New Zealand Fisheries Assessment Research Document 88/18

Hoki acoustic survey, west coast South Island, 1985

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This series documents the scientific basis for stock assessments and fisheries management advice in New Zealand. It addresses the issues of the day in the current legislative context and in the time frames required. The documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Hoki Acoustic Survey W.C.S.I. 1985

Introduction

In 1985, during the hoki spawning season, an acoustic survey of the west coast, from approximately 41 S to 44 S, was undertaken. The survey covered the period 7 th July to 17 th August and was on the Japanese vessel Akagi Maru. (Patchell, G. J. 1985)

The objective of the survey was to produce an absolute biomass estimate of the spawning stock off the W.C.S.I. To allow for the possibility of a significant turnover of fish within the survey area, during the spawning season, the survey design called for the collection of a number of snap-shot biomass estimates throughout the season, and an estimate of the mean residency time of a hoki within the survey area. During the cruise the survey area was covered a number of times, and high density areas, or "aggregations", of hoki were located and acoustically surveyed. Biological data was also collected to help estimate a hoki's mean residency time.

Only a small portion of the acoustic data was originally analyzed and no work has yet been done on estimating the residency time.

The purpose of this report is to give an overview of the survey, by presenting graphically the distribution and estimated biomass of individual aggregations.

Acoustic estimates

The estimates were obtained by applying the echo-integration method, (Burczynski, J. 1979). Only point estimates are given, as the level of uncertainty surrounding the estimates is at present difficult to quantify.

There are five main areas which give rise to uncertainty :

(i) Echo separation

Separation of "fish echoes" from "bottom echoes", has caused problems in the past. If echoes returning from the seabed, are mistakenly integrated this can inflate biomass estimates, whereas if echoes from fish close to the bottom are ignored, an underestimate will occur.

For hoki, the separation is particularly important as they often form layers very close to the seabed, (see figures 2 & 4). A "white line" is used in figure 3, to show how the fish and bottom echoes have actually been separated.

(ii) Species identification

A typical hoki echogram is shown in figure 4. The hoki layer is well defined, and it is this layer of fish which is integrated and used in the hoki biomass estimate. Figures 5 & 6 show more difficult cases. There are two layers of fish, both bottom orientated and at a suitable depth to be considered as hoki. However the only trawl data obtained was from a bottom trawl, so that we have no direct evidence to support the supposition that the shallower of the two layers, is hoki.

G.J Patchell provided for each acoustic transect, guidelines to indicate which fish layers should be taken to be hoki. These guidelines have been followed, even though on occasion they appeared extremely conservative, (not however in relation to the main aggregation, (30/7, 13/8)).

(iii) Survey design

The idea of locating and surveying aggregations of hoki, requires that the boundaries of an aggregation be strictly defined. During the survey this was done subjectively, and it is apparent on numerous occasions, that the recording of acoustic data was prematurely stopped, (ie significant fish densities were still being recorded at the end of transects). This has the effect of reducing an aggregations survey area and hence of reducing the biomass estimate of an aggregation.

(iv) Calibration

There still remains some uncertainty about the transmitter source level and receiving response, at the water temperatures in which the survey was carried out. Recalibration since 1985 has had a significant deflationary effect on original biomass estimates.

(v) Target strength

This is still the area of greatest uncertainty. A mean target strength for individual hoki, of -36 dB is used in the estimates This is substantially lower than the figure of -30 dB originally used, and has an inflationary effect on original biomass estimates.

All of these problem areas are being addressed :

(a) the creation of new software has made echo separation a minor problem

(b) the underwater camera technique being developed should solve some species identification problems

(c) survey design is being considered more carefully, and appropriate strategies are being developed

(d) a new tank is under construction which will aid both the calibration and target strength work

Survey results

Individual aggregations were surveyed for the purpose of biomass estimation over the period 11th July to 15th August. Surveying occurred generally during the day, and the only substantial gap in coverage was from the 6th August to 10th August, when the echo recording system was not working.

The maps which make up the bulk of this paper, summarise the survey results. Each map shows the location of, and biomass estimate for, one or more high density areas, together with the date on which the area was surveyed. The transects used are represented by the sets of lines shown.

Table 2 gives some more detailed information about the aggregations, including the area each covered, and the mean areal density of hoki over the area. Table 1 details the system parameters and fish parameters used to convert the recorded acoustic data into biomass estimates. Mean areal densities are derived from the integrated acoustic data, scaled by a constant obtained from the system parameters, and then divided by the intensity ratio, (which is the linear equivalent of the target strength). The biomass estimate for an aggregation is then found by multiplying its mean areal density by its area, and the average fish weight.

By far the largest aggregations were encountered from the 27th July to 15th August, over which period a single major aggregation forms in the Hokitika canyon, (30/7), and then appears to spread out, (3/8 to 5/8), reform, (13/8), and then spread out again, (14/8 to 15/8). The histogram in figure 1 shows the biomass estimates for fish surveyed in the Hokitika canyon, including a daytime and nighttime estimate for the 30th August.

1986 Acoustic estimate

In the 1986 Hoki TAC paper,(Patchell, G. J. and Coombs, R. F. 1986), the biomass estimate given for the Hokitika canyon aggregation is 1.7 million t. The estimate now given is approximately one tenth of this.

A number of factors have contributed to this difference :

(i) A calibration error inflated the original estimate by a factor of 4.

(ii) The recalibration, (in 1987), revealed another inflationary factor of 2.

(iii) The reassessment of the target strength of hoki, from -30 dB to -36 dB partially compensated for the above by a factor of 4.

(iv) Inadequate echo separation, combined with operator error resulted in bottom echoes being integrated into the original estimate. An inflationary factor of about 3 was involved.

(v) The survey area was originally incorrectly calculated. An inflationary factor of 1.33.

(vi) The transects used were biased towards the denser half of the survey area, and the resulting mean density was applied to the whole of the area. Another inflation by a factor of 1.33.

The original estimate was produced when the deep water acoustic work was at a highly experimental stage. The software available at the time, was difficult to use, and incomplete, requiring that some steps of the analysis be performed manually. Under pressure to produce an absolute biomass estimate, mistakes were unfortunately made.

The current estimates have been produced with as much care as possible, using improved software, and with the best estimates of system parameters, and fish parameters available. Some adjustment of the figures is still possible - increased knowledge of mean tilt angles of hoki, and the size of the swim bladder in spawning fish could affect the target strength, improved calibration facilities may cause a revision of some system parameters, the present software may prove too conservative and may be omitting some fish echoes near the seabed. Nevertheless any alterations in the figures should be small, and almost certainly in an upwards direction.

References

Burczynski, J. 1979. Introduction to the use of sonar systems for estimating fish biomass. FAO Fisheries Technical Paper No. 191. 89 p.

Patchell, G. J., and Coombs, R. F. 1986. Hoki (Macruronus novaezelandiae). In, Baird, G. G., and Mckoy, J. L. (Comps. and Eds.) 1986: Background papers for the Total Allowable Catch recommendations for the 1986-87 New Zealand fishing year 177p. (Preliminary discussion paper, held in Fisheries Research Centre library, Wellington)

Patchell, G. J. 1985. Cruise report Akagi Maru 1985 18p. (Copy held at Fisheries Research Centre Central Data File, Wellington)

Table 1

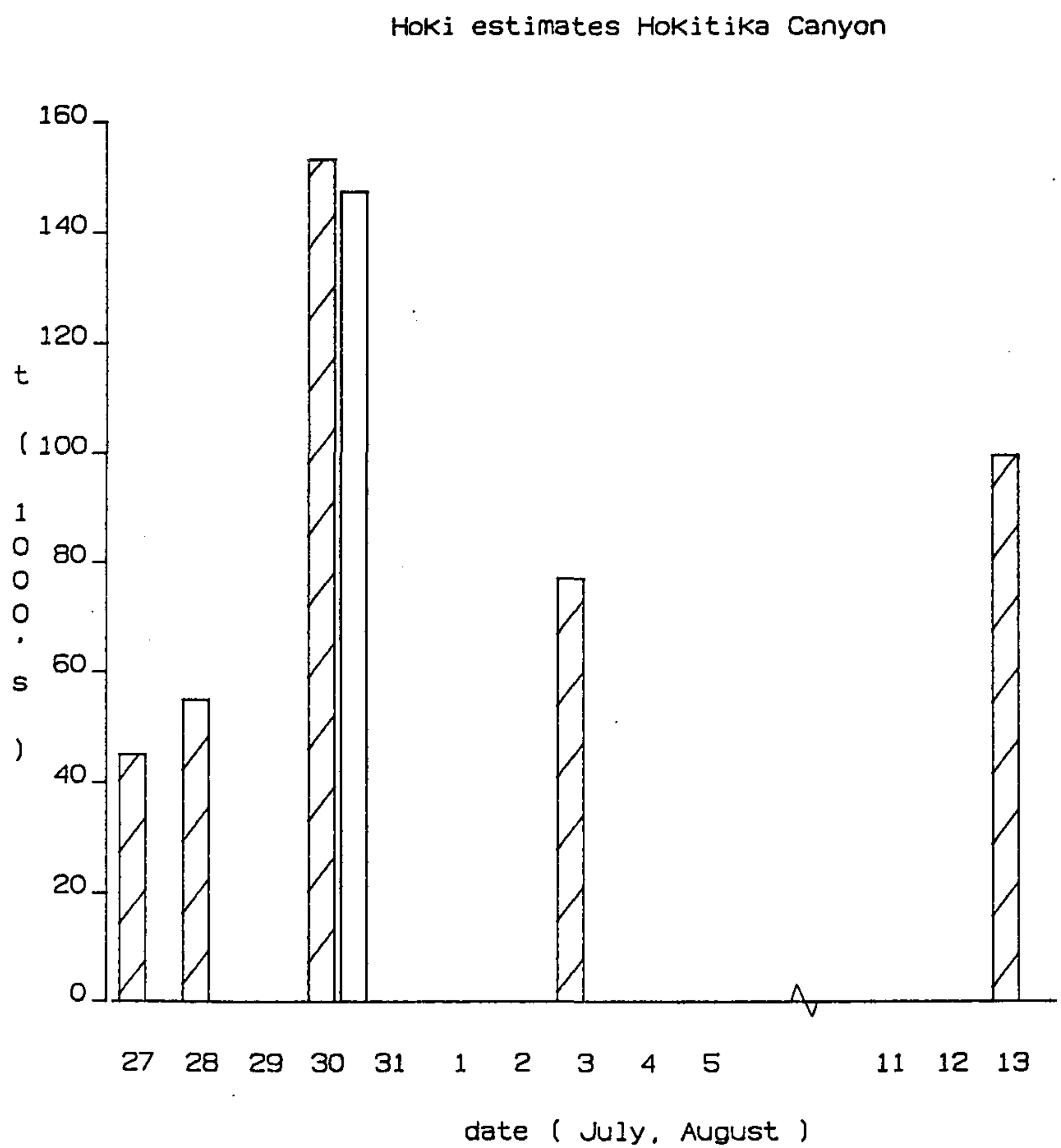
System parameters

sample period	200	micro s
pulse duration	1000	micro s
eff. beam angle	0.02	sr
source level	158000	Pa
preset absp coeff	0.007	dB/m
est absp coeff	0.007	dB/m
tvg max range	650	m
tvg resp. at max range (9th July to 14th July)	669	v/Pa
tvg resp. at max range (15th July to 17th August)	1460	v/Pa

