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An Investigation of Surface Drift on the Labrador Coast

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Les établissements des Sciences et Levés océaniques dans les régions et à l'administration centrale ont cessé de publier leurs diverses séries de rapports depuis décembre 1981. Vous trouverez dans l'index des publications du volume 38 du *Journal canadien des sciences halieutiques et aquatiques*, la liste de ces publications ainsi que le dernier numéro paru dans chaque catégorie. La nouvelle série a commencé avec la publication du Rapport n° 1 en janvier 1982.

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AN INVESTIGATION OF SURFACE DRIFT ON THE LABRADOR COAST

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ABSTRACT

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In 1979 and 1980 card type surface drifters were released by several oil companies at drill sites on the Labrador coast, as part of the Labrador Surface Drift Project of the Department of Energy, Mines and Resources, Ottawa. Locations and times of releases and recoveries are presented with a discussion of wind effects. Results indicate the existence of a distinct onshore surface drift from Labrador drill sites.

RÉSUMÉ

Bezanson, D. and Vandall Jr., P.E. 1984. An investigation of surface drift on the Labrador Coast. Can. Tech. Rep. Hydrogr. Ocean Sci. 51: iv + 14 p.

En 1979 et 1980, plusieurs compagnies petrolières ont relâché des dérivants de surface aux divers sites de forage sur la côte de Labrador sous un project du Département de L'Energie, Mines et Resources Canada. Les positions et temps de mise à l'eau et de recouvrement sont présentés. Les résultats de l'étude indiquent définitivement que de la matiére flottante provenante de ces sites puisse échouer sur la côte.

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INTRODUCTION

The presence of oil exploration drilling in the coastal waters of Labrador has created the necessity for estimating the likelihood of contact between floating material, especially oil, which might be released at a drill site and the shoreline. Operating companies are required by the Department of Energy, Mines and Resources to have an acceptable oil spill contingency plan and an associated oil spill trajectory analysis. Before 1978, these trajectory analyses indicated that spilled oil would not contact the Labrador coast, but it is possible these analyses do not completely represent real drift (Noll, 1978). Surface water movement near the Labrador coast appears to be dominated by the Labrador Current which, although not known in detail, may be expected to provide a large component of drift parallel to the coast in a southeasterly direction (Kiilerich, 1939; Smith et al., 1937). Since westerly winds predominate in the long term at these latitudes, the average contribution from wind should be an offshore component of drift (Great Britain Meteorological Office, 1948), but there remains the possibility of onshore winds persisting for several days. Additional uncertainty exists because of varying estimations of surface drift as a fraction of wind speed. For these reasons, it was decided that an ocean drifter study would provide a better understanding of the possibility of shoreline contact.

The Labrador Surface Drift (LSD) Project, developed by the Resource Management Branch of the Department of Energy, Mines and Resources in 1979, led to the release by drilling operators of several thousand surface drifters at well sites along the Labrador Coast in 1979 and 1980. The Bedford Institute of Oceanography provided the drift cards and functioned as a clearing house for returns. The Labrador Resources Advisory Council

supplied information to the public and solicited public support in the search for the released drift cards and the companies responsible for the drilling programs provided funding and logistic support.

PROGRAM DESIGN

Ocean drifters of various types are used in a variety of applications. The more sophisticated types may transmit their position and other data via satellite, maintain a predetermined depth, or record local conditions. A type widely used by a variety of agencies worldwide involves some form of returnable marker which is designed to drift in a particular manner, be deployed in large numbers and a small percentage subsequently found and returned by the public at large. This is the type furnished for surface and bottom drift experiments by the Bedford Institute of Oceanography clearing house (Bezanson and Deveau, 1981), and the type chosen for the Labrador Surface Drift program.

In order to simulate the movement of floating oil, it is necessary to use a drifter which moves at the same velocity under the influence of wind, avoids deterioration for several months, and is easily found and returned by the public. The BIO surface drifter is a white plastic card in the form of a prepaid business reply card which is written on by the finder and posted for a reward. It is buoyed so as to float vertically with one edge at the surface, so as to be carried along by water motion in the upper 10 cm of the sea surface. It is quite dissimilar to oil floating on the surface in sheets, but oil slicks in the open sea are frequently found to break up into discrete globules floating under the surface (Forrester, 1971). The card is assumed to be a close physical analogue of oil in this state.

