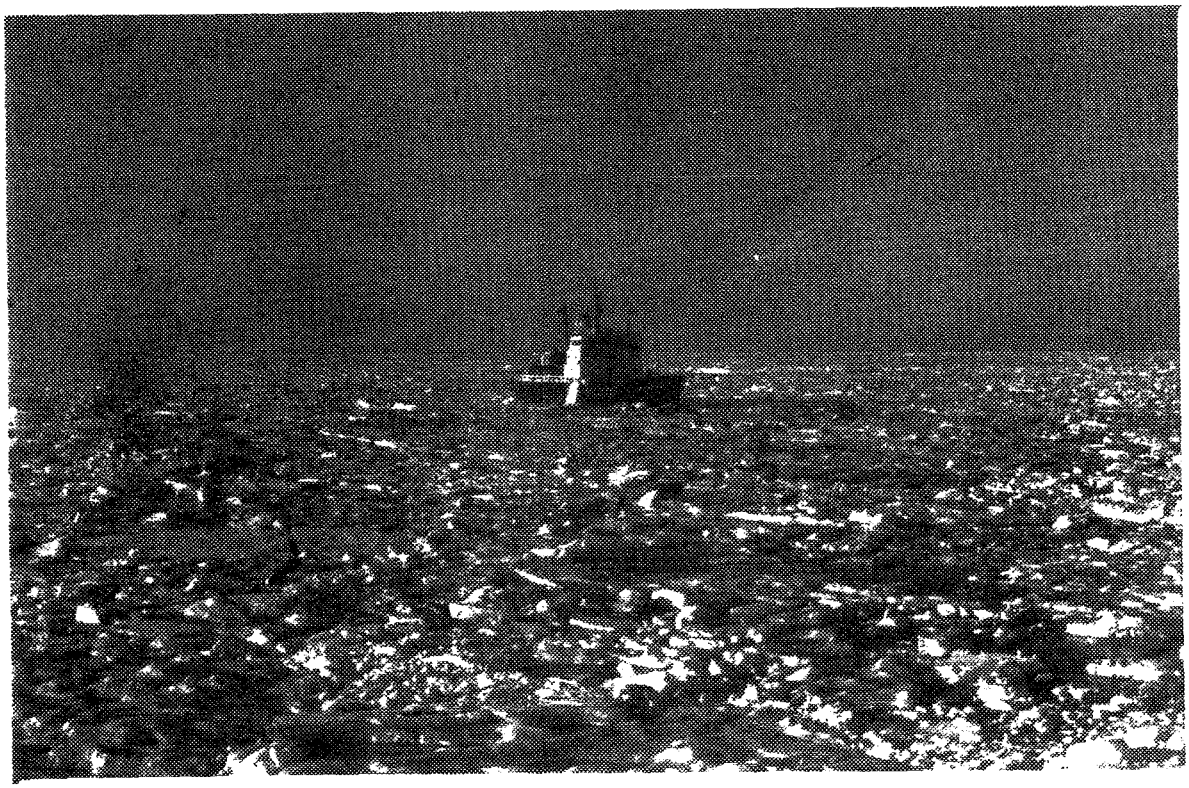


Polar Continental Shelf Project base at Tuktoyaktuk.

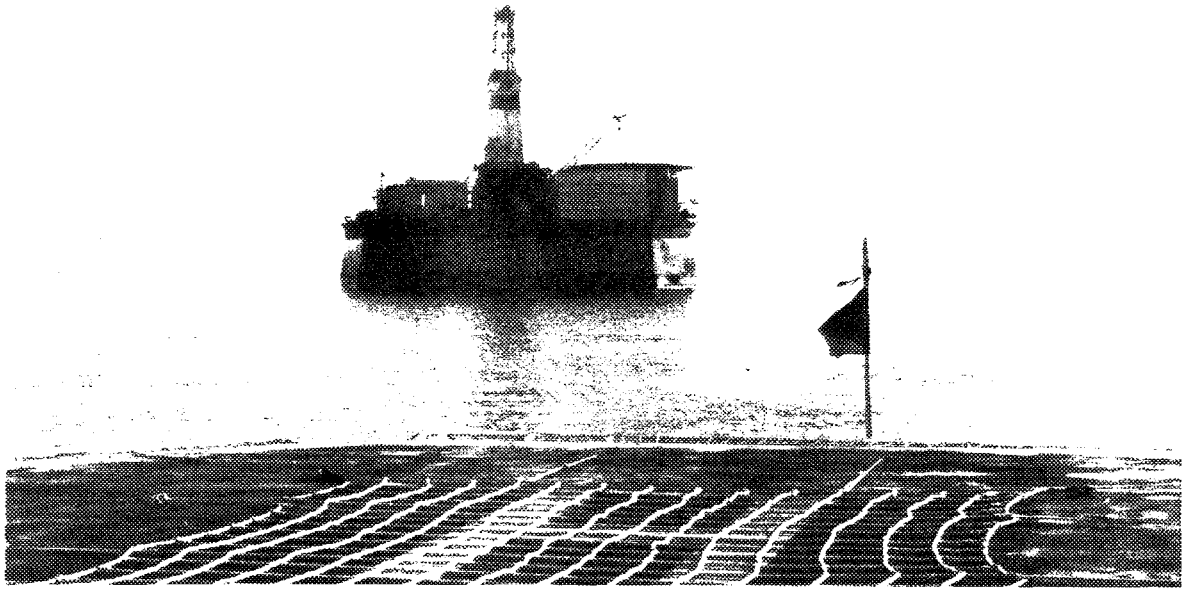
Time for a picnic while our advanced party awaits the arrival of the JOHN P. TULLY