Fish parameters

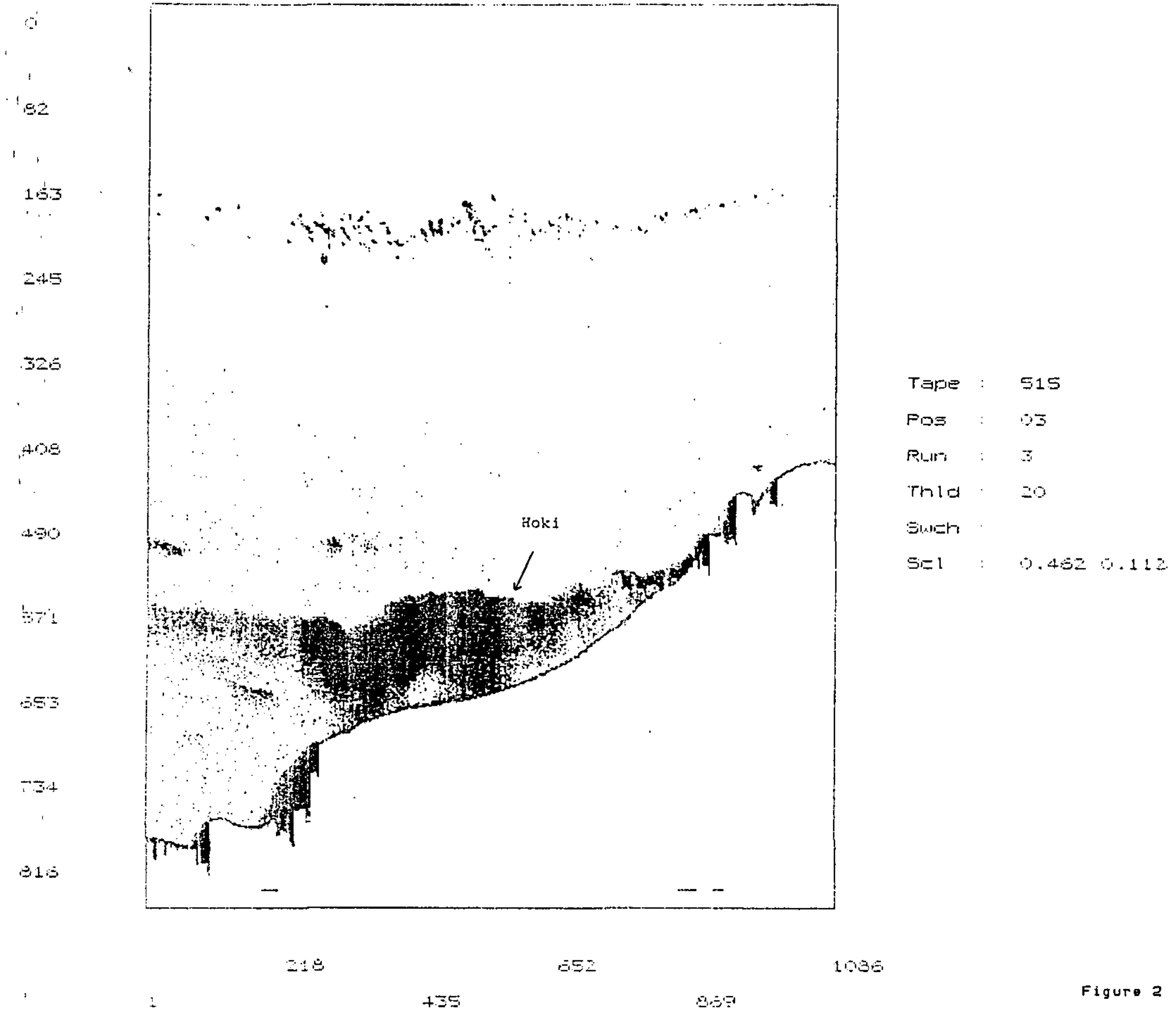
average length	0.85	m
average weight	2.2	kg
intensity ratio	0.00025	

Table 2				
date	no. of trans.	area (sq. kms)	mean areal density (fish per sq. m)	biomass (tonnes)
11-7	5	110	0.022	5000
13-7	4	101	0.026	5000
14-7	4	388	0.008	6000
15-7	4	49	0.020	2000
	5	88	0.026	5000
16-7	6	133	0.029	8000
	4	26	0.039	2000
17-7	7	48	0.031	3000
18-7	13	122	0.028	7000
19-7	7	52	0.046	5000
	3	30	0.037	2000
20-7	12	201	0.031	13000
21-7	9	120	0.014	3000
	3	273	0.006	3000
22-7	8	242	0.011	5000
23-7	5	225	0.021	10000
	6	127	0.013	3000
24-7	3	171	0.019	7000
	7	135	0.042	12000
25-7	4	320	0.019	13000
26-7	6	238	0.011	5000
	5	305	0.025	16000
27-7	4	201	0.018	7000
	3	37	0.549	45000
28-7	5	47	0.537	55000
30-7	9	163	0.426	153000
	7	294	0.227	147000
31-7	6	584	0.032	38000
1-8	12	374	0.024	19000
2-8	6	199	0.049	21000
3-8	11	346	0.101	77000
4-8	6	128	0.028	7000
	4	79	0.044	7000
5-8	4	235	0.051	26000
	6	192	0.072	30000
11-8	5	380	0.007	6000
12-8	9	161	0.038	13000
13-8	9	409	0.165	148000
14-8	6	157	0.130	44000
15-8	8	544	0.100	120000



Hoki estimates Hokitika Canyon
160
140
120
100
80
60
40
20
0
t (1000's)
27
28
29
30
31
1
2
3
4
5
11
12
13
date (July, August)

Figure 1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Hoki
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218
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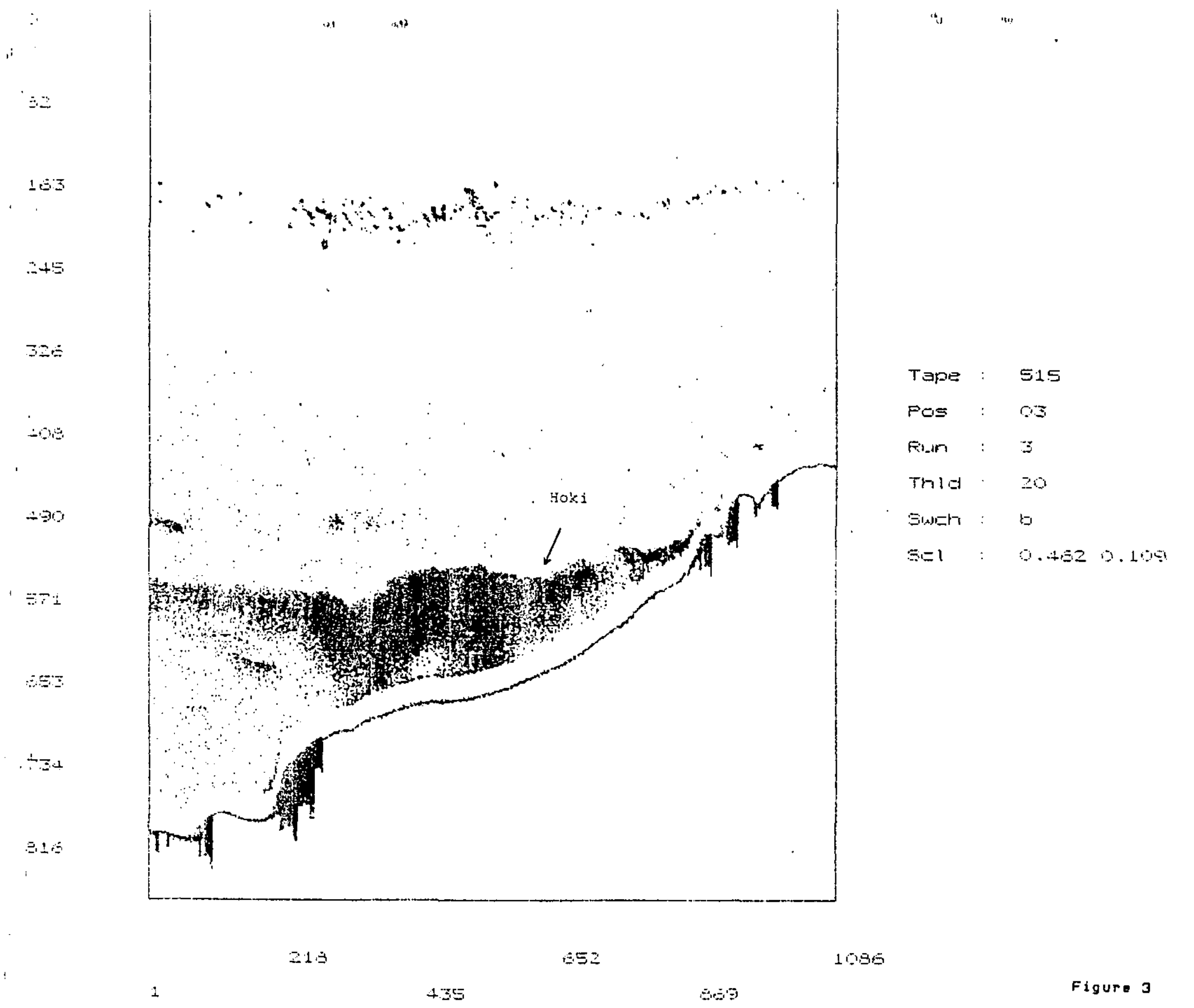
1086
Tape : 515
Pos : 03
Run : 3
Thld : 20
Swch :
Scl : 0.462 0.112

