

e1 3015281 B

ENVIRONMENT CANADA
CONSERVATION AND PROTECTION
ENVIRONMENTAL PROTECTION
PACIFIC AND YUKON REGION

SEDIMENT METAL CHEMISTRY SURVEY OF
OCEAN DUMPSITES IN
BRITISH COLUMBIA
JULY - NOVEMBER 1989
REGIONAL DATA REPORT DR-92-02

BY

D.E. Brothers

JANUARY 1992

LIBRARY
ENVIRONMENT CANADA
CONSERVATION AND PROTECTION
PACIFIC REGION

TABLE OF CONTENTS

	<u>Page</u>
TABLE OF CONTENTS	i
List of Figures	ii
List of Tables	iii
1.0 INTRODUCTION	1
2.0 MATERIALS AND METHODS	2
APPENDIX I ACCURACY DATA	36
APPENDIX II RAW DATA	38

LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1.	Point Grey Ocean Dumpsite - Benthic Sediment Sampling Stations	3
2.	Sand Heads Ocean Dumpsite - Benthic Sediment Sampling Stations	5
3.	Victoria Ocean Dumpsite - Benthic Sediment Sampling Stations	7
4.	Porlier Pass Ocean Dumpsite - Benthic Sediment Sampling Stations	9
5.	Southern Georgia Strait Proposed Ocean Dumpsite - Benthic Sediment Sampling Stations	11
6.	Five Finger Island Ocean Dumpsite - Benthic Sediment Sampling Stations	13
7.	Watts Point Ocean Dumpsite - Benthic Sediment Sampling Stations	15
8.	Thornbrough Channel Ocean Dumpsite - Benthic Sediment Sampling Stations	17
9.	Comox Ocean Dumpsite - Benthic Sediment Sampling Stations	19
10.	Cape Mudge Ocean Dumpsite - Benthic Sediment Sampling Stations	21
11.	Malaspina Strait Ocean Dumpsite - Benthic Sediment Sampling Stations	23
12.	Malcolm Island Ocean Dumpsite - Benthic Sediment Sampling Stations	26
13.	Queen Charlotte Strait Ocean Dumpsite - Benthic Sediment Sampling Stations	28
14.	Port Alice Ocean Dumpsite - Benthic Sediment Sampling Stations	30
15.	Alberni Inlet Ocean Dumpsite - Benthic Sediment Sampling Stations	32
16.	Alberni Inlet - Benthic Sediment Sampling Stations	33

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1.	Point Grey Ocean Dumpsite - Stations 33-41	4
2.	Sand Heads Ocean Dumpsite - Stations 1-3	6
3.	Victoria Ocean Dumpsite - Stations 1-9	8
4.	Porlier Pass Ocean Dumpsite - Stations 1-9	10
5.	Southern Georgia Strait Proposed Ocean Dumpsite - Stations 1-9	12
6.	Five Finger Island Ocean Dumpsite - Stations 1-9	14
7.	Watts Point Ocean Dumpsite - Stations 1-9	16
8.	Thornbrough Channel Ocean Dumpsite - Stations 1-9	18
9.	Comox Ocean Dumpsite - Stations 4-6	20
10.	Cape Mudge Ocean Dumpsite - Stations 4-6	22
11.	Malaspina Strait Ocean Dumpsite - Stations 1-9	24
12.	Malcolm Island Ocean Dumpsite - Stations 4-6	27
13.	Queen Charlotte Strait Ocean Dumpsite - Stations 4-6	29
14.	Port Alice Ocean Dumpsite - Stations 1-4	31
15.	Alberni Inlet Ocean Dumpsite - Stations 18-28	34

1.0 INTRODUCTION

During July, September, October and November 1989, benthic sediment studies were conducted at designated and proposed ocean dumpsites on the southern British Columbia Coast, using the survey vessel C.S.S. Vector. The project was undertaken as part of a routine monitoring and assessment program of ocean dumpsite locations by Environment Canada, Conservation and Protection. At each location, samples for trace metal concentration and particle size distribution were collected over a monitoring grid established to facilitate successive surveys (Figure 1-16). Data from analysis of the samples collected during these studies is presented herein.

2.0 MATERIALS & METHODS

Grab samples were collected using a Smith McIntyre grab sampler. One grab was taken at each station at the dumpsite locations identified in Tables 1-8. Three grabs were taken at each station at the dumpsite locations identified in Tables 9-15. Upon retrieval, water was siphoned from the sediment surface as necessary, and a sample sediment from 0-5 cm was removed for analysis.

All analysis were conducted by the Conservation and Protection Laboratories in West Vancouver, B.C. The raw data is presented in Appendix II and represents a single analysis for each sample after drying and homogenizing. Copper (Cu), lead (Pb), and zinc (Zn) were analyzed using Inductively Coupled Argon Plasma Atomic Emission (ICAP-AE), cadmium (Cd) using Graphite Furnace Atomic Absorption (GFAA), and mercury (Hg) using flameless Atomic Absorption (AA).

Cd, Hg, Pb, Cu and Zn concentrations are presented in the tables, with the mean and standard deviation.

The accuracy data for each lab submission are given in Appendix I. The raw data printouts, with complete ICAP semi-quantitative scan and particle size data (Appendix II), are on microfiche and can be located by matching the sample and lab submission numbers given on the data tables. Precision data for the lab submissions are provided on the data tables, and represent analyses of separate aliquots of dried, homogenized sediments from the sample bag.

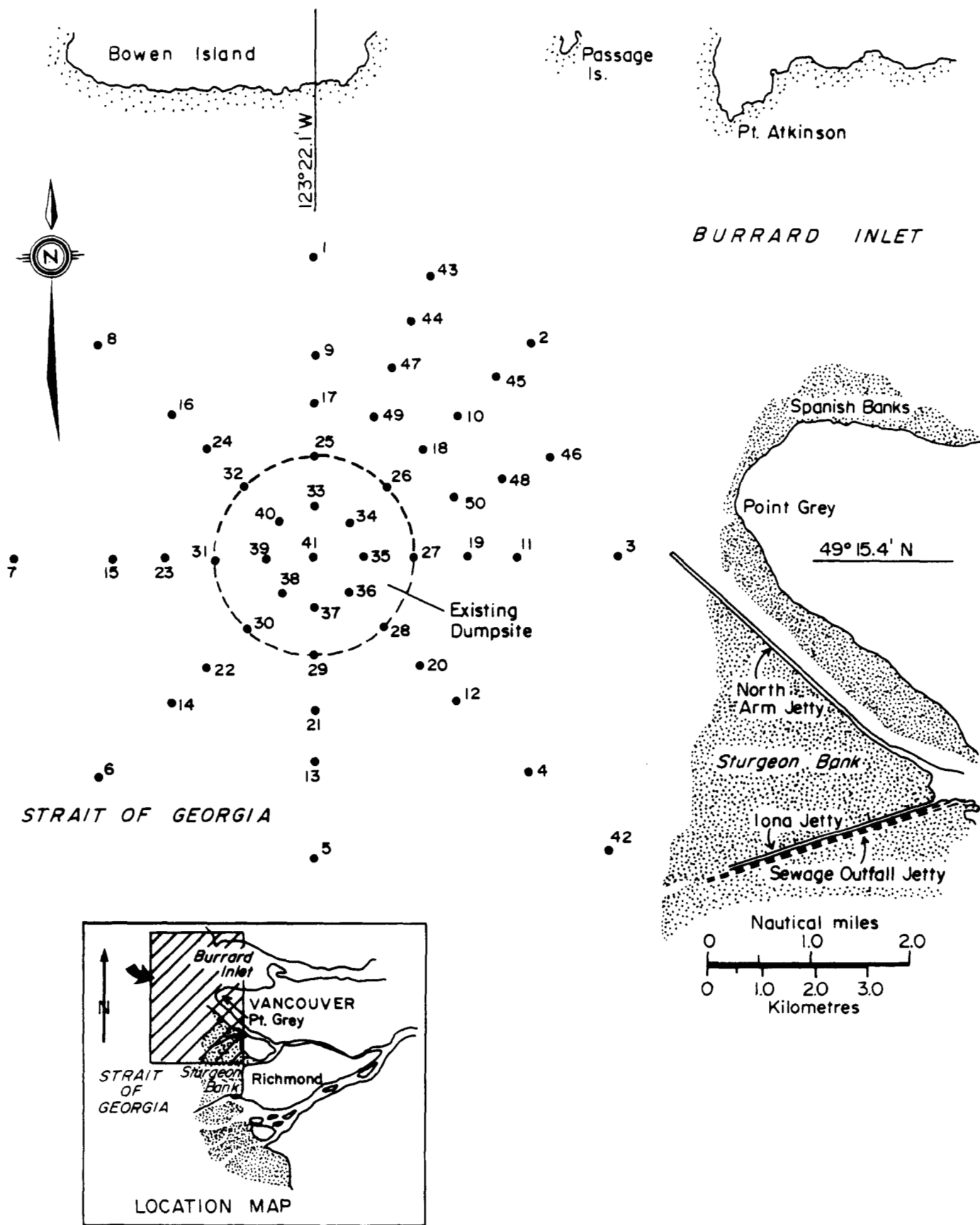


FIGURE 1 POINT GREY OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

POINT GREY DUMPSITE - STATIONS 33-41.

METALS: LAB#900262: 33-41

DATE SAMPLED: OCTOBER 31, 1989

PARTICLE SIZE: LAB# 900262

STN	DEPTH (m)	SAMPLE	SEDIMENT DEPTH (cm)	UG/G DRY WEIGHT				
				HG	CD	PB	CU	ZN
33	247	31	0-5	.050	.07	10	26.8	89.0
34	245	32	0-5	.030	.07	ND(8)	21.0	69.7
35	245	33	0-5	.031	.05	10	22.6	76.7
36	245	34	0-5	.049	.10	9	30.9	94.8
37	246	35	0-5	.059	.10	9	30.2	103.0
38	244	36	0-5	.054	.07	ND(8)	40.2	105.0
39	244	38	0-5	.070	.10	ND(8)	39.4	99.5
40	245	39	0-5	.053	.27	ND(8)	33.9	95.8
41	245	37	0-5	.044	.09	21	29.4	90.2
MEAN				.049	.10	12	30.5	91.5
STD DEV				.013	.07	5	6.6	11.8

PRECISION DATA

SAMPLE	HG	CD	PB	CU	ZN
30	.021	.09	ND(8)	19.0	60.2
77	.020	.09	ND(8)	18.1	55.4
78	.010	.06	ND(8)	17.0	50.8
79	.020	.10	ND(8)	16.8	49.7
80	.020	.10	ND(8)	18.7	49.2
MEAN	.018	.09		17.9	53.1
STD DEV	.005	.02		1.0	4.7

NOTE: numbers in brackets are limits of detection.
 ND - not detected
 Particle size data in appendix II.