To overcome the problem of low population density along the Labrador coast, the Resource Management Branch conducted a public awareness program with a poster in English and the aboriginal eskimo language, Inuktituk, as well as press releases, newspaper articles, radio and television announcements, and community visits.

DEPLOYMENTS

Between September 22 and October 1, 1979, 2,725 cards were released by Total Eastcan Exploration Ltd. on drill sites Gilbert E-47, Roberval K-92 and Bjarni O-82 (Table 1). In 1980 between August 26 and September 18, Petro-Canada Exploration Ltd. deployed 10,000 drifters at or between the Gilbert E-47 and North Leif I-05 drill sites and Chevron Standard Ltd. deployed 8,000 drifters at the South Labrador M-79 drill site between September 22 and October 9, for a total of 20,725 releases by this project.

The drifter used in 1979 consisted of a plastic business reply card in a buoyant plastic envelope weighted with metal at one edge but this design was prone to leakage and sinking. In 1980 the design was simplified by discarding the envelope and weight and buoying one edge of the high density plastic card itself with rubber foam. Both designs floated in the same manner as described in the previous section.

RESULTS

Card returns as of September 30, 1981 are given in Table 2 and illustrated in Figs. 1 and 2. Percentage returns and the components of the average local winds during the deployment period are given in Table 3, with wind components given as 'onshore' taken as winds from 55°N true and 'longshore' meaning winds from 325°N true. Negative values show offshore winds

in some cases and occasionally the longshore component opposes the direction of the Labrador Current. The wind data were collected by the drill ships releasing the drifters and terminated with the drilling season following deployment.

While numbers do not warrant a detailed statistical analysis, some indications can be derived from these results. Returns on the Labrador coast occured with deployments from only the most northerly site although the mid-Labrador sites produced a substantial number of returns on the Newfoundland coast. The highest percentage returns occurs from the most northerly site, Gilbert E-47, which is the closest site to the coast. Returns from this site were distributed along the Labrador coast and the northern coasts of Newfoundland. A substantial number entered the Gulf of St. Lawrence, with at least one drifter reaching Les Petits Mechins on the Gaspé coast. The Gulf recoveries may have entered by way of the Strait of Belle Isle or possibly through the Cabot Strait after passing east of Newfoundland, carried by local coastal currents (Petrie and Anderson, 1982). The absence of recoveries on the south coast of Newfoundland, together with a concentration of recoveries on the west coast favours the more direct route through the Strait of Belle Isle. Returns continued to occur over the two years of the study with 0.6% the 1979 deployments at the Gilbert E-47 site being recovered, and 0.34% of the 1980 deployments at that site. Available wind data for the deployment periods are given in Table 3. Vectorial averages are presented as onshore components (from the northeast toward the southwest) and longshore components (northwest toward southeast) in km/hr. Onshore components occurred at the Gilbert E-47 site, which had the highest return rate, and offshore winds at the various other sites which had lower return rates. Winds and proximity to shore appeared

to work together to increase returns from this site. At the South Labrador M-79 site, a 0.33% recovery occurred despite offshore winds during the deployment period.

Several deployment sites show no recoveries at all. However, at least one site in each general region (upper, middle and lower Labrador) shows returns. The total number of returns does not permit an analysis of differences between sites within groupings, but there is an indication of a trend toward fewer returns from sites farther from shore.

No returns from Europe have occurred, which was unexpected in view of North Atlantic circulation patterns and the frequency of drift bottle returns from Europe (Huntsman et al., 1954; Reimer, 1980). The possibility that this was due to limited longevity of this type of drifter is somewhat discounted by the fact that returns from Canadian waters occurred after over 700 days at large, and that the drift distance to Ireland is only twice that of the longest recovery made in Canada. No returns were made below the 47th parallel nor from points north or east of a release location. Immediately northeast of the release site, the long and sparsely inhabited coastline of Greenland may have received drifters without generating returns.