Figure 2



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Hoki
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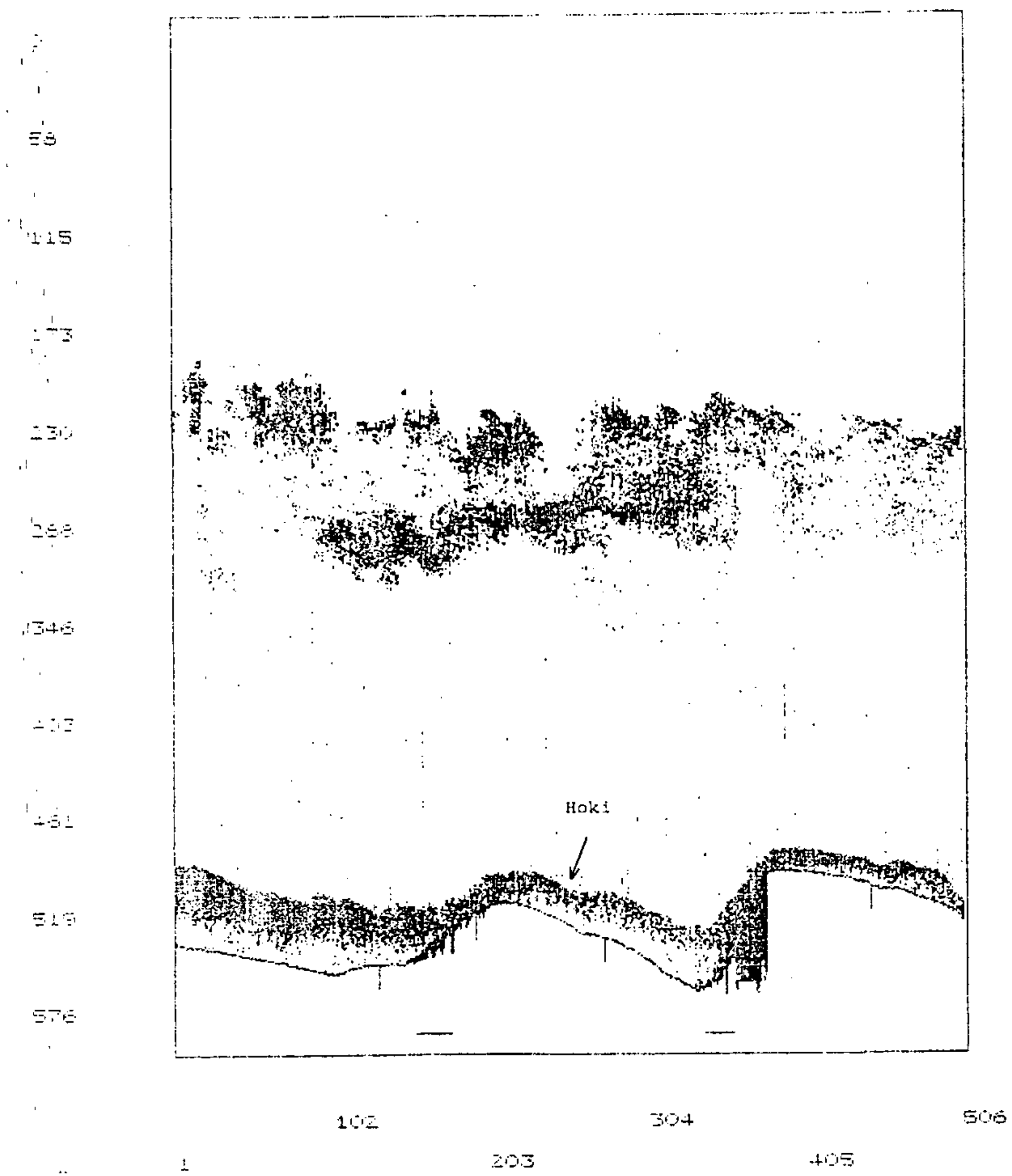
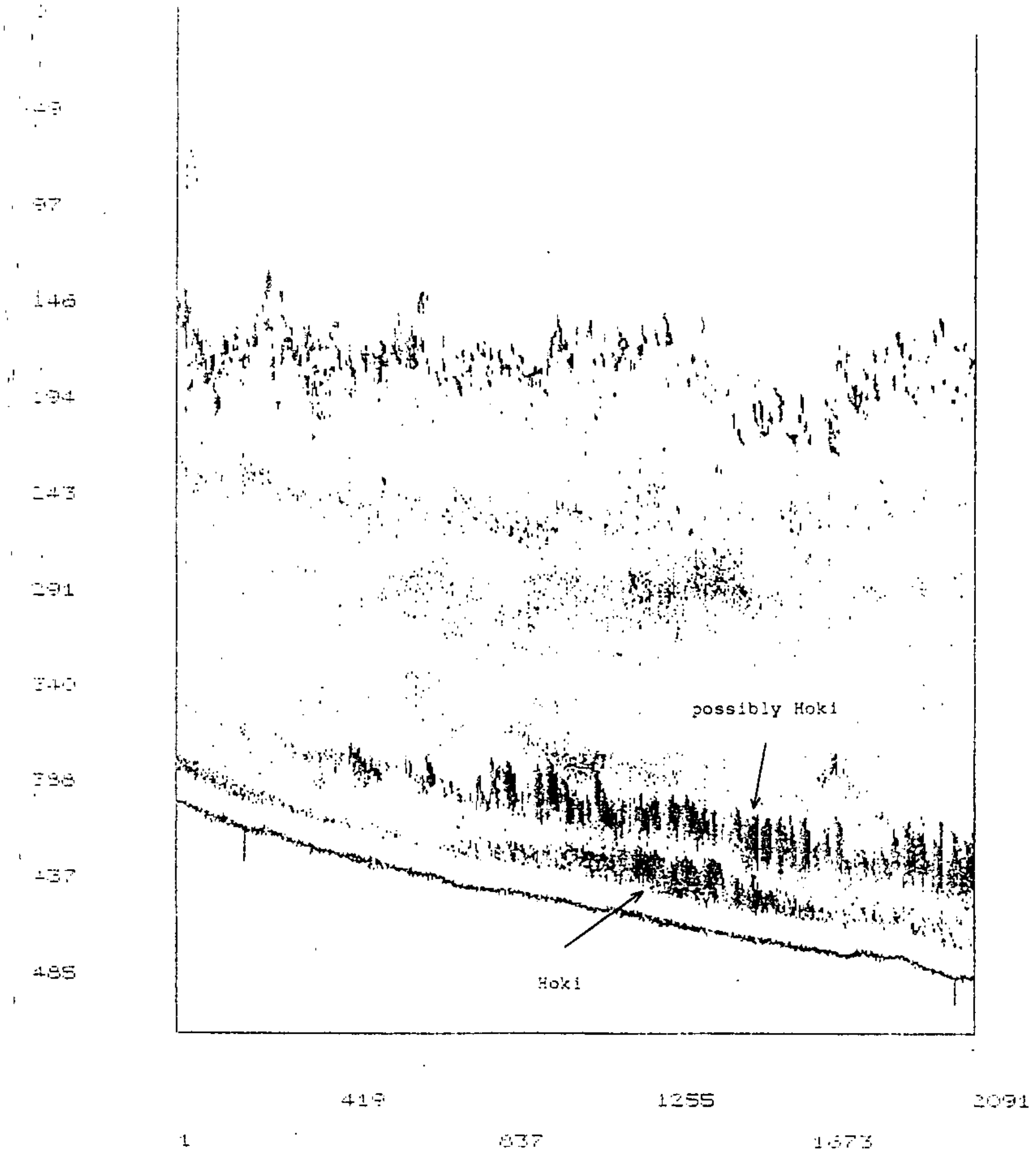
Tape : 515
Pos : 03
Run : 3
Thld : 20
Swch : b
Scl : 0.462 0.109

Figure 3



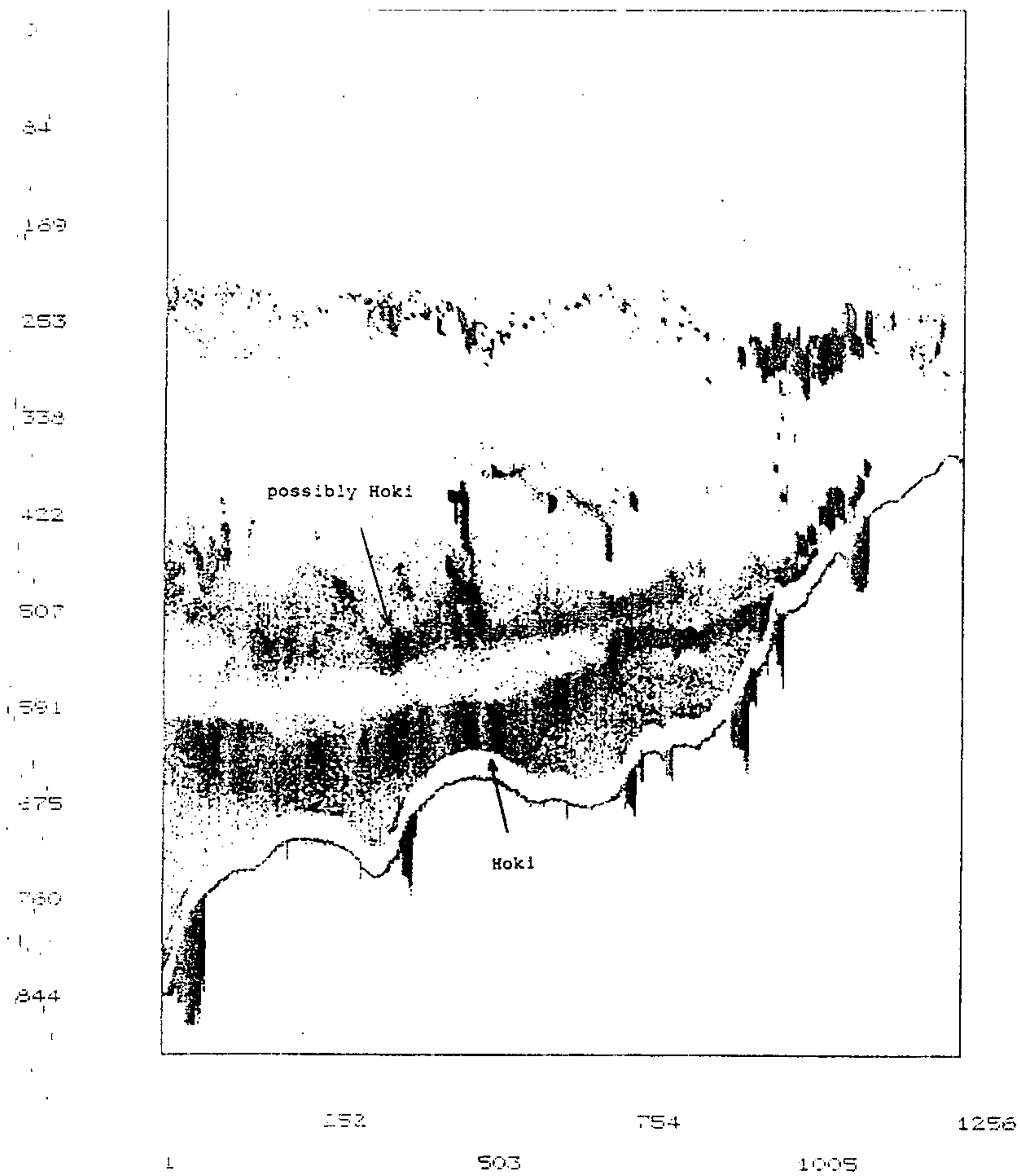
Tape : 515
Pos : 36
Run : 36
Thld : 10
Swch
Scl 0.986 0.159