cf:SCPPGD89

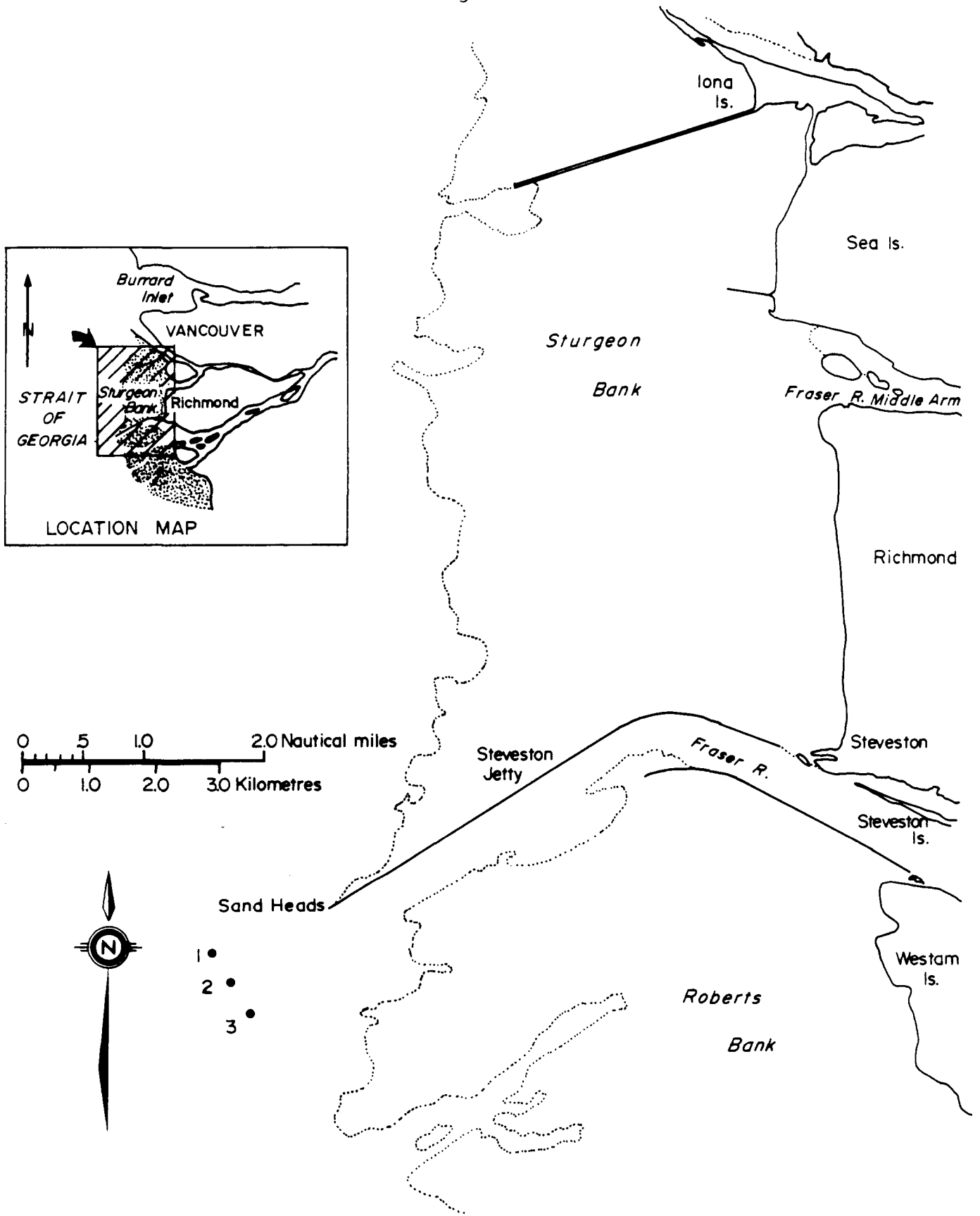


FIGURE 2 SAND HEADS OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

SANDHEADS DUMPSITE - STATIONS 1-3.

METALS: LAB #900262: 28-30

DATE SAMPLED: OCTOBER 31, 1989

PARTICLE SIZE: LAB# 900262

STN	DEPTH (m)	SAMPLE	SEDIMENT DEPTH (cm)	HG	UG/G DRY WEIGHT			
					CD	PB	CU	ZN
4	114	29	0-5	.050	.23	ND(8)	32.8	94.8
5	70	30	0-5	.021	.09	ND(8)	19.0	60.2
6	73	28	0-5	.039	.20	ND(8)	28.6	82.0
MEAN				.037	.17		26.8	79.0
STD DEV				.015	.07		7.1	17.5

PRECISION DATA

SAMPLE	HG	CD	PB	CU	ZN
30	.021	.09	ND(8)	19.0	60.2
77	.020	.09	ND(8)	18.1	55.4
78	.010	.06	ND(8)	17.0	50.8
79	.020	.10	ND(8)	16.8	49.7
80	.020	.10	ND(8)	18.7	49.2
MEAN	.018	.09		17.9	53.1
STD DEV	.005	.02		1.0	4.7

NOTE: numbers in brackets are limits of detection.
 ND - not detected
 Particle size data in appendix II.

cf:SCPSHD89

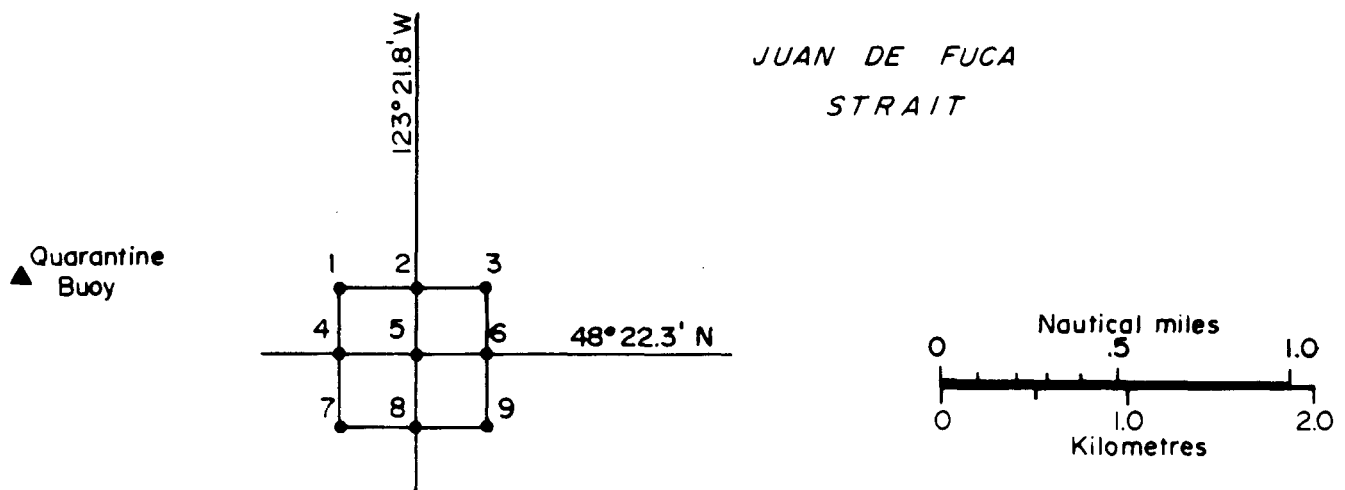
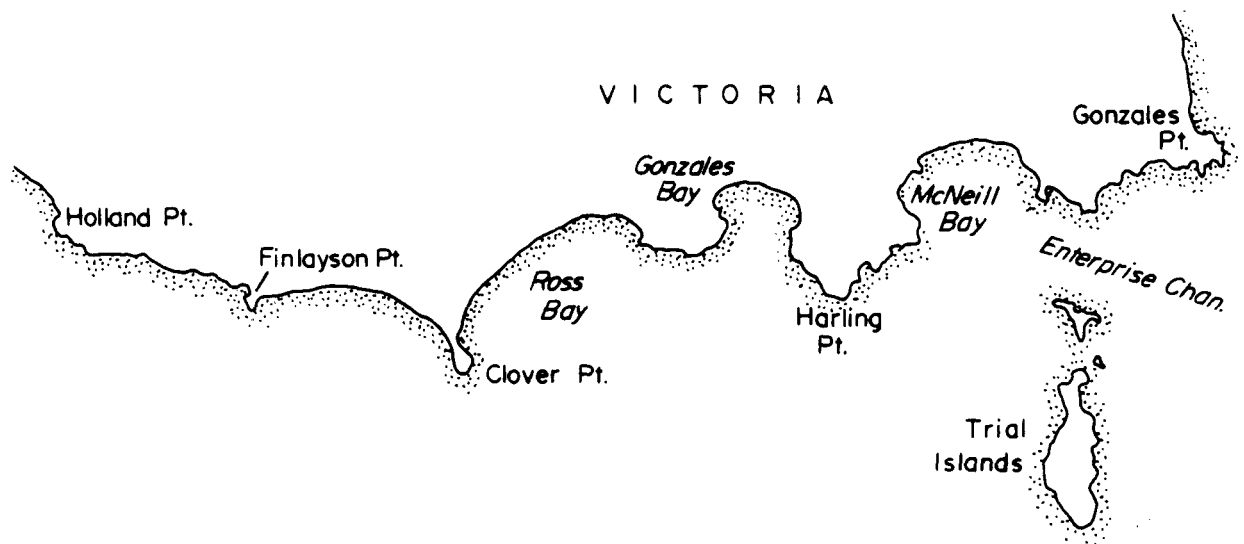


FIGURE 3 VICTORIA OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

VICTORIA DUMPSITE - STATIONS 1-9.

DATE SAMPLED: OCTOBER 30, 1989

METALS: LAB #900262: 1-9

PARTICLE SIZE: LAB# #900262

STN	DEPTH (m)	SAMPLE	SEDIMENT DEPTH (cm)	HG	UG/G DRY WEIGHT				ZN
					CD	PB	CU		
1	97	1	0-5	.028	ND(.02)	10	19.2	68.1	
2	105	2	0-5	.033	ND(.02)	ND(8)	29.0	63.4	
3	117	3	0-5	.009	ND(.02)	ND(8)	9.4	44.0	
4	97	6	0-5	.225	.06	32	18.9	88.1	
5	100	5	0-5	.020	ND(.02)	ND(8)	16.5	56.3	
6	108	4	0-5	.045	ND(.02)	ND(8)	9.6	45.0	
7	101	7	0-5	.018	.03	ND(8)	12.0	48.9	
8	104	8	0-5	.010	ND(.02)	ND(8)	8.1	41.4	
9	104	9	0-5	.010	ND(.02)	ND(8)	10.0	46.1	
MEAN				.044	.05	21	14.7	55.7	
STD DEV				.069	.02	16	6.8	15.2	

PRECISION DATA

SAMPLE	HG	CD	PB	CU	ZN
10	.085	.03	ND(8)	41.2	140.0
69	.070	ND(.02)	ND(8)	40.0	127.0
70	.077	ND(.02)	ND(8)	40.3	128.0
71	.058	ND(.02)	ND(8)	40.4	129.0
72	.066	ND(.02)	ND(8)	42.5	154.0
MEAN	.071	.03		40.9	135.6
STD DEV	.010			1.0	11.5

NOTE: numbers in brackets are limits of detection.
 ND - not detected.
 Particle size data in appendix II.