CONCLUSIONS

The results of this study have firmly demonstrated that a portion of floating material or oil released at certain Labrador drill sites can reach the Labrador and Newfoundland coasts and may even enter the Gulf of St. Lawrence. There is no clear indication of the relative amounts which would reach these coastlines versus other coastlines, but the results suggest to a degree that the European coastline is not greatly at risk from

material floating in the manner of the present drifter, that is with little windage area, and several centimetres depth of submerged area. To evaluate the difference between nearby sites, or to firmly specify the route of entry to the Gulf of St. Lawrence, further deployments would be necessary. The suggestion of limited risk to the European coastline should be verified by future analysis of returns.

ACKNOWLEDGEMENTS

Total project costs of $9,537.50 in 1979 and $27,000.00 in 1980 were borne by Total Eastcan Exploration Ltd., Petro-Canada Exploration Ltd. and Chevron Standard Ltd. These companies also assisted by deploying the drift cards. Mailed returns were compiled by S. Shunamon of the Bedford Institute ocean drifter clearing house.

The authors also wish to acknowledge the assistance of others in the Department of Energy, Mines and Resources, the Department of Fisheries and Oceans and the Labrador Resource Advisory Council, as well as all those persons who found and returned drift cards.

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TABLE 1. DRIFTER RELEASES

Drill Site	Latitude	Longitude	Serial Numbers	Date
Gilbert E-47	58°52'	62°08'	25401-26400	September 22-27, 1979
Roberval K-92	54°52'	55°45'	27401-28125	September 14-29, 1979
North Bjarni O-82	55°31'	57°42'	26401-27400	September 18-October 1, 1979
Gilbert E-47	58°52'	62°08'	45001-52000	August 26-September 11, 1980
en route	55°59'	57°40'	52001-53000	September 13, 1980
North Leif I-05	54°24'	55°15'	53001-55000	September 17-18, 1980
South Labrador M-79	55°49'	58°27'	55001-57000 58001-61000	September 22-October 9, 1980

TABLE 2. DRIFTER RECOVERIES

Card Number	Release Position Latitude	Longitude	Release Date	Recovery Position Latitude	Longitude	Recovery Date	Elapsed Days
25,405	58°52'N	62°08'W	22/09/79	50°42'N	57°25'W	03/12/79	72
25,690	58°52'N	62°08'W	22/09/79	51°35'N	55°26'W	01/11/80	406
25,775	58°52'N	62°08'W	22/09/79	53°25'N	55°47'W	15/09/81	724
26,036	58°52'N	62°08'W	25/09/79	51°22'N	55°35'W	21/11/80	423
26,336	58°52'N	62°08'W	27/09/79	58°03'N	62°14'W	23/08/81	727
26,339	58°52'N	62°08'W	27/09/79	57°55'N	62°06'W	15/07/80	292
45,154	58°52'N	62°08'W	26/08/80	57°28'N	61°35'W	25/07/81	333
45,165	58°52'N	62°08'W	26/08/80	56°50'N	61°12'W	20/08/81	359
45,317	58°52'N	62°08'W	26/08/80	51°36'N	55°36'W	20/11/80	86
45,372	58°52'N	62°08'W	26/08/80	58°03'N	62°14'W	23/08/81	362
45,407	58°52'N	62°08'W	26/08/80	50°12'N	55°44'W	06/03/81	192
45,721	58°52'N	62°08'W	26/08/80	48°59'N	66°58'W	21/05/81	268
45,804	58°52'N	62°08'W	26/08/80	49°44'N	57°56'W	30/04/81	247
45,824	58°52'N	62°08'W	26/08/80	58°33'N	62°42'W	14/07/81	322
45,879	58°52'N	62°08'W	26/08/80	51°35'N	55°45'W	10/09/81	380