Figure 4



Tape : 516
Pos : 10
Run : 10
Thld : 10
Swch : b
Scl 0.240 0.183

Figure 5



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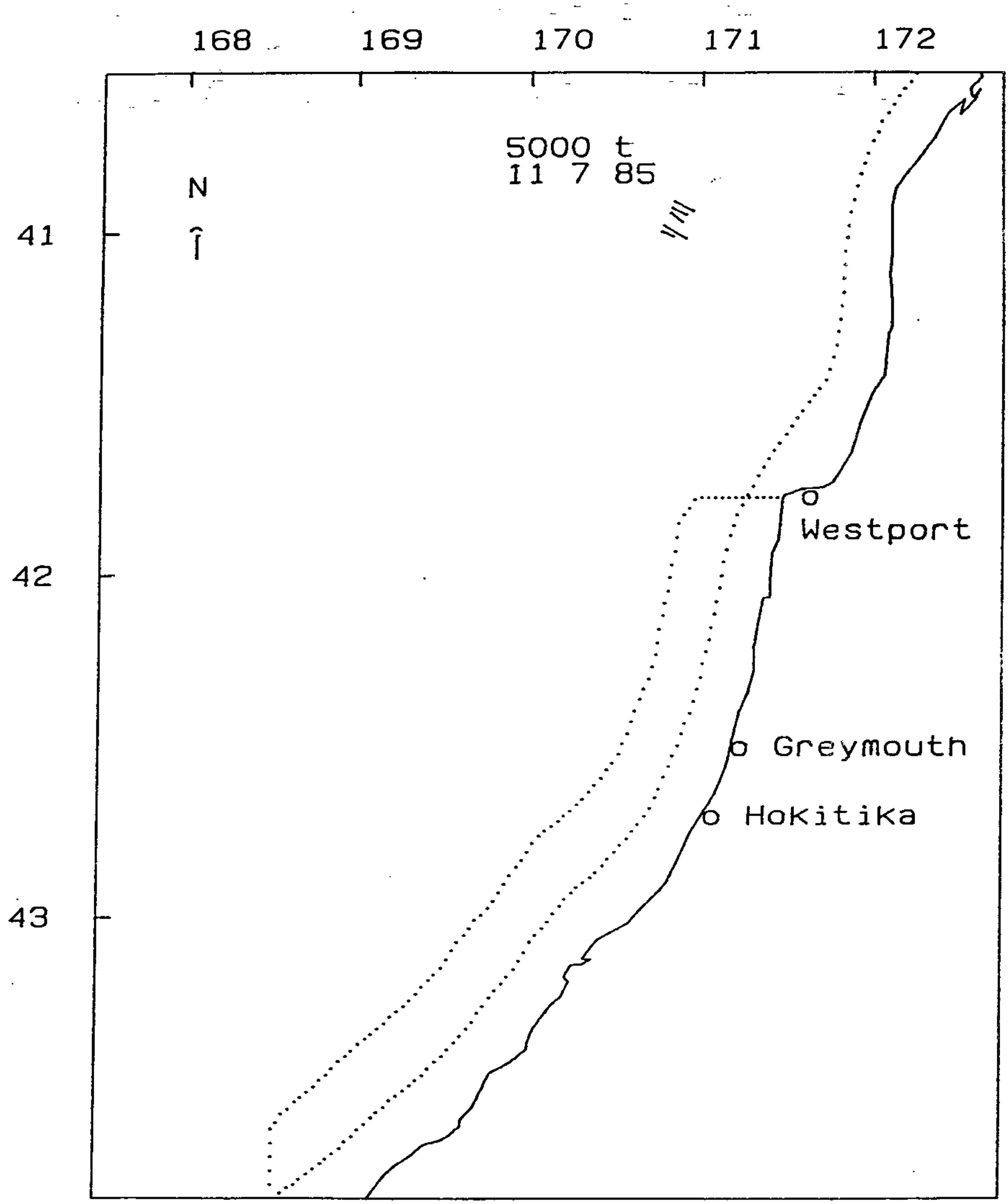
Run : 55
Thld : 10
Swch : b
Scl : 0.399 0.106

Figure 6



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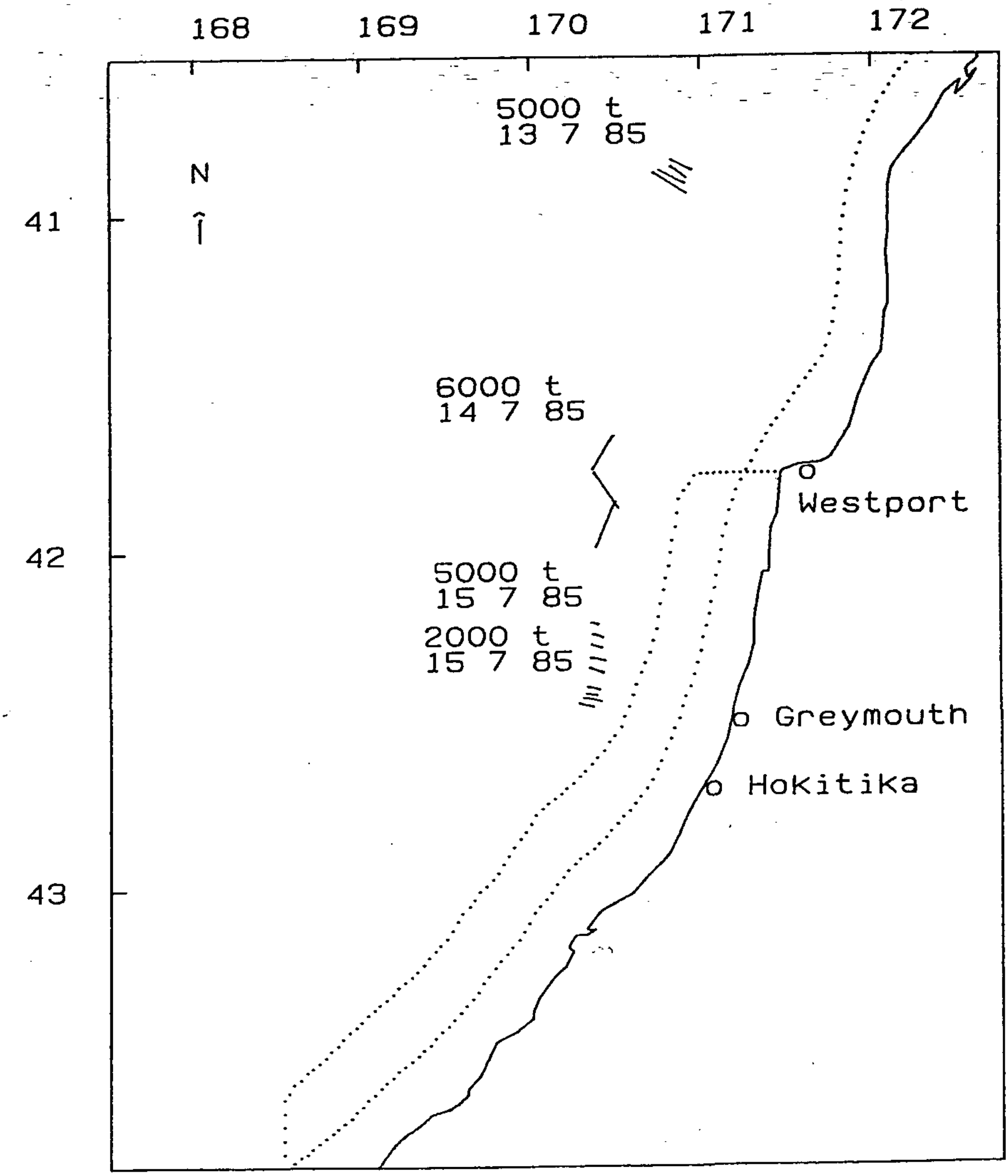

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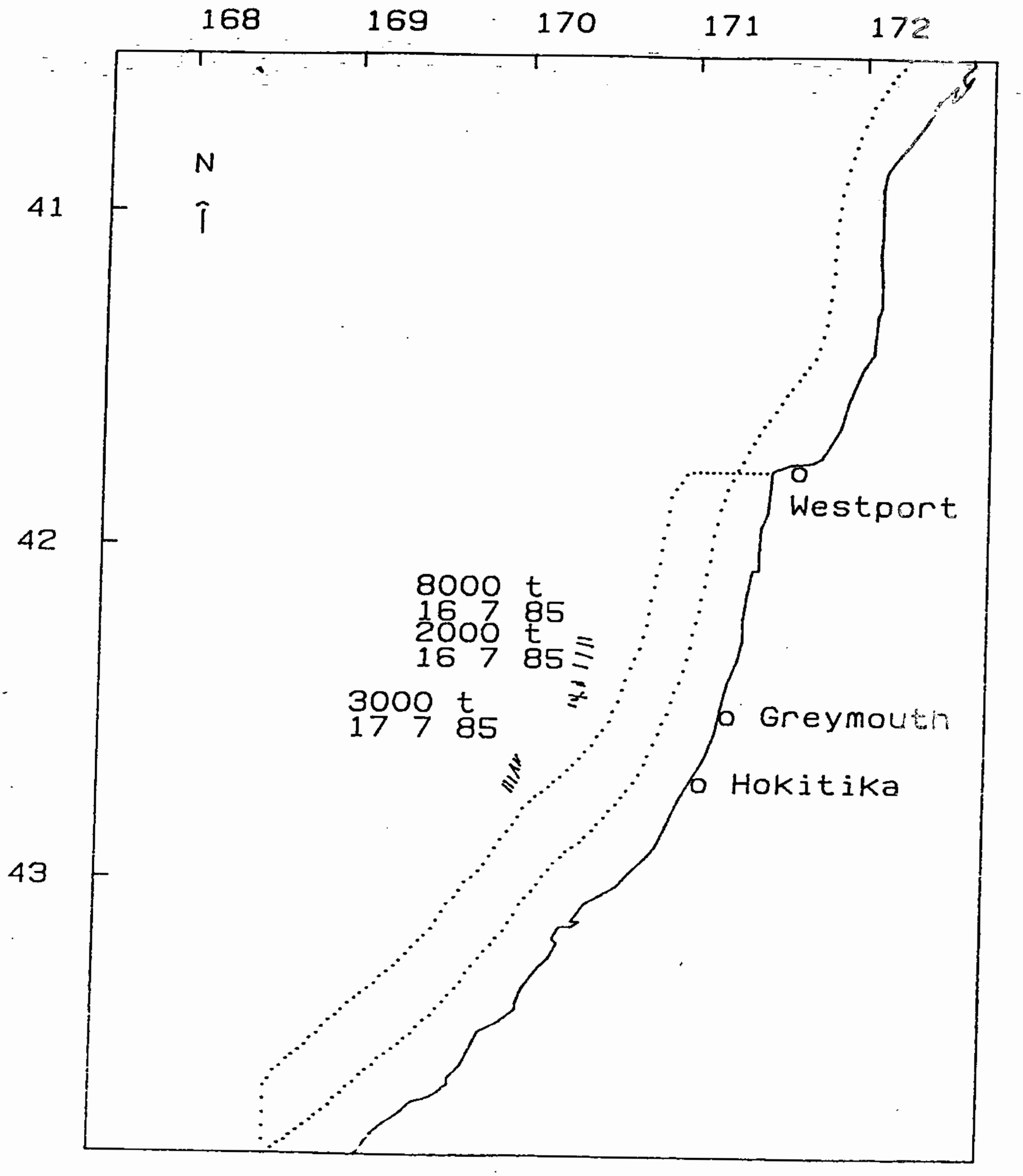