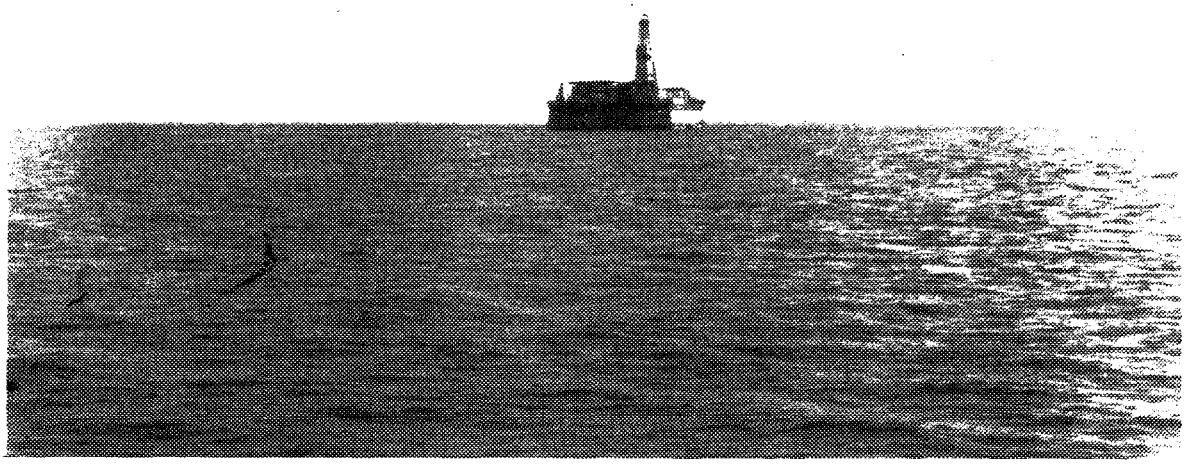
The MARTHA L. BLACK, a west coast Canadian Coast Guard ice breaker, escorted the JOHN P. TULLY into the Canadian Arctic.



Ice conditions, off Wainwright and Pt. Barrow, Alaska, were very bad this season.



MOLIPAQ, carrying out further tests on the Amauligak oil field.



This caisson is resting on the bottom in 35 metres of water.

Our positioning system is transported out to the sites in this Sikorsky S61 helicopter.

This Bell 212 helicopter was used to retrieve the positioning system as the S61 was not available.

CONCLUSIONS

A substantial improvement in atmosphere was noted aboard the JOHN P. TULLY this year. The survey staff was treated as important participants and valued members of a total team effort which was a welcome change. Credit for this must be given to the acting Captain, John Anderson.

The season was highly successful from the moment we left IOS in July to our return in late September. GEBCO and Magnetic information gathered on our journey north was of the highest quality and hydrography, once in the Beaufort Sea, was also productive. The heavy ice of Wainwright and Point Barrow held up the ship and her entry into the Beaufort Sea for 6 days but these types of delays are to be expected occasionally.

In 1981, A.D. O'Connor, H.I.C. of the Hudson 81 project stated that "10,000 line miles of sounding can be expected from a good season." We produced 13,550 line miles of sounding. What more need be said?

RECOMMENDATIONS

1. Expensive surveys, such as the "Tully" surveys, this past season are limited in their area of work because of the difficulty in moving their dedicated positioning system. I suggest that we contract out positioning to the companies already providing this service in a much wider area of the Beaufort Sea. By doing this, we will not be limited to one area, but will be able to work anywhere in their coverage.

2. The 206 Bell Helicopter is not suitable for our use and a larger machine is recommended. I consider it unsafe to fly this machine (Bell 206) over open water and for trips of many miles out to the ship.

3. The control valves for the fire fighting apparatus should be moved from the Hydrographic Chartroom to the helicopter deck. The present location of these valves is inconvenient for everyone.

4. The present carpet in the Hydrographic Chartroom should be removed and something with less pile substituted. The present carpet unsuitable for a work area and its loose fibres infiltrate all electronic equipment.

5. Substantial improvements have been made by the addition of the corridor to the helicopter landing pad but a few problems still remain. The chartroom should be considered out of bounds as a waiting room or thoroughfare or marshalling area during helicopter flights.

6. In order to maximize our efforts on Arctic surveys all four launches should be used.

7. There is no convenient storage area for survey equipment aboard the ship. The wet lab on the officers accommodation deck is the only convenient space and shelves should be built in this area.

8. Weather information on SAIL was not accurate this past season. This should be corrected.

9. The launches should all be set up to travel at or near the same speed (16.5-17 knots). This will simplify launch scheduling.

10. Launch antennas must be mounted so that they do not get broken when coming along side the ship. Also all Trisponder units should be mounted inside the launch so that they do not fill up with water.

11. All launches should be equipped with radar. This will increase launch safety in reduced visibility.

12. All automated field surveys should be equipped with a VAX computer and associated software and hardware. Colour graphics terminals with CARED software are a must.

13. A monitor clock should be fitted aboard the JOHN P. TULLY and time from the master clock imprinted on all data records.

14. Launch recovery remains a dangerous operation even though substantial improvements were made to the lower block during the Queen Charlotte survey this year. Further improvement is required.

15. Battery charging aboard the launches still causes problems. Various controls and extension cords should be made foolproof so that batteries are fully charged each morning.

16. A more extensive parts supply for launches should be taken into the field. Parts such as windshield wiper motors, wiper blades and arms were in short supply this season.

17. Some method of monitoring data being logged on Targa cartridges should be investigated. A number of shifts were lost to no data this season.