TABLE 2. continued

Card Number	Release Latitude	Position Longitude	Release Date	Recovery Latitude	Position Longitude	Recovery Date	Elapsed Days
45,910	58°52'N	62°08'W	26/08/80	58°03'N	62°14'W	23/08/81	362
46,832	58°52'N	62°08'W	27/08/80	53°36'N	55°55'W	20/07/81	327
46,963	58°52'N	62°08'W	27/08/80	53°35'N	56°05'W	15/07/81	324
47,278	58°52'N	62°08'W	31/08/80	56°48'N	61°17'W	20/08/81	354
47,488	58°52'N	62°08'W	31/08/80	58°30'N	63°15'W	01/08/81	335
47,502	58°52'N	62°08'W	31/08/80	58°27'N	63°15'W	25/10/80	55
47,553	58°52'N	62°08'W	31/08/80	49°19'N	54°50'W	09/03/81	190
47,978	58°52'N	62°08'W	31/08/80	58°33'N	62°42'W	14/07/81	317
48,715	58°52'N	62°08'W	01/09/80	56°48'N	61°17'W	20/08/81	353
48,968	58°52'N	62°08'W	01/09/80	58°03'N	62°14'W	23/08/81	356
48,969	58°52'N	62°08'W	01/09/80	56°50'N	61°12'W	20/08/81	353
49,548	58°52'N	62°08'W	03/09/80	49°30'N	54°30'W	03/09/81	365
50,736	58°52'N	62°08'W	06/09/80	58°03'N	62°14'W	23/08/81	351
51,355	58°52'N	62°08'W	11/09/80	56°47'N	61°20'W	01/08/81	324
51,169	58°52'N	62°08'W	11/09/80	58°03'N	62°14'W	23/08/81	346

TABLE 2. continued

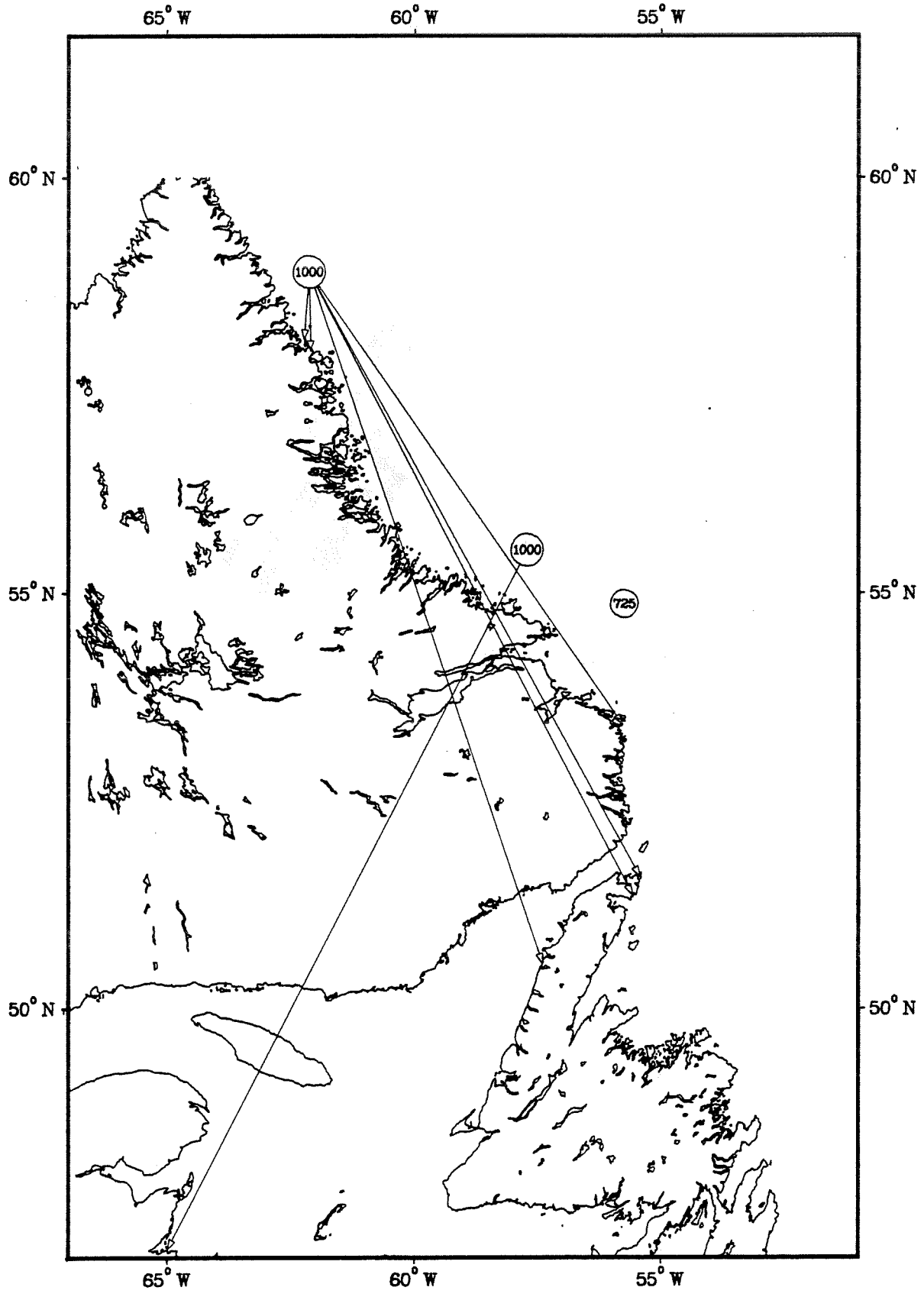