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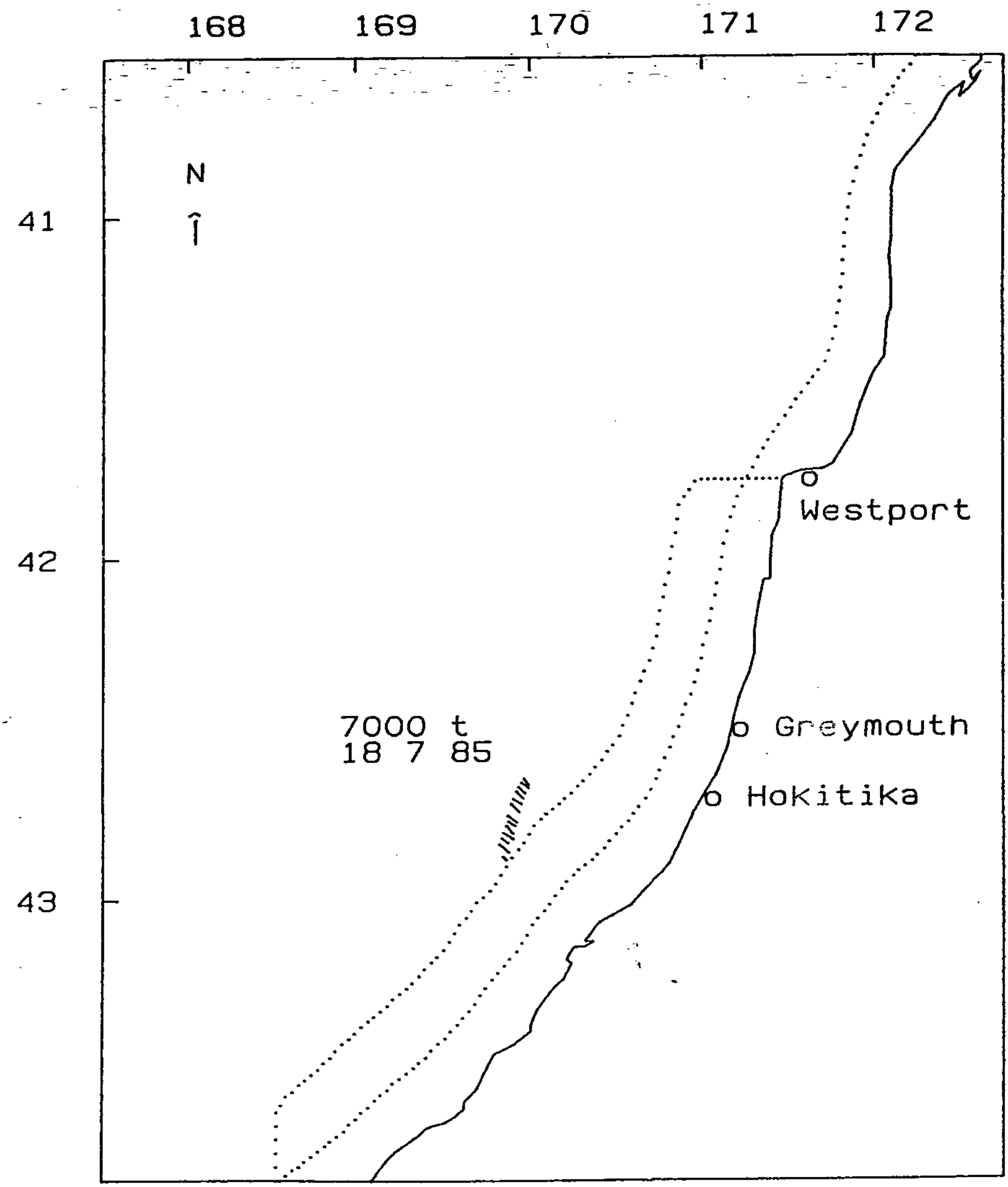

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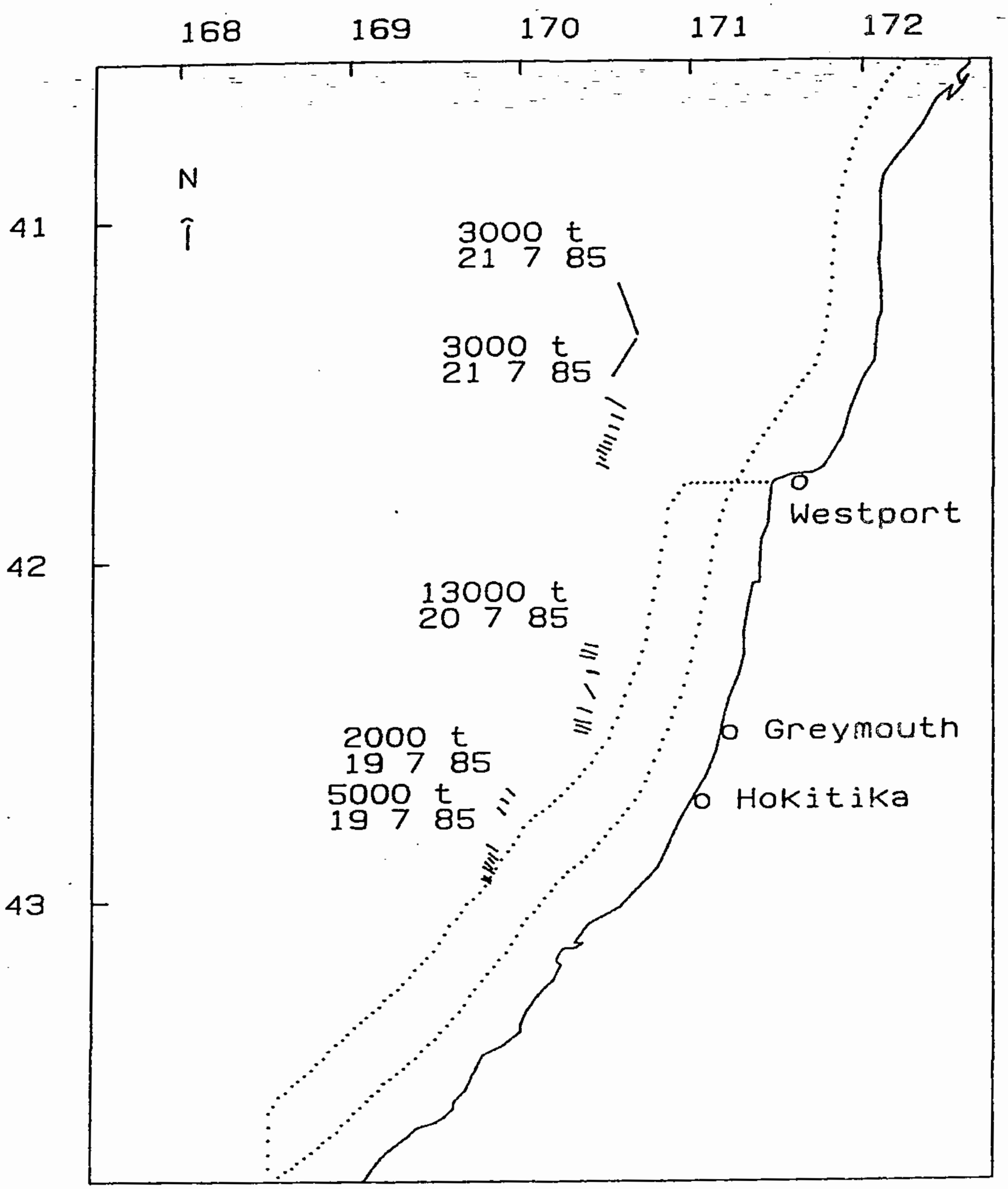

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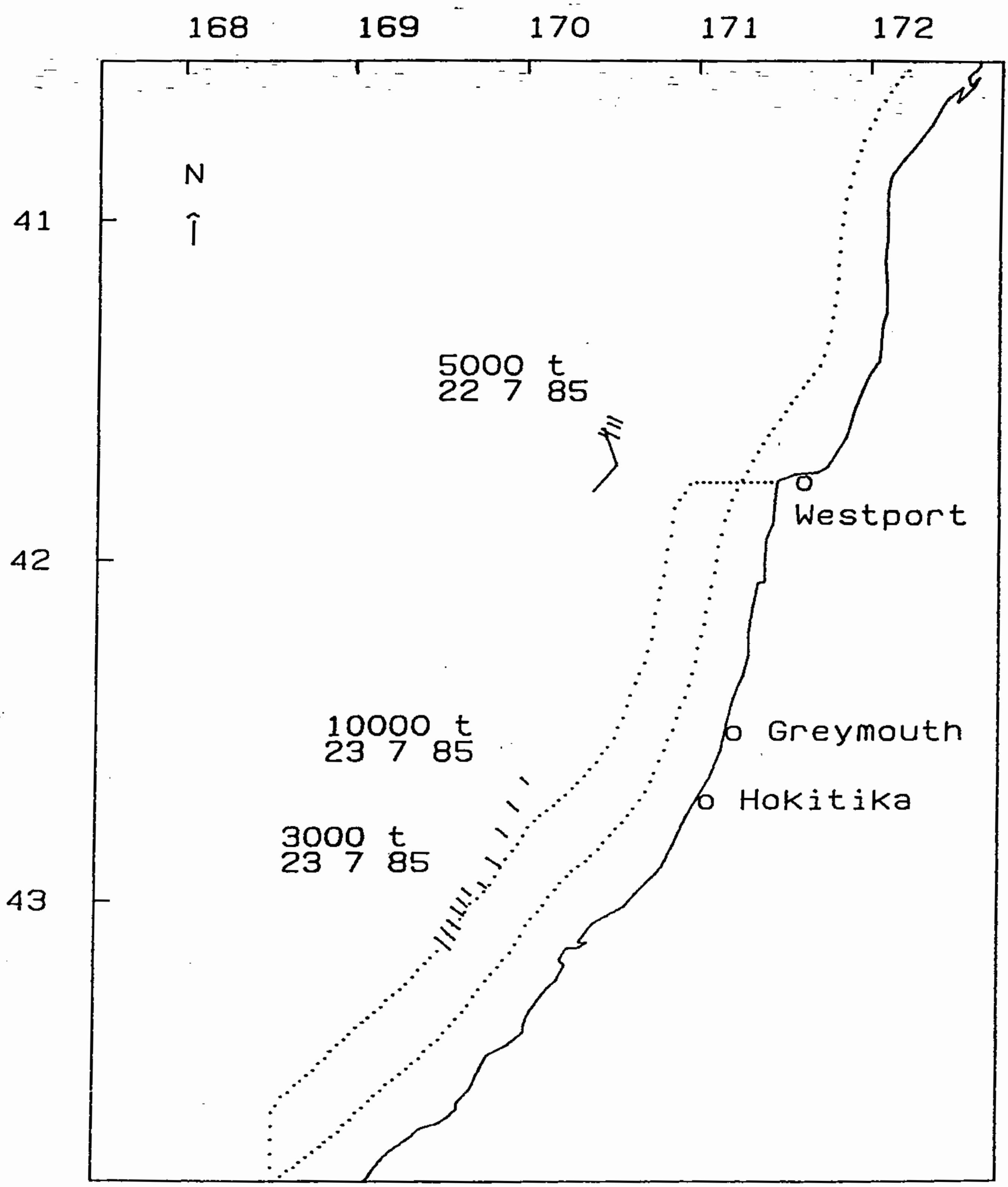