cf:SCPVD89

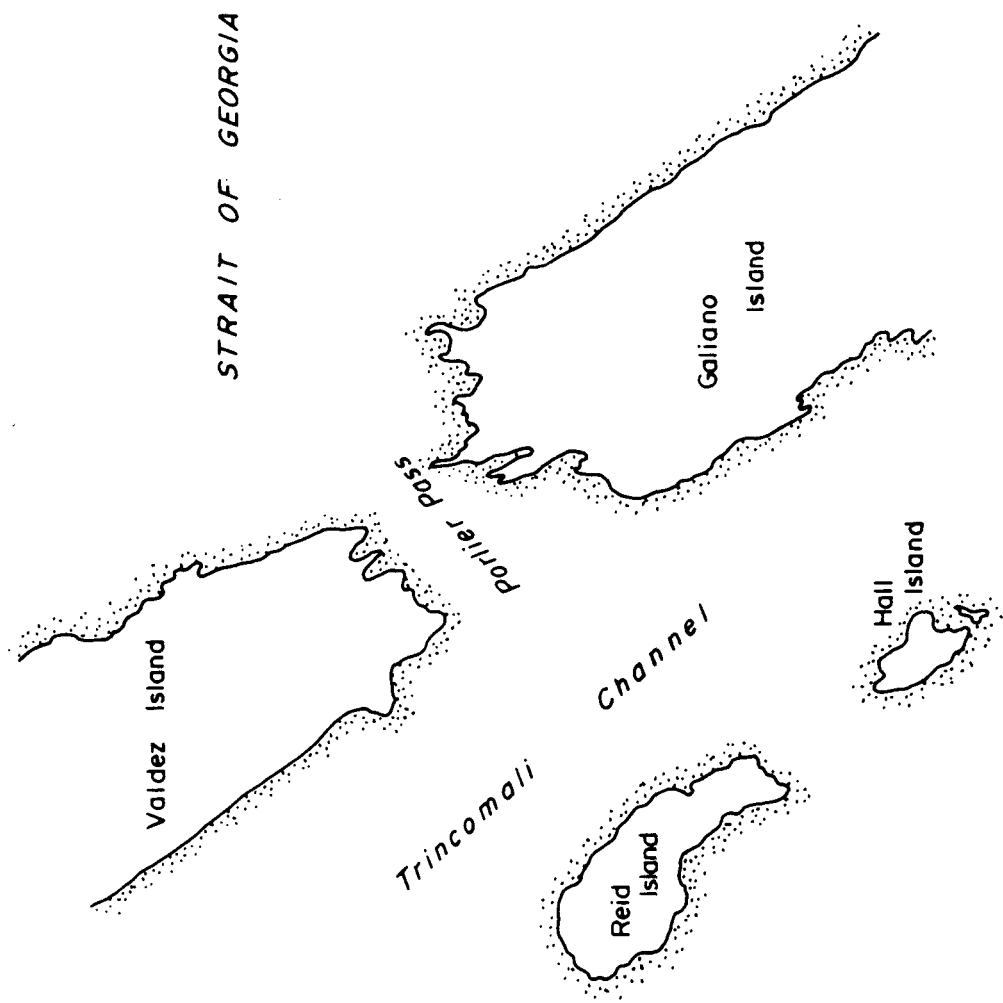
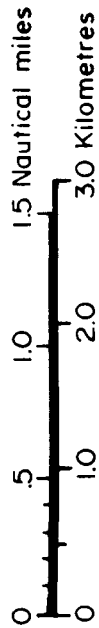
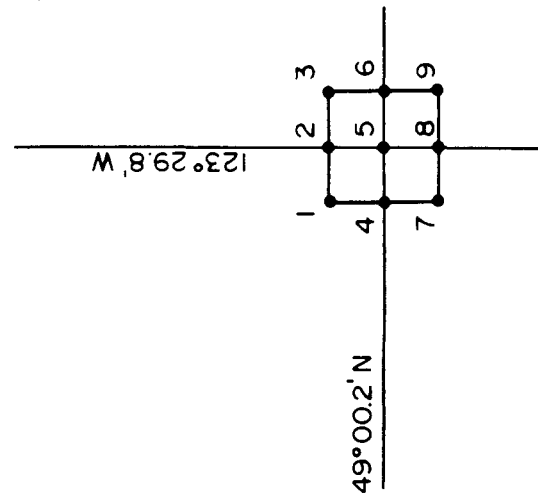
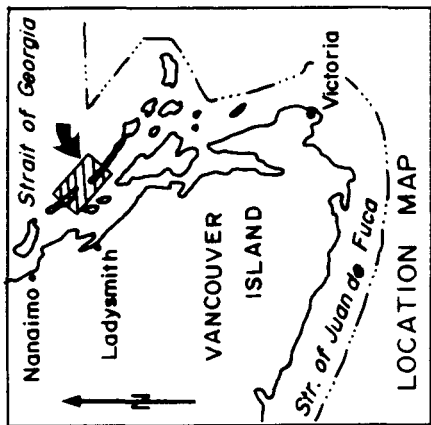


FIGURE 4 PORLIER PASS OCEAN DUMPSITE -- BENTHIC SEDIMENT SAMPLING STATIONS

PORLIER PASS DUMPSITE - STATIONS 1-9.

DATE SAMPLED: OCTOBER 31, 1989

METALS: LAB# 900262: 10-18
PARTICLE SIZE: LAB# 900262

STN	DEPTH (m)	SAMPLE	SEDIMENT DEPTH (cm)	HG	UG/G DRY WEIGHT			
					CD	PB	CU	ZN
1	189	10	0-5	.085	.03	ND(8)	41.2	140.0
2	204	11	0-5	.079	ND(.02)	ND(8)	37.4	132.0
3	212	12	0-5	.080	ND(.02)	ND(8)	53.5	156.0
4	188	15	0-5	.084	.02	ND(8)	40.7	146.0
5	203	14	0-5	.083	.07	10	39.9	141.0
6	108	13	0-5	.087	.07	ND(8)	39.9	135.0
7	170	16	0-5	.084	.03	ND(8)	40.9	149.0
8	170	17	0-5	.090	ND(.02)	ND(8)	40.6	150.0
9	194	18	0-5	.088	ND(.02)	ND(8)	40.2	152.0
MEAN				.084	.04	10	41.6	144.6
STD DEV				.004	.02		4.6	8.1

PRECISION DATA

SAMPLE	HG	CD	PB	CU	ZN
10	.085	.03	ND(8)	41.2	140.0
69	.070	ND(.02)	ND(8)	40.0	127.0
70	.077	ND(.02)	ND(8)	40.3	128.0
71	.058	ND(.02)	ND(8)	40.4	129.0
72	.066	ND(.02)	ND(8)	42.5	154.0
MEAN	.071	.03		40.9	135.6
STD DEV	.010			1.0	11.5

NOTE: numbers in brackets are limits of detection.
 ND - not detected
 Particle size data in appendix II.

cf:SCPPPD89

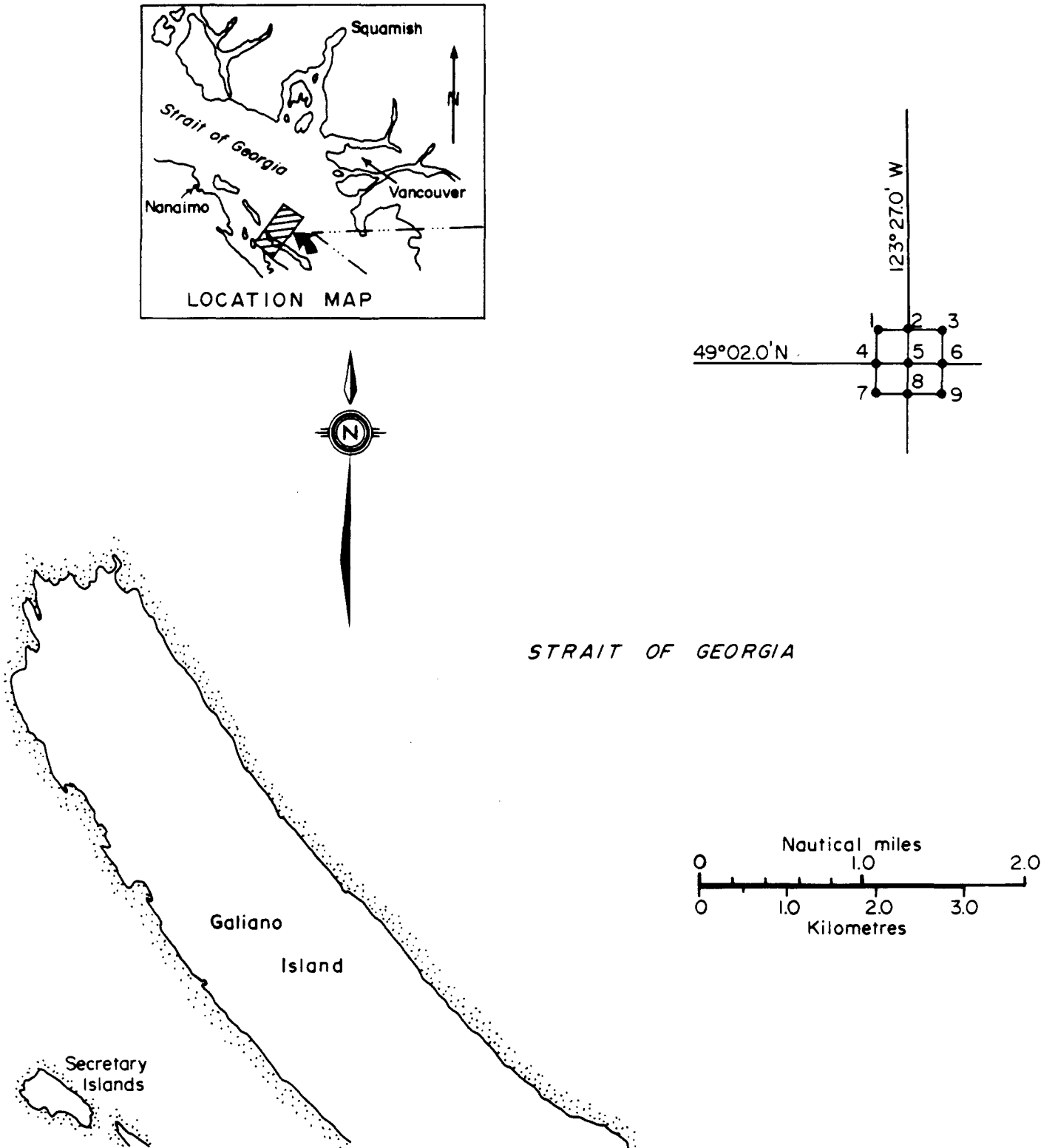


FIGURE 5 SOUTHERN GEORGIA STRAIT PROPOSED OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

TABLE 5

SOUTHERN GEORGIA STRAIT DUMPSITE - STATIONS 1-9.

METALS: LA# 900262: #19-27

DATE SAMPLED: OCTOBER 31, 1989

PARTICLE SIZE: LAB# 900262

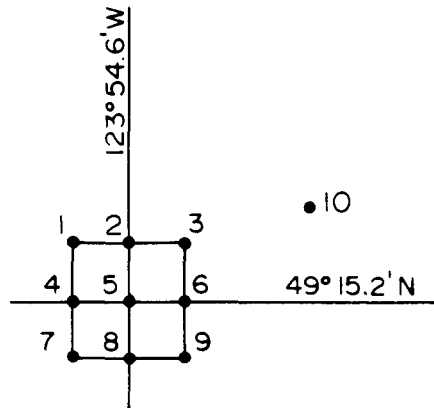
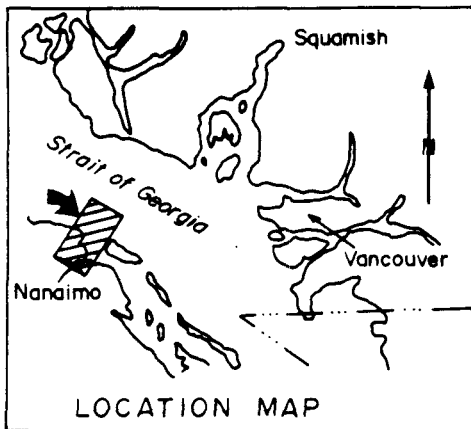
STN	DEPTH (m)	SAMPLE	SEDIMENT DEPTH (cm)	HG	UG/G DRY WEIGHT			
					CD	PB	CU	ZN
1	339	19	0-5	.072	.03	ND(8)	29.1	119.0
2	330	20	0-5	.075	.20	ND(8)	33.4	125.0
3	323	21	0-5	.083	.07	ND(8)	31.3	119.0
4	335	22	0-5	.099	.35	ND(8)	30.3	126.0
5	335	23	0-5	.075	.35	8	31.7	122.0
6	335	24	0-5	.078	.40	ND(8)	31.7	120.0
7	337	25	0-5	.080	.20	ND(8)	33.5	125.0
8	337	26	0-5	.058	1.70	ND(8)	31.5	123.0
9	335	27	0-5	.063	.61	ND(8)	30.3	112.0
MEAN				.076	.43	8	31.4	121.2
STD DEV				.012	.51		1.4	4.4