Card Number	Release Latitude	Position Longitude	Release Date	Recovery Latitude	Position Longitude	Recovery Date	Elapsed Days
54,140	54°24'N	55°15'W	18/09/80	49°05'N	53°37'W	17/05/81	241
58,252	55°49'N	58°27'W	26/09/80	51°37'N	55°54'W	22/11/80	57
60,126	55°49'N	58°27'W	27/09/80	50°02'N	57°43'W	05/05/81	220
60,250	55°49'N	58°27'W	27/09/80	49°32'N	55°39'W	30/09/81	368
64,132	55°49'N	58°27'W	09/10/80	51°38'N	55°26'W	07/06/81	241
64,178	55°49'N	58°27'W	09/10/80	48°33'N	58°44'W	22/12/80	74
64,311	55°49'N	58°27'W	09/10/80	49°19'N	54°50'W	13/03/81	155
64,486	55°49'N	58°27'W	09/10/80	48°42'N	58°54'W	30/03/81	172
64,599	55°49'N	58°27'W	09/10/80	51°37'N	55°32'W	15/08/81	310
64,619	55°49'N	58°27'W	09/10/80	51°36'N	55°36'W	20/11/80	42
64,621	55°49'N	58°27'W	09/10/80	50°04'N	57°41'W	21/04/81	194
64,637	55°49'N	58°27'W	09/10/80	51°25'N	56°26'W	29/05/81	232
64,730	55°49'N	58°27'W	09/10/80	49°36'N	57°57'W	28/04/81	201
64,731	55°49'N	58°27'W	09/10/80	51°36'N	55°36'W	20/11/80	42
64,772	55°49'N	58°27'W	09/10/80	49°19'N	54°50'W	14/05/81	217
64,799	55°49'N	58°27'W	09/10/80	50°43'N	57°22'W	17/11/80	39
64,992	55°49'N	58°27'W	09/10/80	51°30'N	56°30'W	10/05/81	213