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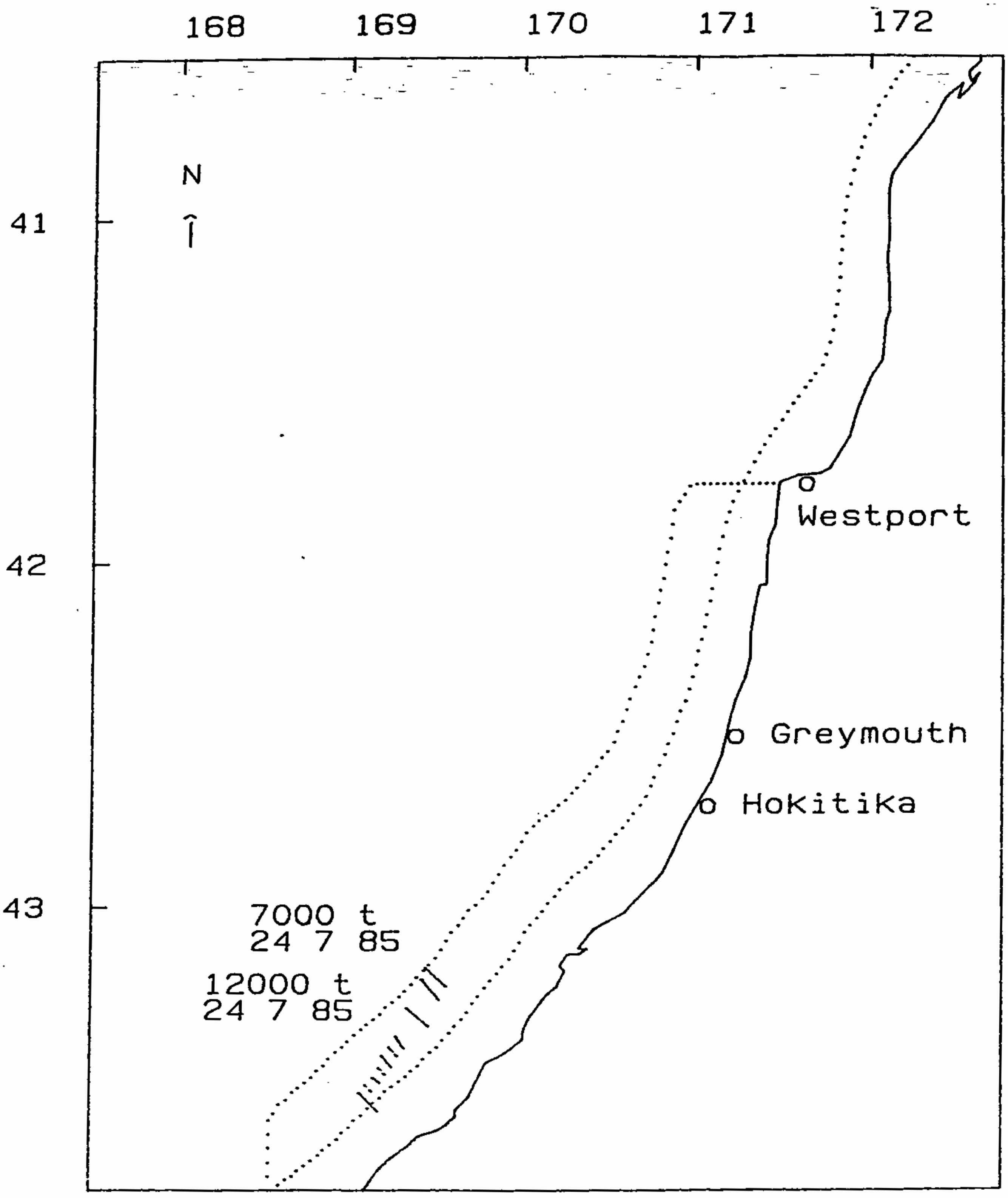

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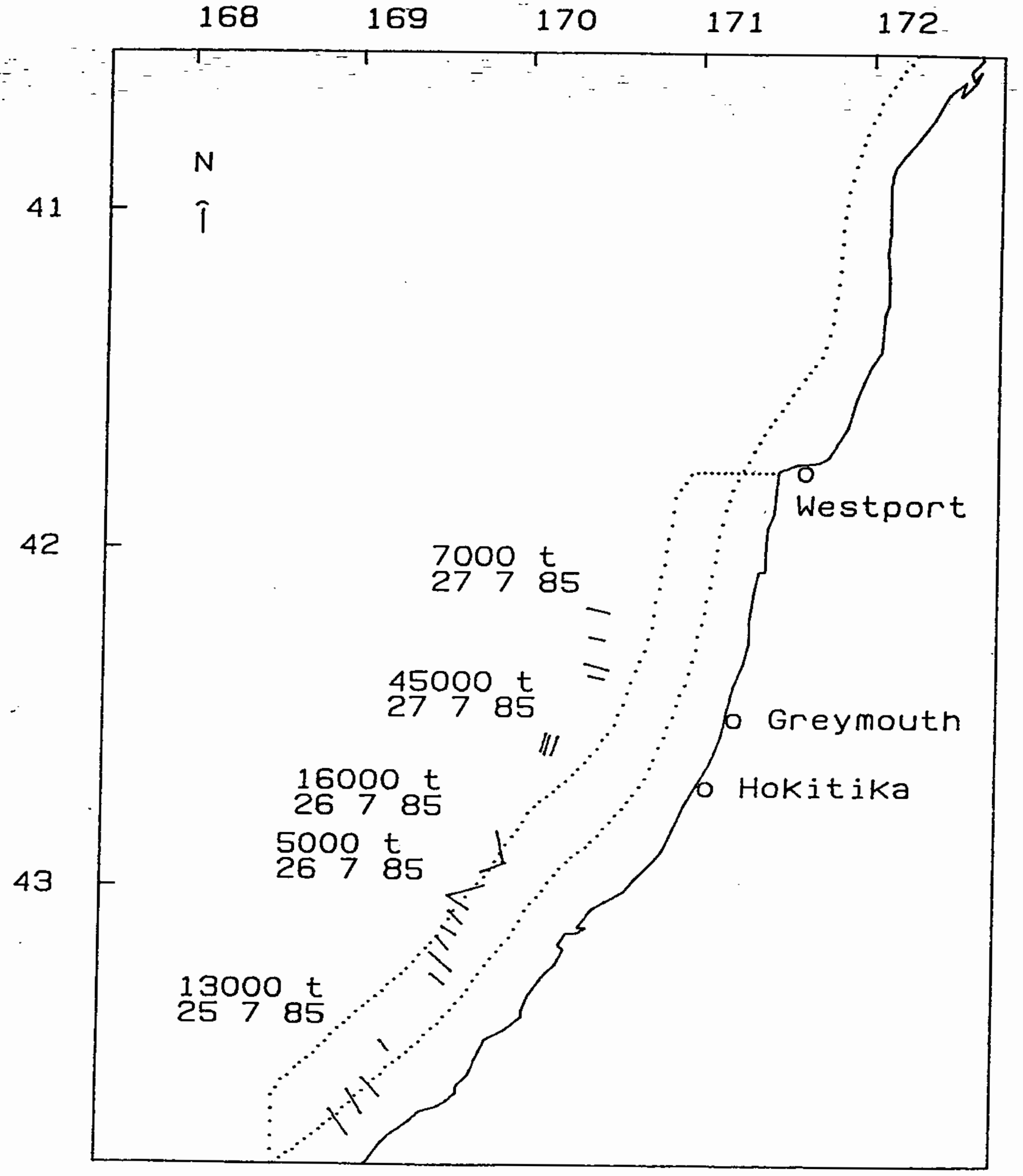