PRECISION DATA

SAMPLE	HG	CD	PB	CU	ZN
20	.075	.02	ND(8)	33.4	125.0
73	.047	.10	ND(8)	34.1	127.0
74	.074	.17	ND(8)	32.1	119.0
75	.072	.20	ND(8)	32.1	114.0
76	.075	.17	ND(8)	32.4	117.0
MEAN	.069	.13		32.8	120.4
STD DEV	.012	.07		.9	5.5

NOTE: numbers in brackets are limits of detection.
 ND - not detected.
 Particle size data in appendix II.

cf:SCPSGSD89



STRAIT OF GEORGIA

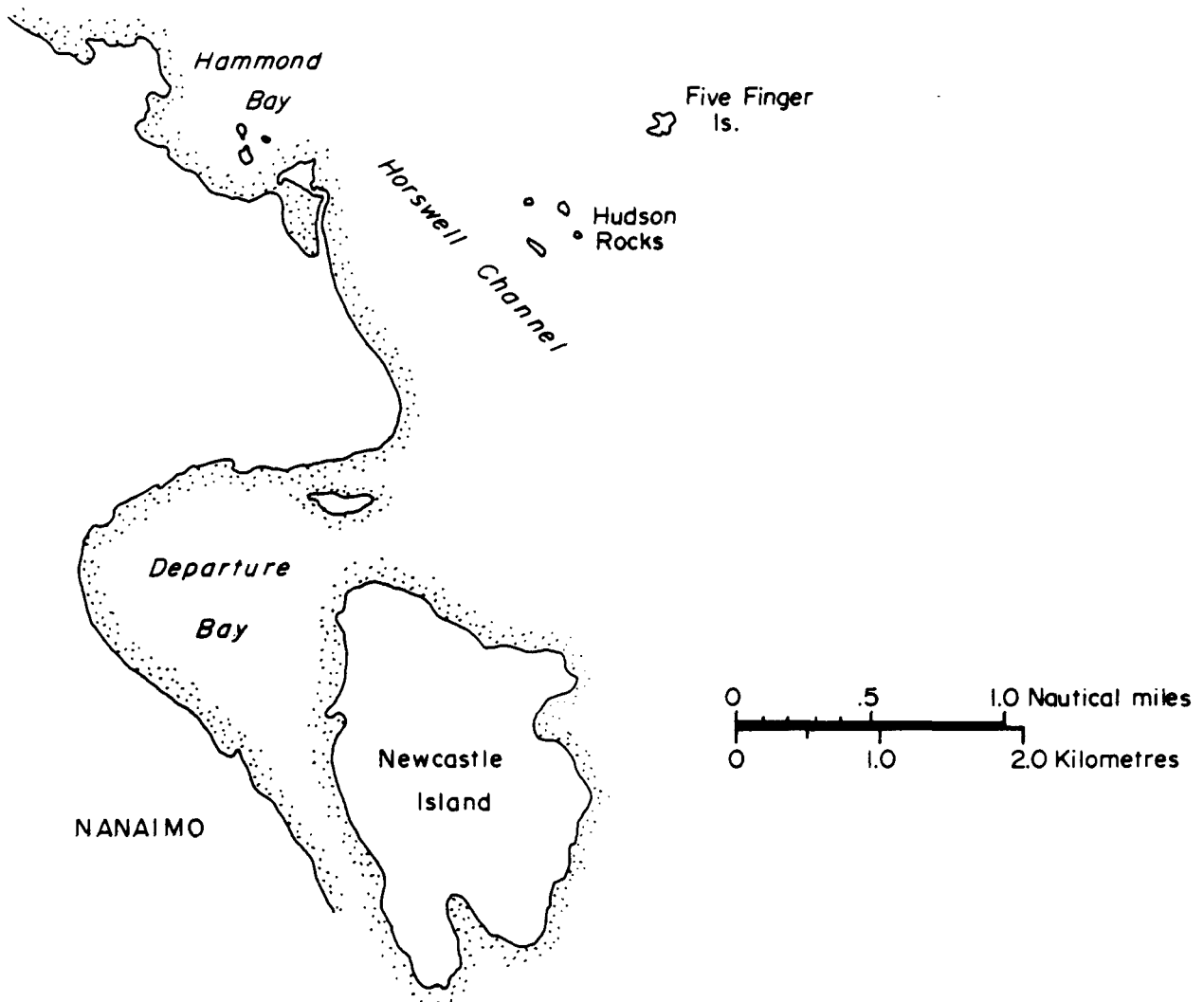


FIGURE 6 FIVE FINGER ISLAND OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

FIVE FINGER DUMPSITE - STATIONS 1-9.

METALS: LAB#900262: 58-66

DATE SAMPLED: NOVEMBER 02, 1989

PARTICLE SIZE: LAB# 900262

STN	DEPTH (m)	SAMPLE	SEDIMENT DEPTH (cm)	HG	UG/G DRY WEIGHT			ZN
					CD	PB	CU	
1	303	58	0-5	.096	.10	ND(8)	52.6	216.0
2	293	59	0-5	.094	.22	ND(8)	49.4	215.0
3	282	60	0-5	.062	ND(.02)	10	28.7	159.0
4	282	63	0-5	.110	.22	9	52.1	189.0
5	301	62	0-5	.110	.23	ND(8)	51.0	188.0
6	297	61	0-5	.099	.20	10	51.5	171.0
7	293	64	0-5	.075	.29	ND(8)	47.3	180.0
8	290	65	0-5	.092	.27	9	44.6	176.0
9	300	66	0-5	.054	.42	ND(8)	41.3	130.0
MEAN				.088	.24	10	46.5	180.4
STD DEV				.020	.09	1	7.7	26.7

PRECISION DATA

SAMPLE	HG	CD	PB	CU	ZN
60	.062	ND(.02)	10	28.7	159.0
89	.061	.04	10	27.8	158.0
90	.076	.06	10	30.6	160.0
91	.066	.03	10	28.1	149.0
92	.069	ND(.02)	10	28.6	157.0
MEAN					
	.067	.04	10	28.8	156.6
STD DEV					
	.006	.02	0	1.1	4.4

NOTE: numbers in brackets are limits of detection.
 ND - not detected.
 Particle size data in appendix II.

cf:SCPF89

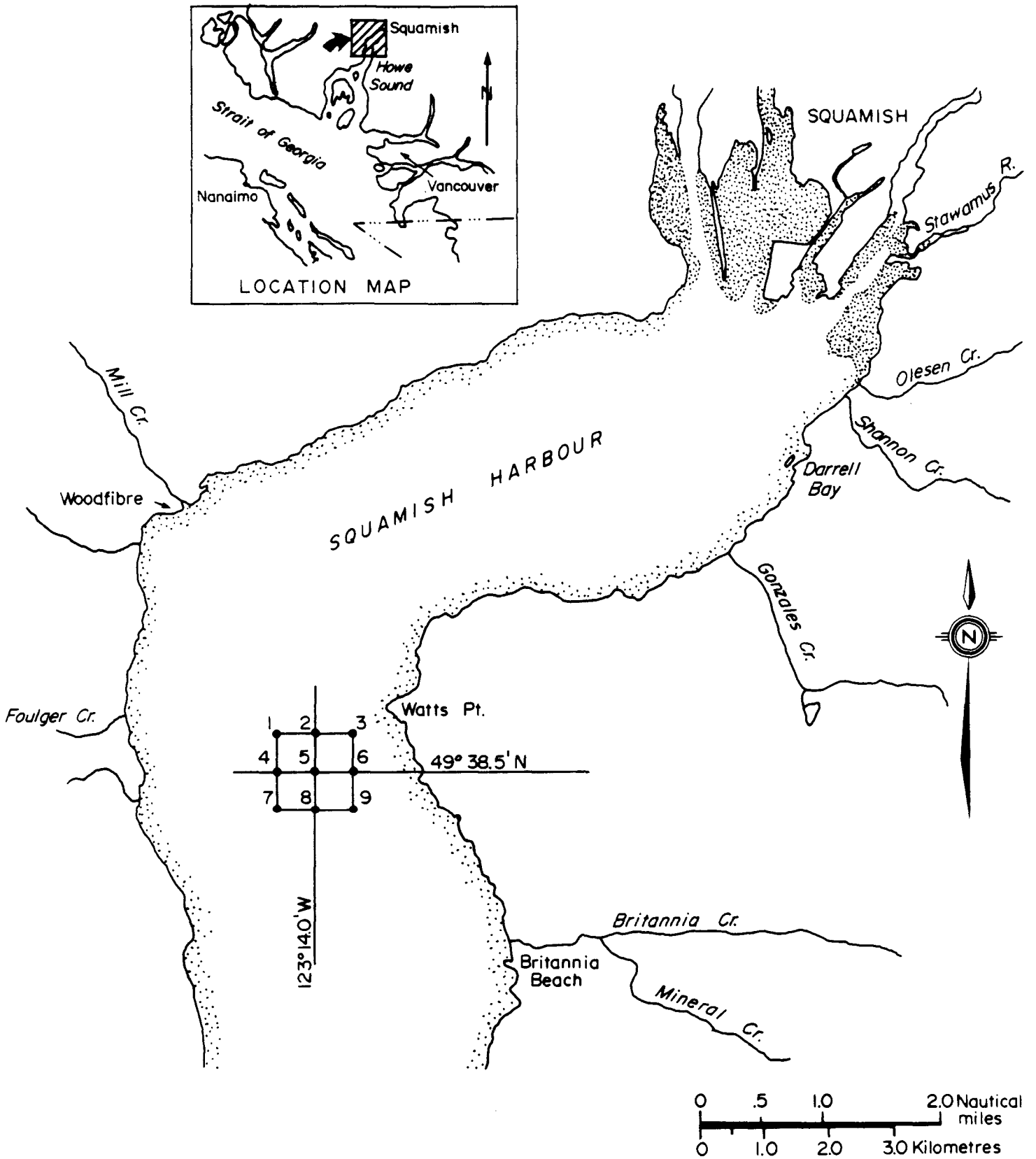


FIGURE 7 WATTS POINT OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

TABLE 7

WATTS POINT DUMPSITE - STATIONS 1-9.