TABLE 3. PERCENTAGE RETURNED AND AVERAGE WINDS

Drill Site	Number of Releases	Dates	Return as of 30/09/81	(Avg. Winds (km/hr))* Onshore	Longshore
Gilbert E-47 58°52' 62°08'	1000	Sept. 22-27, 1979	6(0.6%)	.8	1.0
Roberval K-92 54°52' 55°45'	725	Sept. 14-29, 1979	0(0%)	-3.2	3.3
North Bjarni O-82 55°31' 57°42'	1000	Sept. 18-Oct. 1, 1979	0(0%)	-5.5	2.1
Gilbert E-47 58°52' 62°08'	7000	Aug. 26-Sept. 11, 1980	24(0.34%)	1.5	-1.5
en route 55°59' 57°40'	1000	Sept. 13, 1980	0(0%)	---	---
North Leif I-05 54°24' 55°15'	2000	Sept. 17-18, 1980	1(0.05%)	---	---
South Labrador M-79 55°49' 58°27'	8000	Sept. 22-Oct. 9, 1980	16(0.33%)	-1.4	1.9

* These winds were averaged over the release period. Data for longer periods at these sites was not available.

LABRADOR SURFACE DRIFT PROJECT,1979



PLOT 1 22.32.44 TUES 9 FEB, 1982 JOB-ACCIAVU , BEDFORD INSTITUTE DISSPLA VER 8.2
REL2725(3), REC:7(7), REC:FAR:0, REL:FAR:62

Figure 1

LABRADOR SURFACE DRIFT PROJECT, 1980

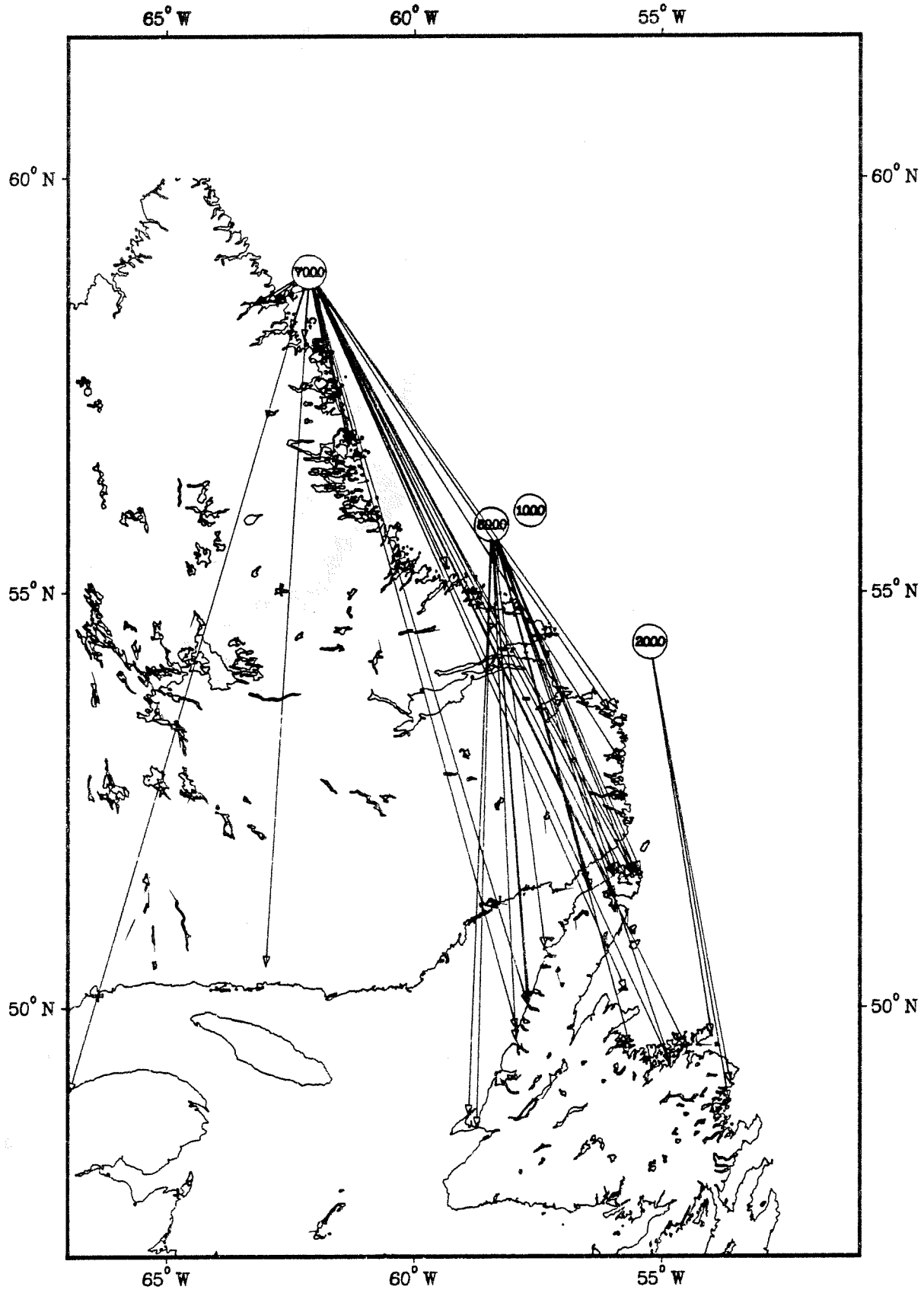


Figure 2

PLOT 2 03.15.14 THUR 4 MAR, 1982 JOB-ACCNLJW , BEDFORD_INSTITUTE DISSPLA VER 8.2
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