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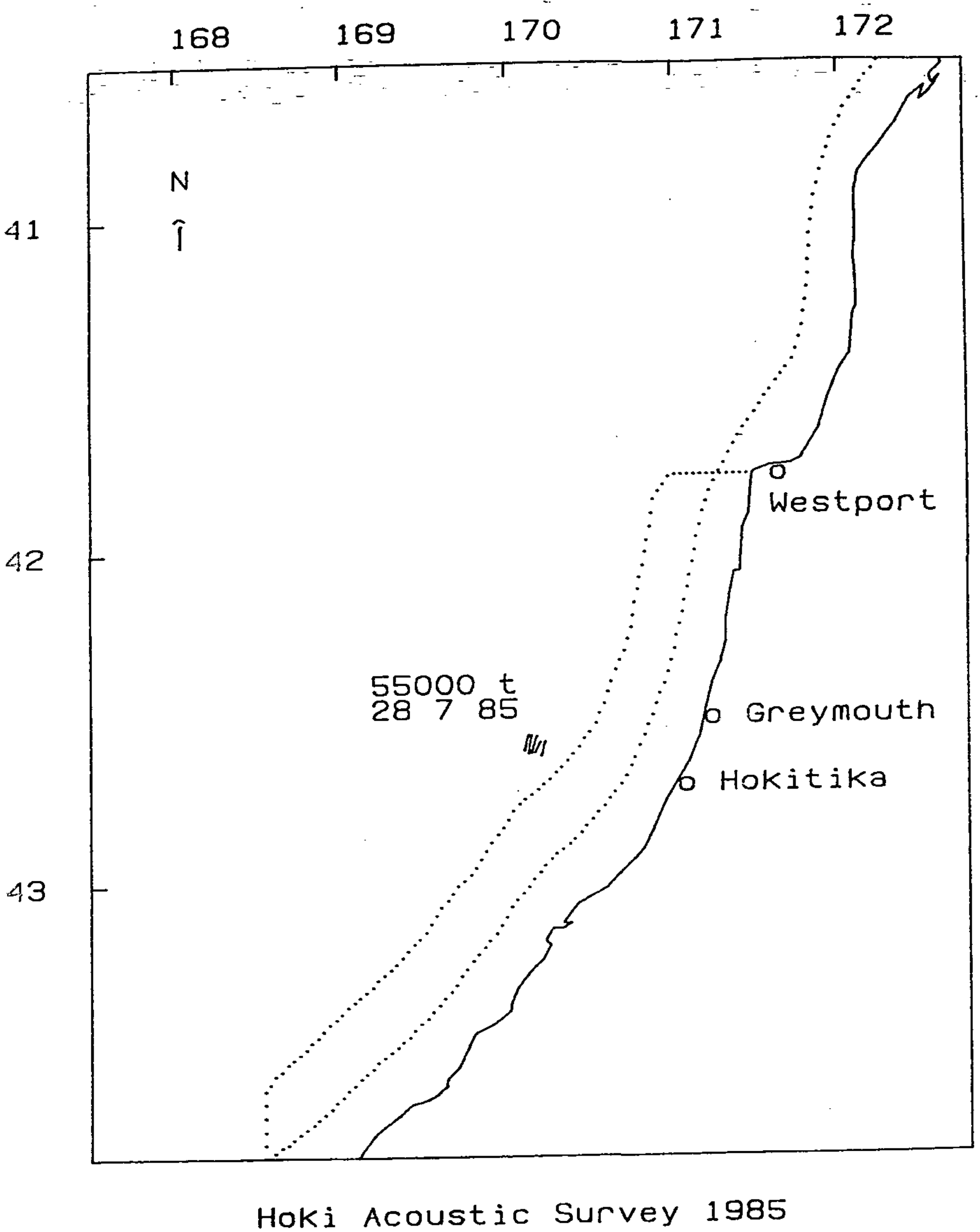
168
169
170
171
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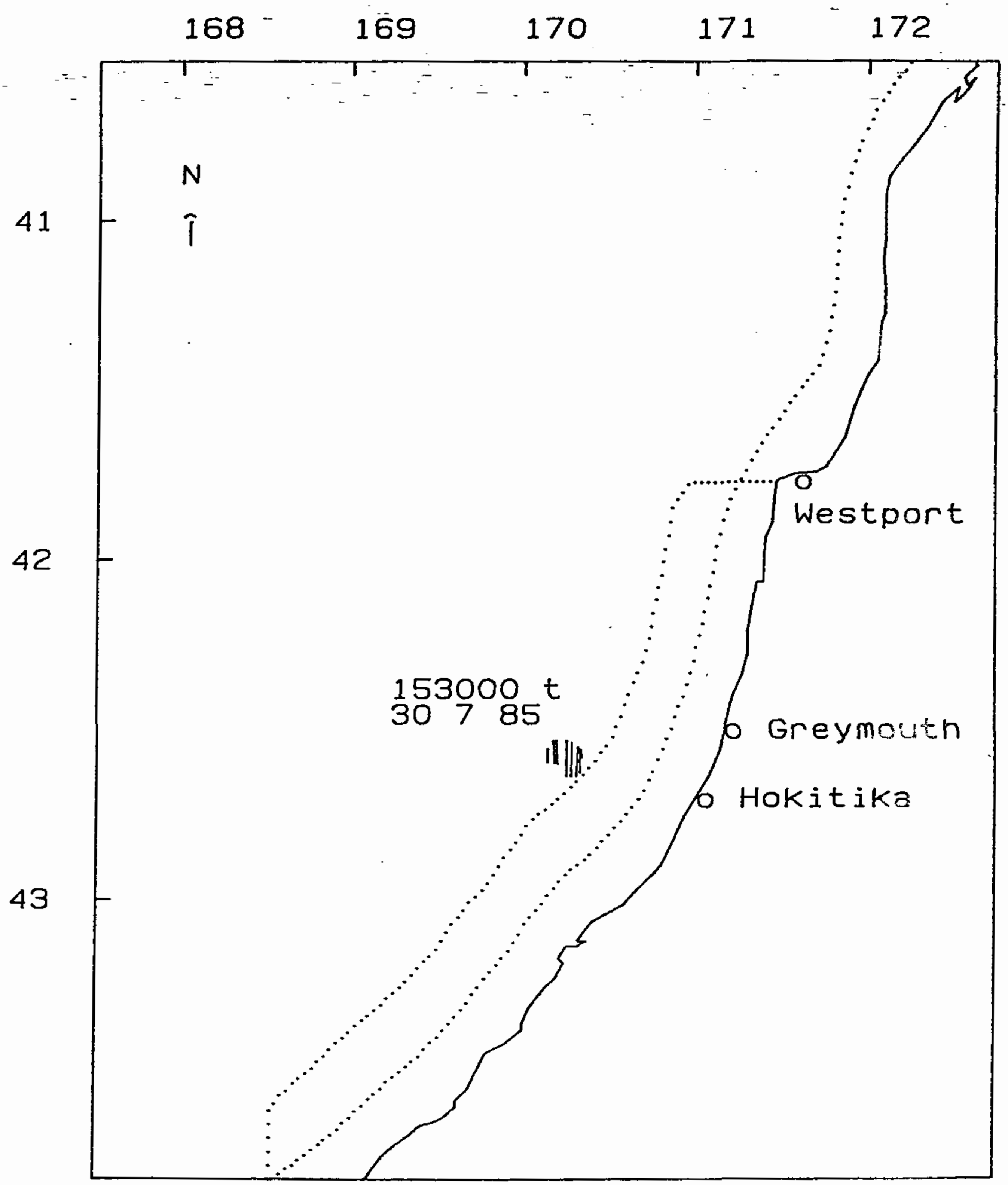
43
N
55000 t
28 7 85
Westport
Greymouth
Hokitika
Hoki Acoustic Survey 1985



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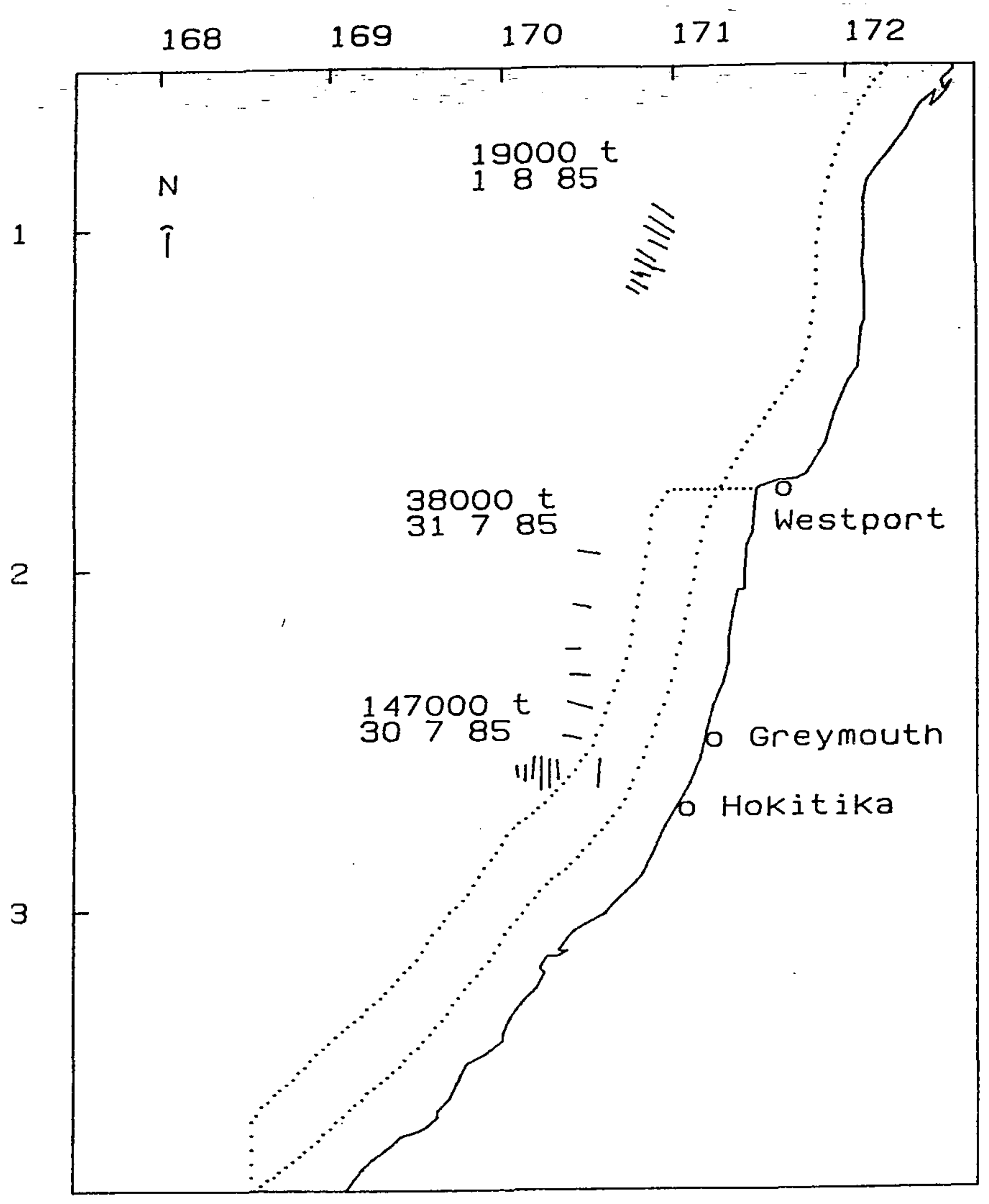