METALS: LAB#900262: 40-48

DATE SAMPLED: NOVEMBER 01, 1989

PARTICLE SIZE: LAB# 900262

STN	DEPTH (m)	SAMPLE	SEDIMENT DEPTH (cm)	HG	UG/G DRY WEIGHT			
					CD	PB	CU	ZN
1	232	40	0-5	.091	.20	ND(8)	92.3	111.0
2	230	41	0-5	.169	.23	ND(8)	63.4	87.0
3	232	42	0-5	.083	.21	ND(8)	121.0	130.0
4	229	45	0-5	.120	.53	ND(8)	106.0	128.0
5	227	44	0-5	.140	.28	ND(8)	76.1	97.6
6	228	43	0-5	.110	.24	ND(8)	155.0	142.0
7	233	46	0-5	.083	.21	ND(8)	141.0	143.0
8	234	47	0-5	.700	.19	ND(8)	63.3	91.9
9	234	48	0-5	.080	.24	9	164.0	137.0
MEAN				.175	.26	9	109.1	118.6
STD DEV				.199	.11		38.5	22.1

PRECISION DATA

SAMPLE	HG	CD	PB	CU	ZN
40	.091	.20	ND(8)	92.3	111.0
81	.085	.18	ND(8)	90.4	103.0
82	.083	.18	ND(8)	90.5	105.0
83	.095	.19	ND(8)	93.9	111.0
84	.099	.22	ND(8)	94.7	107.0
MEAN	.091	.19		92.4	107.4
STD DEV	.007	.02		1.9	3.6

NOTE: numbers in brackets are limits of detection.
 ND - not detected.
 Particle size data in appendix II.

cf:SCPWPD89

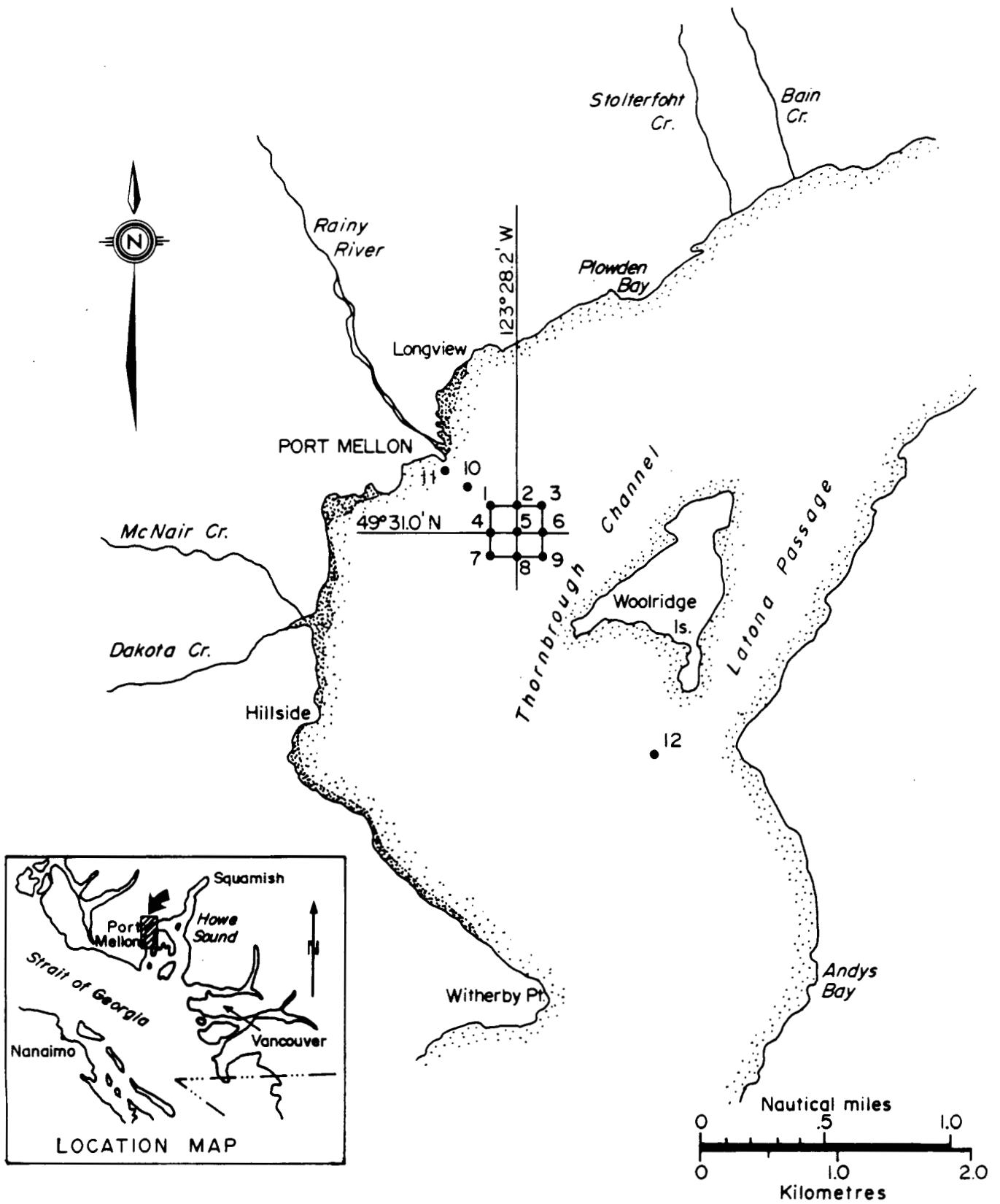


FIGURE 8 THORNBROUGH CHANNEL OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

TABLE 8

THORNBROUGH CHANNEL DUMPSITE - STATIONS 1-9.

METALS: LAB#900262: 49-57

DATE SAMPLED: NOVEMBER 01, 1989

PARTICLE SIZE: LAB# 900262

STN	DEPTH (m)	SAMPLE	SEDIMENT DEPTH (cm)	HG	UG/G DRY WEIGHT			ZN
					CD	PB	CU	
1	148	51	0-5	.100	.75	46	37.3	103.0
2	192	50	0-5	.057	.55	10	47.7	90.9
3	218	49	0-5	.064	.31	ND(8)	42.1	94.5
4	197	52	0-5	.120	.98	35	77.0	170.0
5	212	53	0-5	.073	.40	ND(8)	45.4	125.0
6	213	54	0-5	.069	.29	10	45.1	133.0
7	212	57	0-5	.088	.38	10	47.3	107.0
8	213	56	0-5	.150	.47	25	77.7	180.0
9	213	55	0-5	.120	.28	10	63.2	146.0
MEAN				.093	.49	21	53.6	127.7
STD DEV				.031	.24	15	15.1	32.4

PRECISION DATA

SAMPLE	HG	CD	PB	CU	ZN
50	.057	.55	10	47.7	90.9
85	.074	.51	10	47.5	88.8
86	.070	.51	ND(8)	47.8	86.9
87	.074	.46	10	46.0	84.2
88	.070	.50	10	44.3	77.6
MEAN	.069	.51	10	46.7	85.7
STD DEV	.007	.03	0	1.5	5.1

NOTE: numbers in brackets are limits of detection.
 ND - not detected.
 Particle size data in appendix II.

cf:SCPTCD89

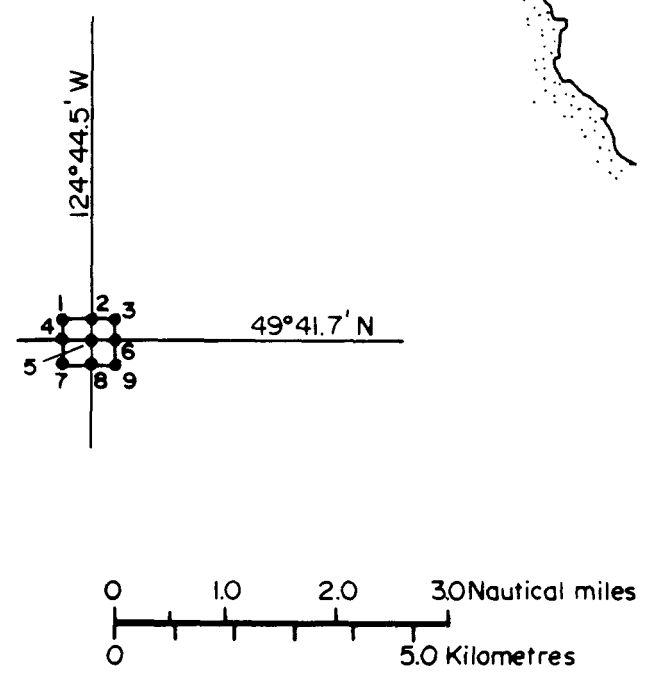
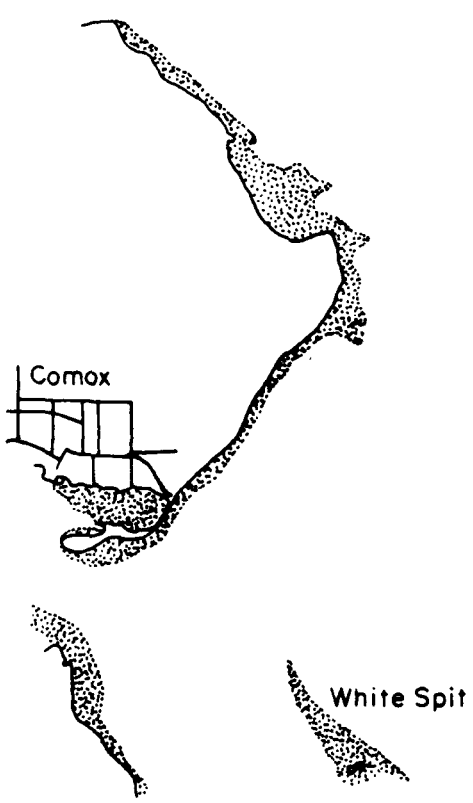
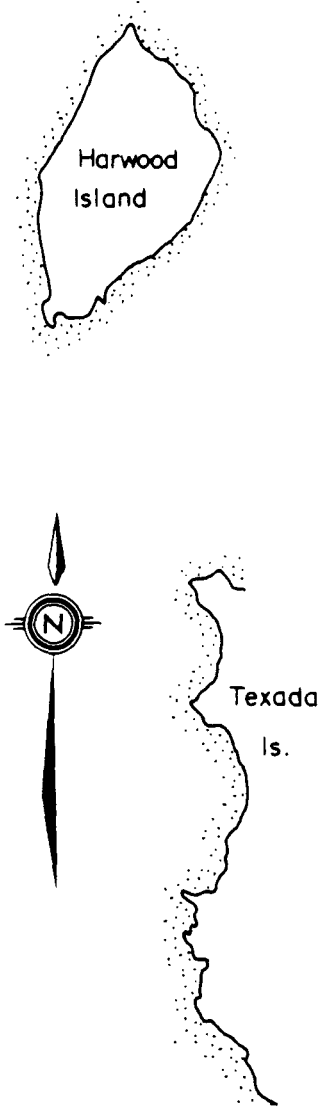
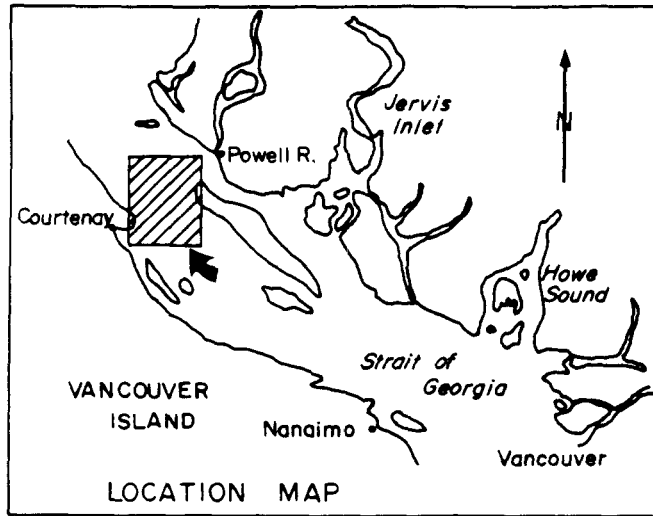


FIGURE 9 COMOX OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

TABLE 9

COMOX DUMPSITE - STATIONS 4 - 6

DATE SAMPLED: SEPTEMBER 18, 1989

METALS: LAB# 900261: 73-81

PARTICLE SIZE: LAB# 900261

STN	DEPTH (m)	SAMPLE	SEDIMENT DEPTH (cm)	HG	UG/G DRY WEIGHT			
					CD	PB	CU	ZN
4	204	73	0-5	.095	.23	10	52.6	116.0
		74	0-5	.076	.10	10	51.6	111.0
		75	0-5	.076	.10	20	54.9	114.0
		MEAN		.082	.14	13	53.0	113.7
		STD DEV		.011	.08	6	1.7	2.5
5	202	76	0-5	.081	.10	10	56.6	120.0
		77	0-5	.082	.10	20	55.9	119.0
		78	0-5	.077	.10	10	55.4	108.0
		MEAN		.080	.10	13	56.0	115.7
		STD DEV		.003	.00	6	.6	6.7
6	199	79	0-5	.088	.10	20	60.0	141.0
		80	0-5	.087	.10	10	56.2	119.0
		81	0-5	.110	.10	20	59.7	129.0
		MEAN		.095	.10	17	58.6	129.7
		STD DEV		.013	.00	6	2.1	11.0