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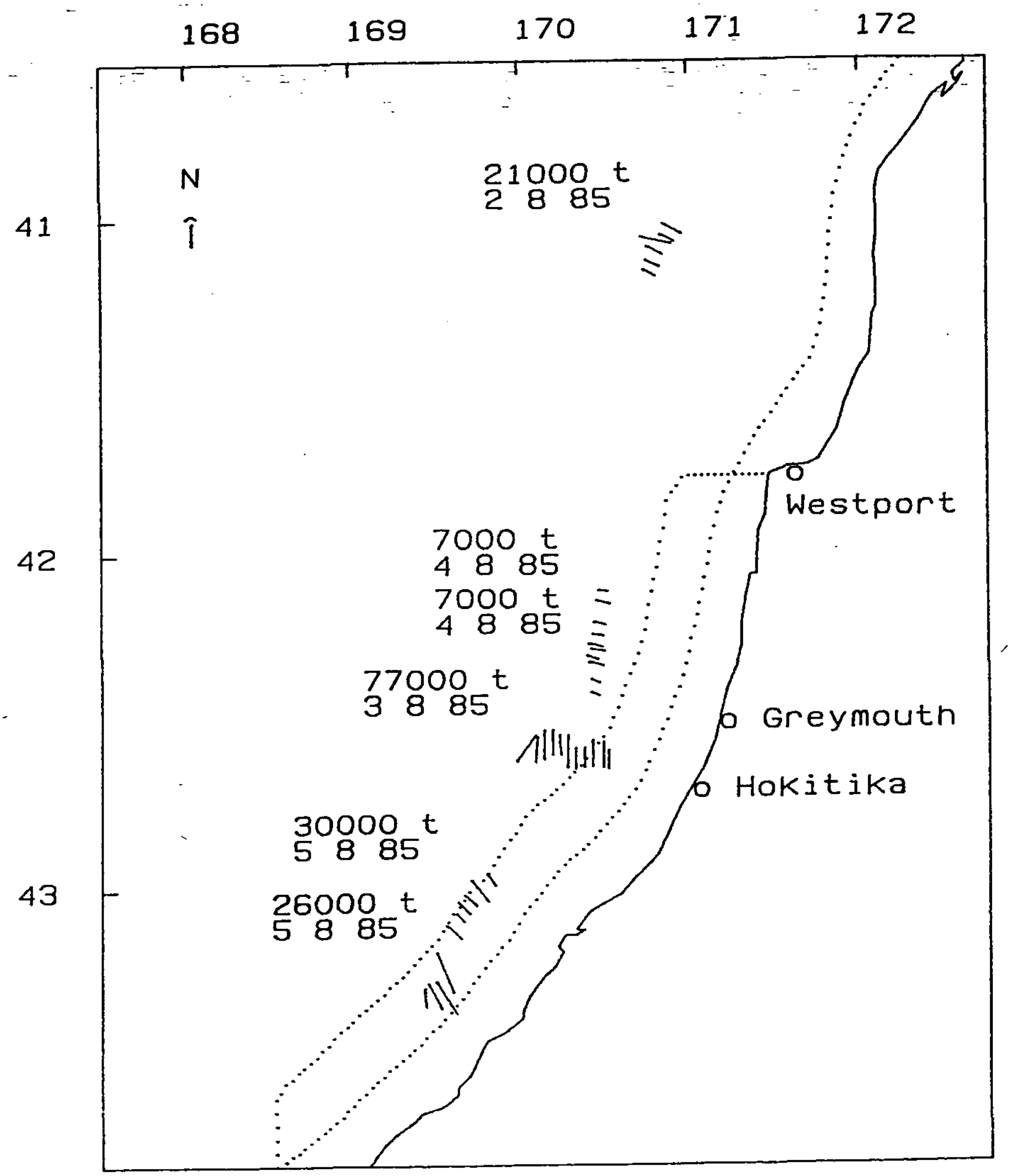

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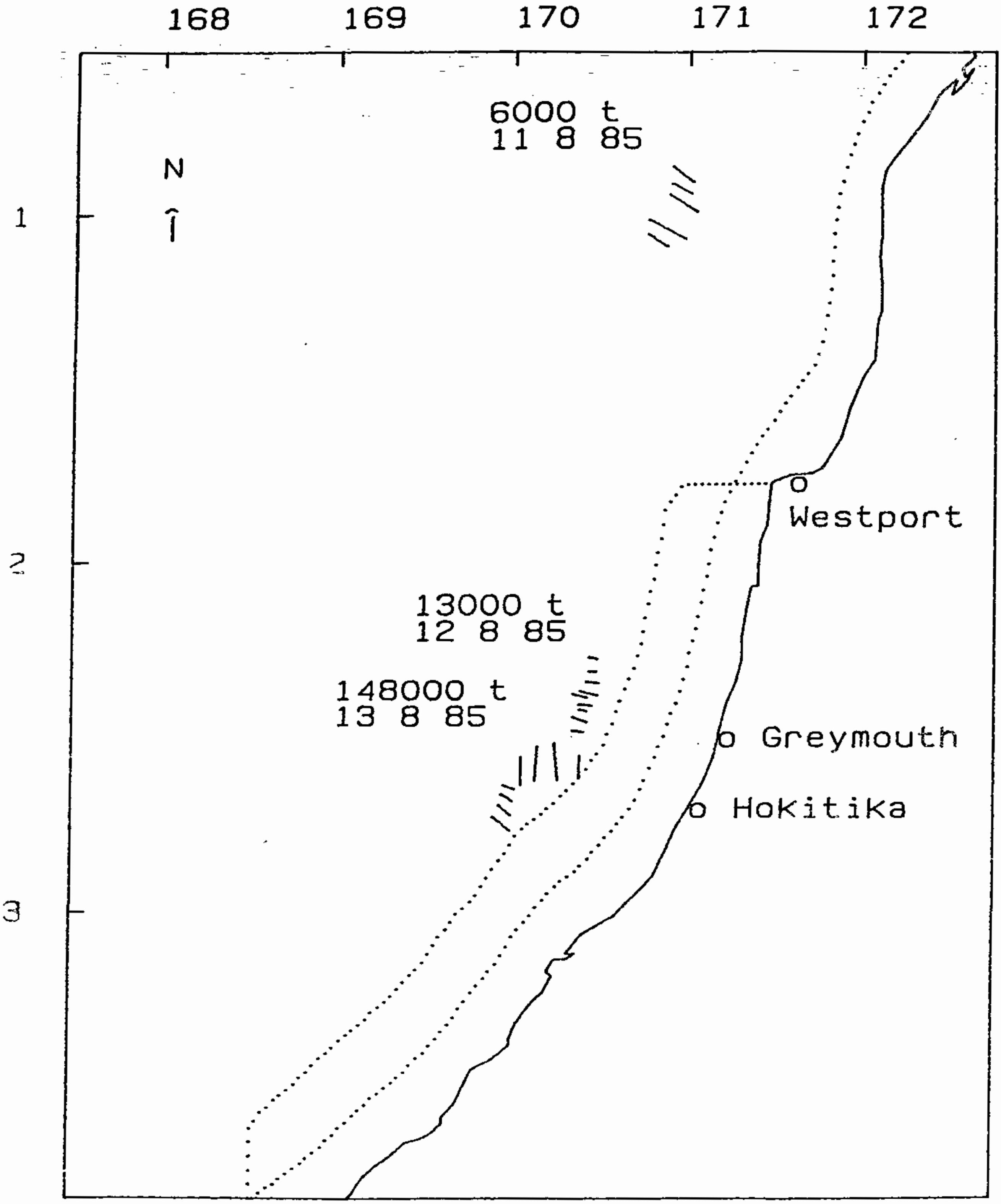

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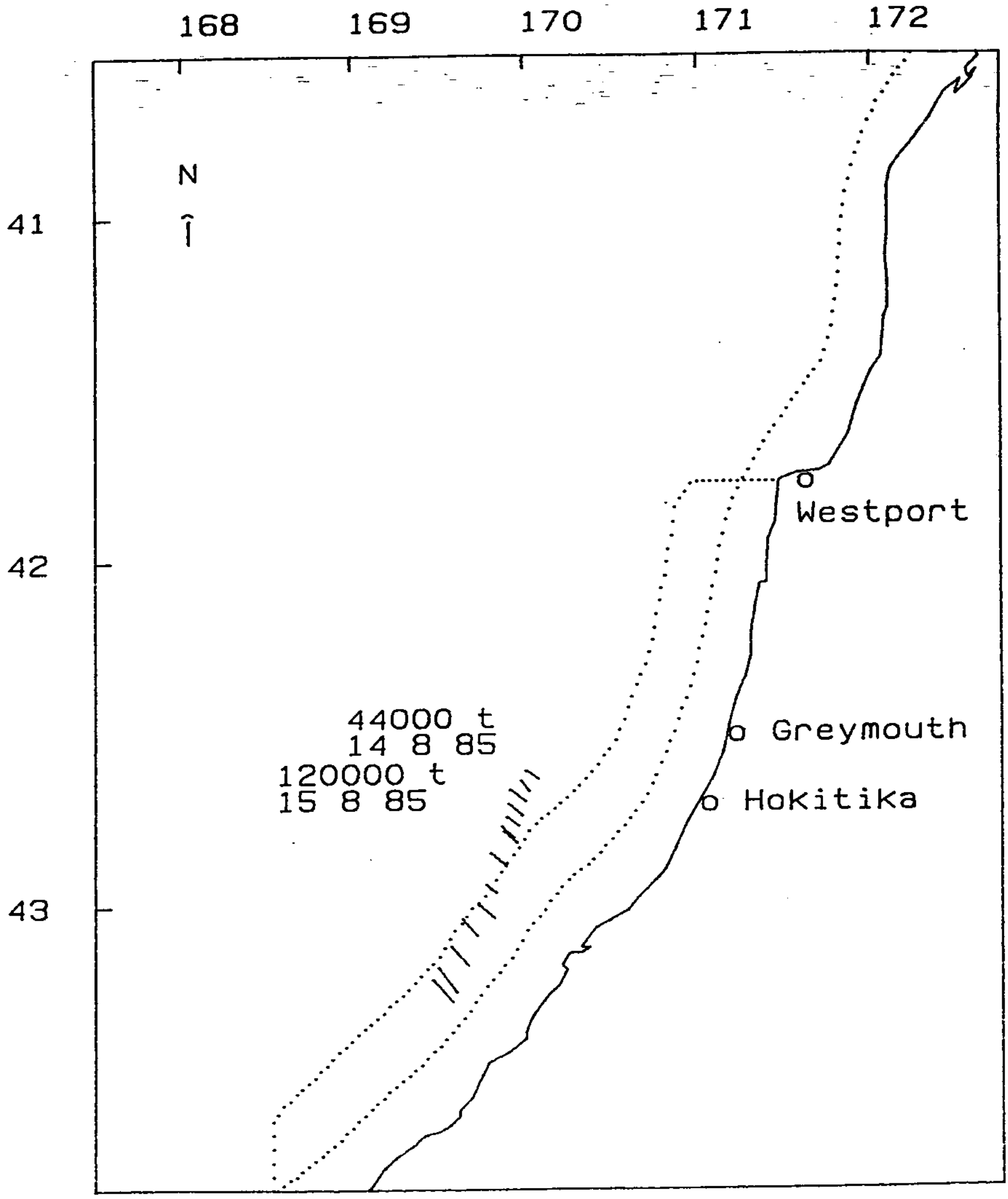

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