PRECISION DATA

SAMPLE	HG	CD	PB	CU	ZN
80	.087	.10	10	56.2	119.0
152	.089	.10	17	54.1	115.0
153	.091	.10	17	56.4	122.0
154	.090	.10	17	54.6	114.0
155	.094	.08	20	56.7	118.0
MEAN	.090	.10	16	55.6	117.6
STD DEV	.003	.01	4	1.2	3.2

NOTE: numbers in brackets are limits of detection.
 ND - not detected.
 Particle size data in appendix II.

cf:SCPCD89

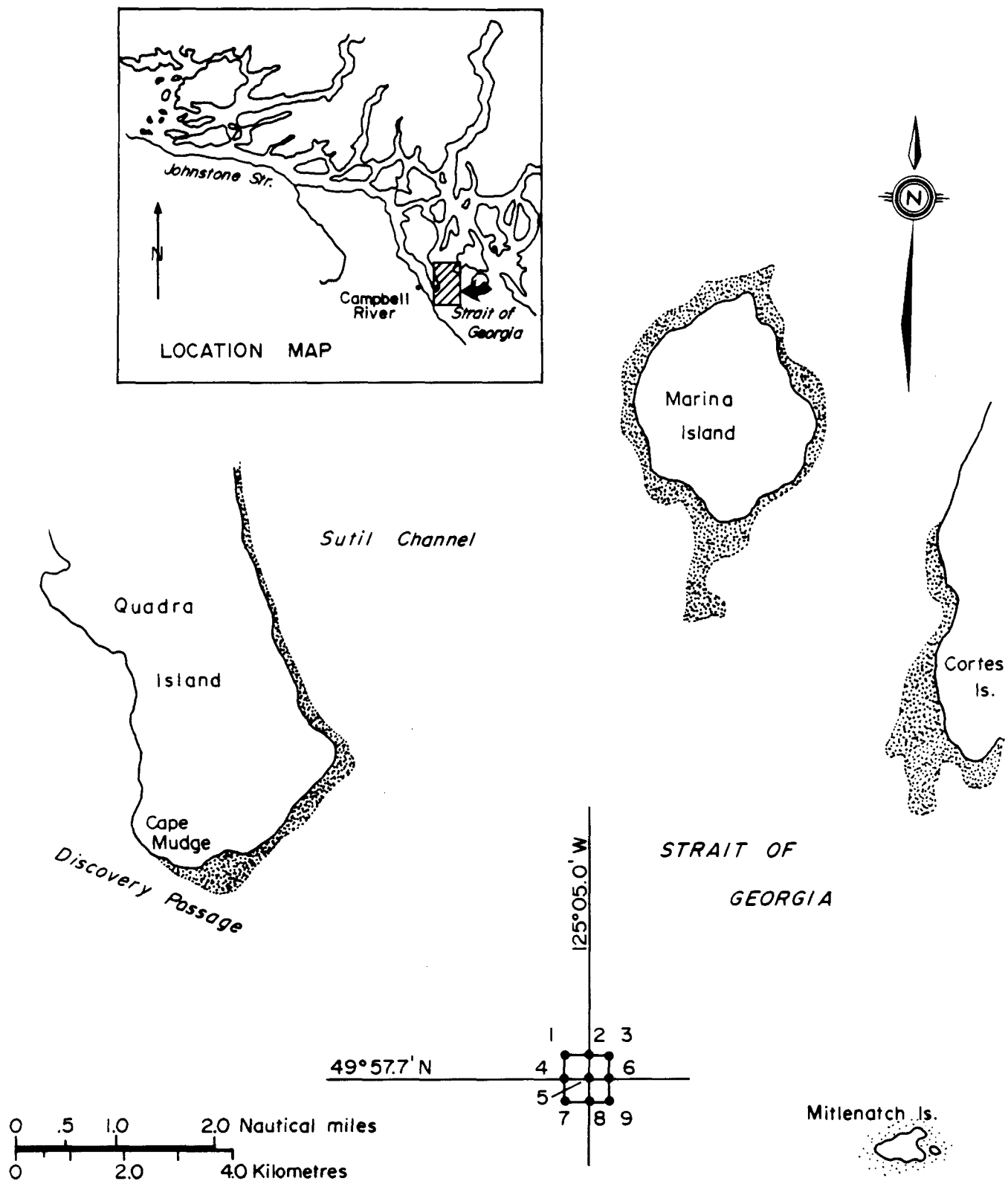


FIGURE 10 CAPE MUDGE OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

TABLE 10

CAPE MUDGE DUMPSITE - STATIONS 4 - 6

METALS: LAB# 900261: 64-72

DATE SAMPLED: SEPTEMBER 18, 1989

PARTICLE SIZE: LAB# 900261

STN	DEPTH (m)	SAMPLE	SEDIMENT DEPTH (cm)	HG	UG/G DRY WEIGHT			
					CD	PB	CU	ZN
4	252	64	0-5	.026	.04	ND(8)	22.3	53.7
		65	0-5	.020	4.40	ND(8)	23.0	49.8
		66	0-5	.023	.44	ND(8)	22.7	43.1
		MEAN		.023	1.63		22.7	48.9
		STD DEV		.003	2.41		.4	5.4
5	249	67	0-5	.037	.10	ND(8)	28.0	58.8
		68	0-5	.029	.10	ND(8)	27.8	56.4
		69	0-5	.037	1.50	ND(8)	28.9	52.5
		MEAN		.034	.57		28.2	55.9
		STD DEV		.005	.81		.6	3.2
6	270	70	0-5	.041	.25	ND(8)	32.6	67.3
		71	0-5	.039	.40	ND(8)	31.3	70.0
		72	0-5	.046	2.00	10	34.9	66.3
		MEAN		.042	.88		32.9	67.9
		STD DEV		.004	.97		1.8	1.9

PRECISION DATA

SAMPLE	HG	CD	PB	CU	ZN
70	.041	.25	ND(8)	32.6	67.3
148	.040	.23	ND(8)	32.2	59.3
149	.039	.23	ND(8)	31.5	62.0
150	.045	.24	ND(8)	35.0	69.0
151	.040	.22	8	34.6	68.9
MEAN	.041	.23	8	33.2	65.3
STD DEV	.002	.01		1.5	4.4

NOTE: numbers in brackets are limits of detection.
 ND - not detected.
 Particle size data in appendix II.

cf:SCPCMD89

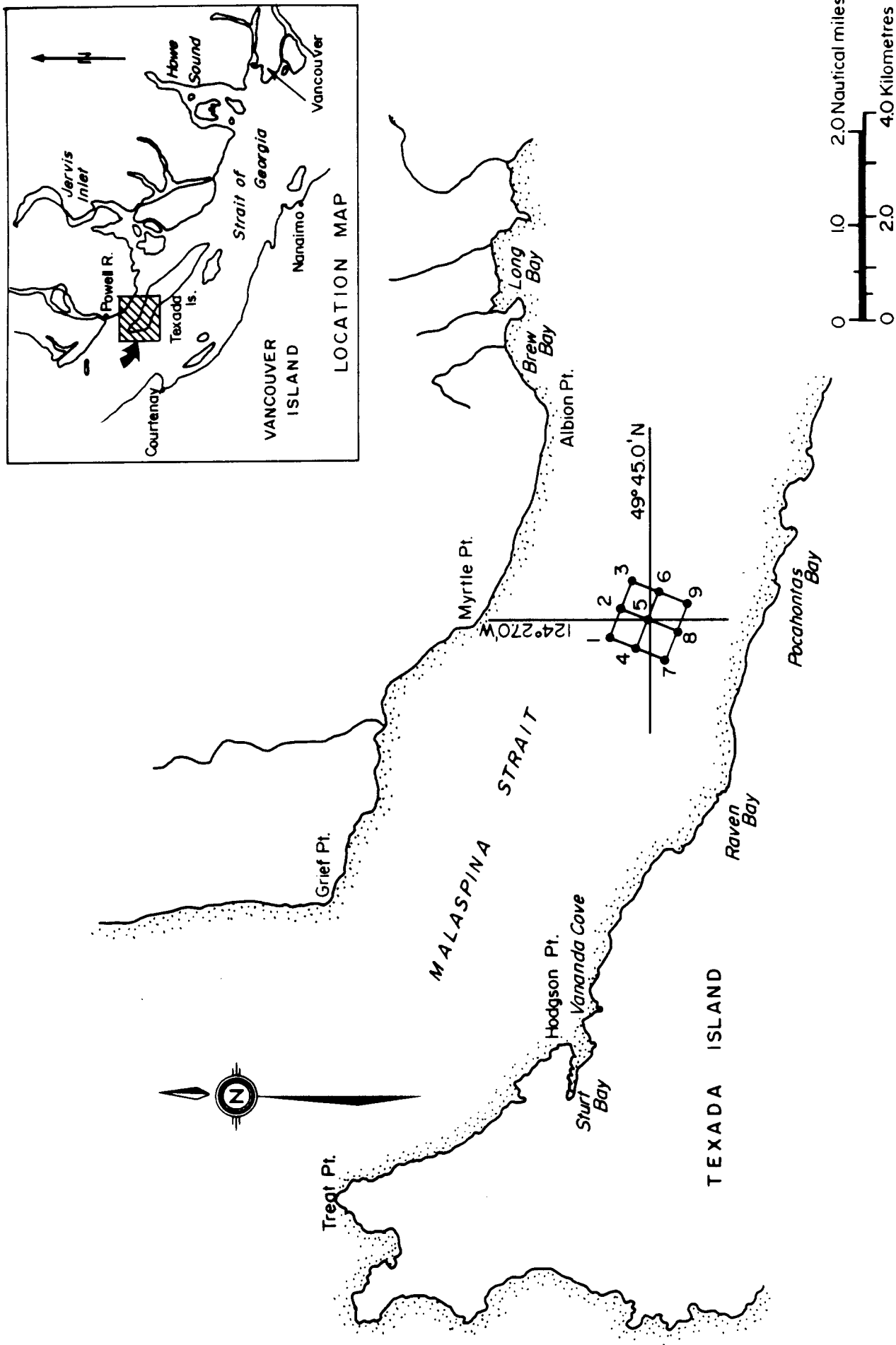


FIGURE II MALASPINA STRAIT OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

TABLE 11

MALASPINA STRAIT DUMPSITE - STATIONS 1 - 9

METALS: LAB# 900261: 97-123

DATE SAMPLED: SEPTEMBER 18, 1989

PARTICLE SIZE: LAB# 900261

STN	DEPTH (m)	SAMPLE	SEDIMENT DEPTH (cm)	HG	UG/G DRY WEIGHT			
					CD	PB	CU	ZN
1	336	97	0-5	.231	.78	36	84.8	306.0
		98	0-5	.216	.83	33	84.6	270.0
		99	0-5	.215	.71	36	78.0	253.0
		MEAN		.221	.77	35	82.5	276.3
		STD DEV		.009	.06	2	3.9	27.1
		2	341	100	0-5	.150	.63	40
101	0-5			.204	.63	37	81.2	243.0
102	0-5			.202	.76	37	79.4	233.0
MEAN				.185	.67	38	79.1	235.7
STD DEV				.031	.08	2	2.3	6.4
3	337			103	0-5	.199	.70	32
		104	0-5	.197	1.50	44	82.7	247.0
		105	0-5	.198	.81	38	82.8	241.0
		MEAN		.198	1.00	38	81.5	247.3
		STD DEV		.001	.43	6	2.2	6.5
		4	338	106	0-5	.224	.88	34
107	0-5			.206	.82	33	84.9	239.0
108	0-5			.211	.05	34	87.9	232.0
MEAN				.214	.58	34	85.9	253.0
STD DEV				.009	.46	1	1.8	30.5
5	337			109	0-5	.205	1.00	37
		110	0-5	.227	6.80	34	82.2	271.0
		111	0-5	.187	1.10	29	72.8	235.0
		MEAN		.206	2.97	33	80.8	262.7
		STD DEV		.020	3.32	4	7.4	24.6
		6	336	112	0-5	.257	.07	31
113	0-5			.194	.22	35	130.0	283.0
114	0-5			.211	.82	36	84.3	238.0
MEAN				.221	.37	34	97.5	257.3
STD DEV				.033	.40	3	28.3	23.2
7	319			115	0-5	.208	.80	35
		116	0-5	.216	.95	31	88.8	280.0
		117	0-5	.230	.95	35	89.6	242.0
		MEAN		.218	.90	34	87.5	267.7
		STD DEV		.011	.09	2	3.0	22.2
		8	334	118	0-5	.219	.80	32
119	0-5			.223	.93	29	75.2	257.0
120	0-5			.234	.95	38	80.3	231.0
MEAN				.225	.89	33	77.2	253.7
STD DEV				.008	.08	5	2.7	21.2

9	330	121	0-5	.188	.78	33	77.8	231.0	
		122	0-5	.167	.74	31	80.3	282.0	
		123	0-5	.221	1.50	32	80.1	238.0	
				<u>MEAN</u>	<u>.192</u>	<u>1.01</u>	<u>32</u>	<u>79.4</u>	<u>250.3</u>
				<u>STD DEV</u>	<u>.027</u>	<u>.43</u>	<u>1</u>	<u>1.4</u>	<u>27.6</u>

PRECISION DATA

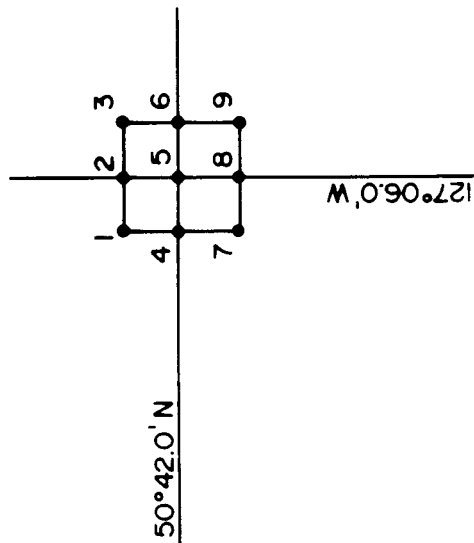
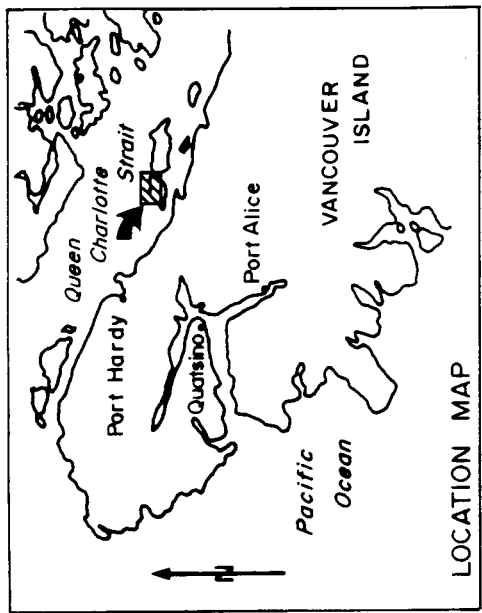
SAMPLE	HG	CD	PB	CU	ZN	
100	.150	.63	40	76.7	231.0	
160	.195	.58	32	69.0	206.0	
161	.214	.63	31	70.9	222.0	
162	.204	.54	35	71.3	207.0	
163	.201	.64	34	74.2	212.0	
	<u>MEAN</u>	<u>.193</u>	<u>.60</u>	<u>34</u>	<u>72.4</u>	<u>215.6</u>
	<u>STD DEV</u>	<u>.025</u>	<u>.04</u>	<u>4</u>	<u>3.0</u>	<u>10.7</u>
110	.227	6.80	34	82.2	271.0	
164	.212	5.10	31	78.0	262.0	
165	.219	6.00	32	76.7	252.0	
166	.223	5.70	33	79.7	263.0	
167	.217	5.90	35	70.2	240.0	
	<u>MEAN</u>	<u>.220</u>	<u>5.90</u>	<u>33</u>	<u>77.4</u>	<u>257.6</u>
	<u>STD DEV</u>	<u>.006</u>	<u>.61</u>	<u>2</u>	<u>4.5</u>	<u>11.9</u>
120	.234	.95	38	80.3	231.0	
168	.222	.85	35	79.5	223.0	
169	.223	.89	35	78.0	216.0	
170	.225	.89	40	78.5	224.0	
171	.206	.87	37	77.5	213.0	
	<u>MEAN</u>	<u>.222</u>	<u>.89</u>	<u>37</u>	<u>78.8</u>	<u>221.4</u>
	<u>STD DEV</u>	<u>.010</u>	<u>.04</u>	<u>2</u>	<u>1.1</u>	<u>7.1</u>

NOTE: numbers in brackets are limits of detection.

cf: SCPMSD89

ND - not detected.

Particle size data in appendix II.



QUEEN CHARLOTTE STRAIT

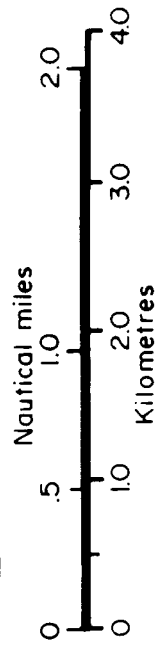
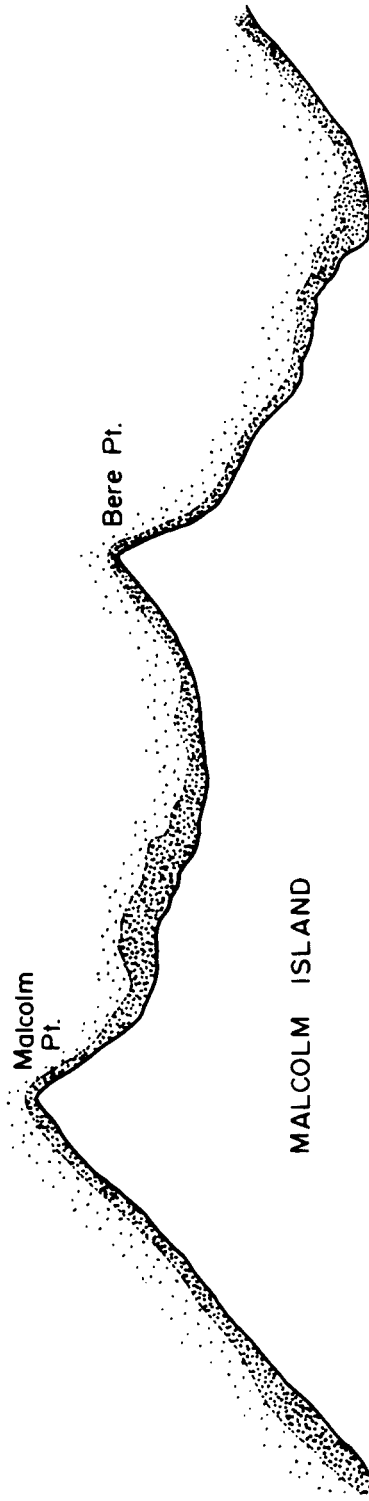


FIGURE 12 MALCOLM ISLAND OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

TABLE 12

MALCOLM ISLAND DUMPSITE - STATIONS 4 - 6

METALS: LAB# 900261: 49-57

DATE SAMPLED: SEPTEMBER 16, 1989

PARTICLE SIZE: LAB# 900261

STN	DEPTH (m)	SAMPLE	SEDIMENT DEPTH (cm)	HG	UG/G DRY WEIGHT			ZN
					CD	PB	CU	
4	159	49	0-5	.025	.10	ND(8)	14.0	40.0
		50	0-5	.019	.08	ND(8)	13.0	40.5
		51	0-5	.025	.10	ND(8)	14.0	47.3
		MEAN		.023	.09		13.7	42.6
		STD DEV		.003	.01		.6	4.1
5	197	52	0-5	.024	.20	ND(8)	14.0	51.8
		53	0-5	.027	.10	ND(8)	14.0	40.8
		54	0-5	.037	.10	ND(8)	15.0	50.4
		MEAN		.029	.13		14.3	47.7
		STD DEV		.007	.06		.6	6.0
6	120	55	0-5	.044	.26	ND(8)	34.0	107.0
		56	0-5	.040	.18	ND(8)	33.4	114.0
		57	0-5	.039	.24	ND(8)	30.6	89.9
		MEAN		.041	.23		32.7	103.6
		STD DEV		.003	.04		1.8	12.4

PRECISION DATA

SAMPLE	HG	CD	PB	CU	ZN
50	.019	.08	ND(8)	13.0	40.5
140	.024	.09	ND(8)	14.0	52.5
141	.020	.09	ND(8)	12.0	43.2
142	.020	.08	9	13.0	41.8
143	.022	.10	ND(8)	13.0	49.2
MEAN	.021	.09	9	13.0	45.4
STD DEV	.002	.01		.7	5.2

NOTE: numbers in brackets are limits of detection.
 ND - not detected.
 Particle size data in appendix II.

cf:SCPMID89

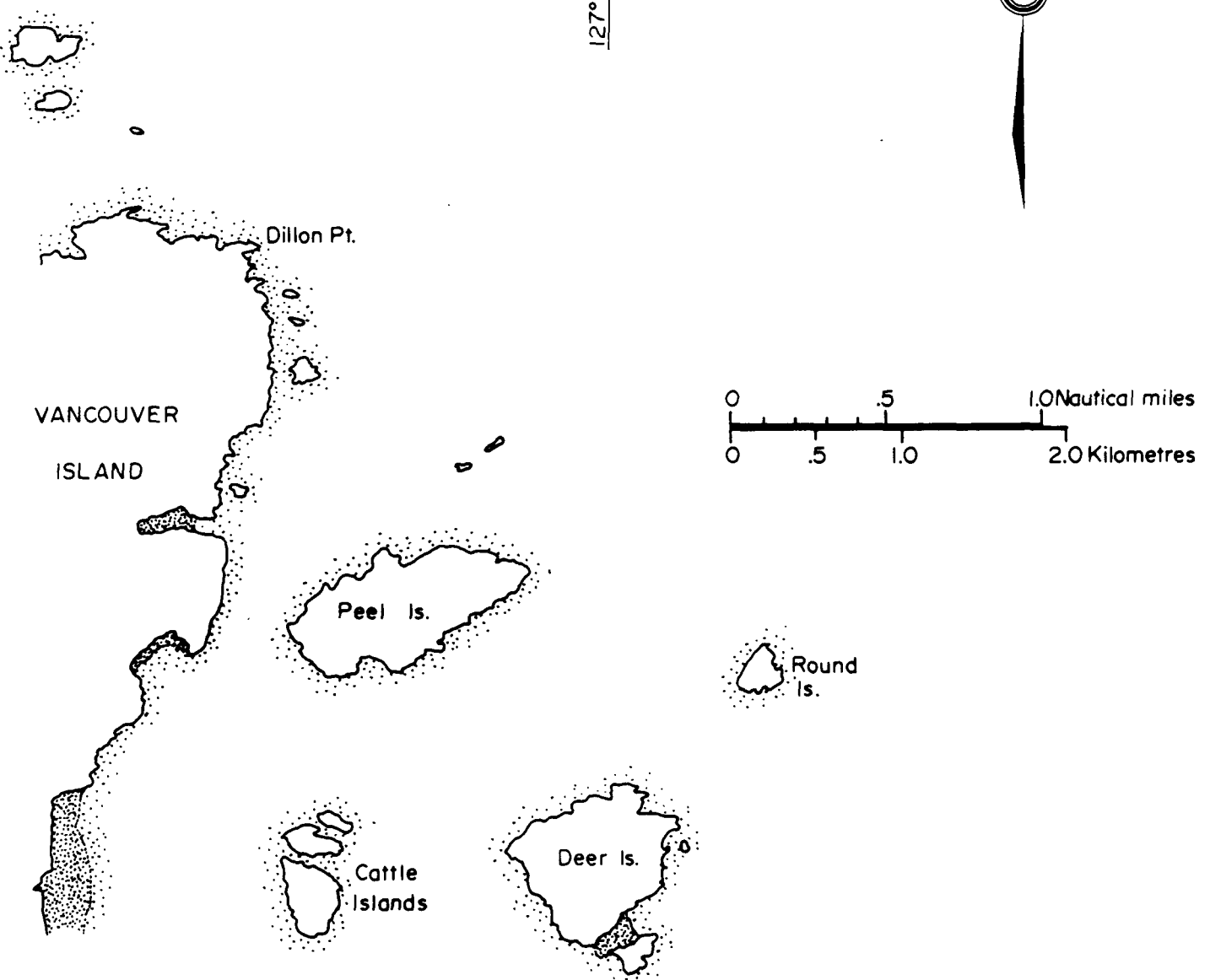
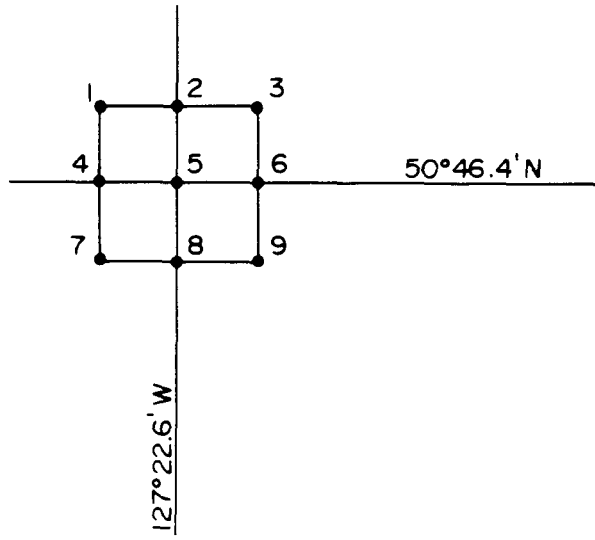
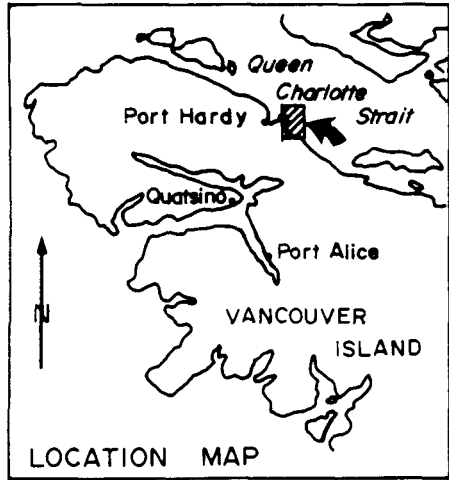


FIGURE 13 QUEEN CHARLOTTE STRAIT OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

TABLE 13

QUEEN CHARLOTTE STRAIT DUMPSITE - STATIONS 4 - 6

METALS: LAB# 900261: 40-48

DATE SAMPLED: SEPTEMBER 16, 1989

PARTICLE SIZE: LAB# 900261

STN	DEPTH (m)	SAMPLE	SEDIMENT DEPTH (cm)	HG	UG/G DRY WEIGHT			
					CD	PB	CU	ZN
4	382	40	0-5	.072	.45	20	21.9	85.7
		41	0-5	.069	.40	10	22.1	80.8
		42	0-5	.073	.43	10	22.5	74.0
		MEAN		.071	.43	13	22.2	80.2
		STD DEV		.002	.03	6	.3	5.9
5	344	43	0-5	.040	.22	10	16.0	67.7
		44	0-5	.046	.19	ND(8)	14.0	60.3
		45	0-5	.045	.29	ND(8)	16.6	57.1
		MEAN		.044	.23	10	15.5	61.7
		STD DEV		.003	.05		1.4	5.4
6	339	46	0-5	.066	.50	ND(8)	18.4	77.4
		47	0-5	.085	.47	ND(8)	18.9	73.7
		48	0-5	.071	.62	ND(8)	18.8	69.5
		MEAN		.074	.53		18.7	73.5
		STD DEV		.010	.08		.3	4.0

PRECISION DATA

SAMPLE	HG	CD	PB	CU	ZN
40	.072	.45	20	21.9	85.7
136	.120	.44	10	21.3	82.0
137	.062	.47	10	22.4	90.6
138	.079	.49	10	22.0	90.8
139	.076	.45	10	21.9	89.0
MEAN	.082	.46	12	21.9	87.6
STD DEV	.022	.02	4	.4	3.7

NOTE: numbers in brackets are limits of detection.
 ND - not detected.
 Particle size data in appendix II.

cf:SCPQCSD89

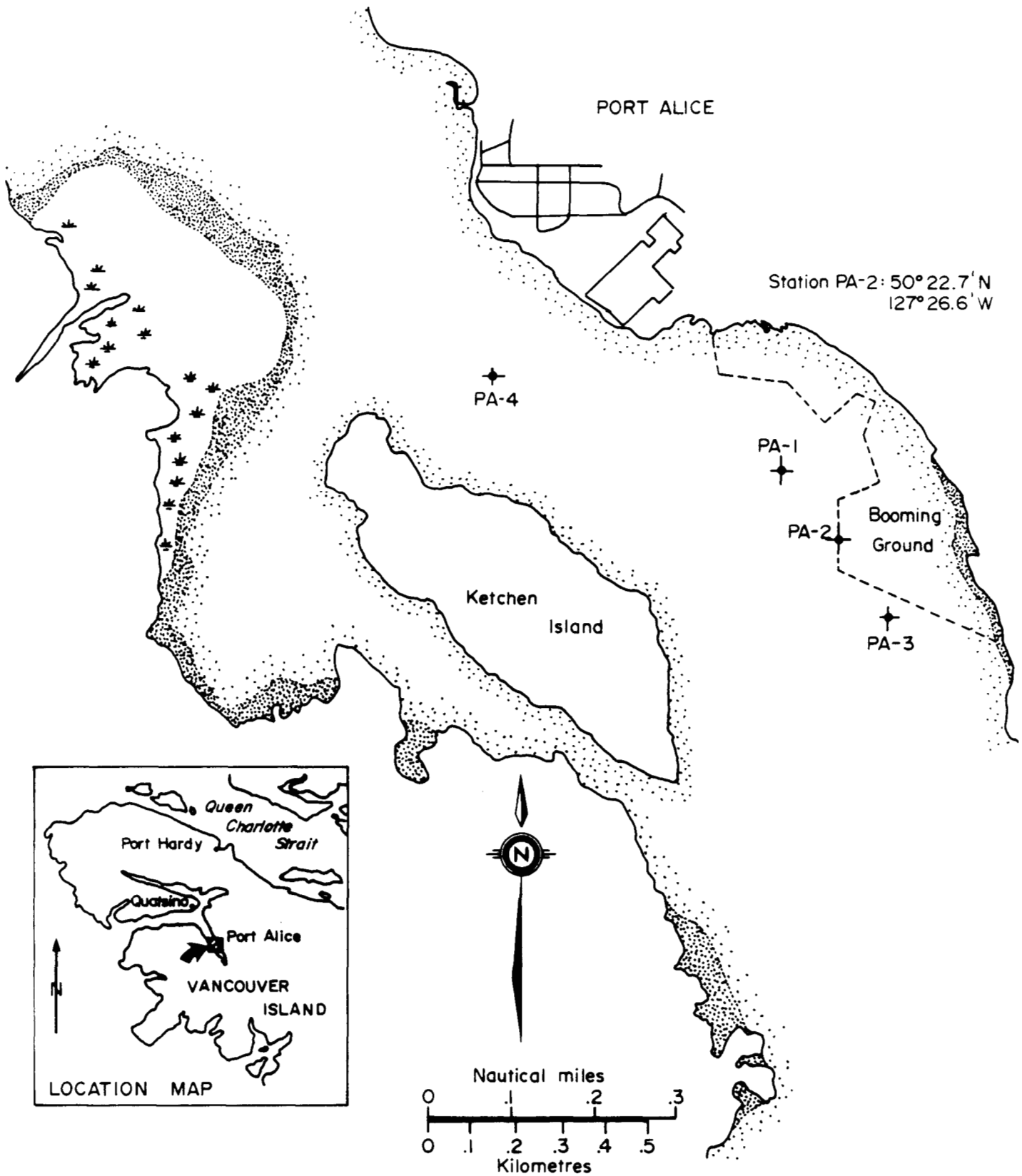


FIGURE 14 PORT ALICE OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

TABLE 14

PORT ALICE DUMPSITE - STATIONS 1 - 4

METALS: LAB#900261: 1-12

DATE SAMPLED: SEPTEMBER 15, 1989

PARTICLE SIZE: LAB# 900261

STN	DEPTH (m)	SAMPLE	SEDIMENT DEPTH (cm)	HG	UG/G DRY WEIGHT				
					CD	PB	CU	ZN	
1	60	7	0-5	.295	2.62	35	117.0	141.0	
			0-5	.330	2.45	32	112.0	111.0	
			0-5	.327	2.56	30	120.0	132.0	
		MEAN			.317	2.54	32	116.3	128.0
		STD DEV			.019	.09	3	4.0	15.4
2	62	4	0-5	.193	4.10	33	145.0	216.0	
			0-5	.197	3.79	37	138.0	210.0	
			0-5	.206	3.25	37	138.0	230.0	
		MEAN			.199	3.71	36	140.3	218.7
		STD DEV			.007	.43	2	4.0	10.3
3	55	1	0-5	.206	1.99	51	113.0	372.0	
			0-5	.237	2.29	39	124.0	323.0	
			0-5	.308	2.15	43	146.0	400.0	
		MEAN			.250	2.14	44	127.7	365.0
		STD DEV			.052	.15	6	16.8	39.0
4	39	10	0-5	.271	4.10	38	162.0	169.0	
			0-5	.254	4.60	36	150.0	184.0	
			0-5	.290	4.60	32	151.0	166.0	
		MEAN			.272	4.43	35	154.3	173.0
		STD DEV			.018	.29	3	6.7	9.6

PRECISION DATA

SAMPLE	HG	CD	PB	CU	ZN
10	.271	4.10	38	162.0	169.0
124	.257	4.50	35	153.0	184.0
125	.367	4.60	46	153.0	184.0
126	.252	3.90	37	153.0	164.0
127	.262	4.10	35	150.0	171.0
MEAN	.282	4.24	38	154.2	174.4
STD DEV	.048	.30	5	4.5	9.1

NOTE: numbers in brackets are limits of detection.
 ND - not detected.
 Particle size data in appendix II.

cf:SCPPAD89

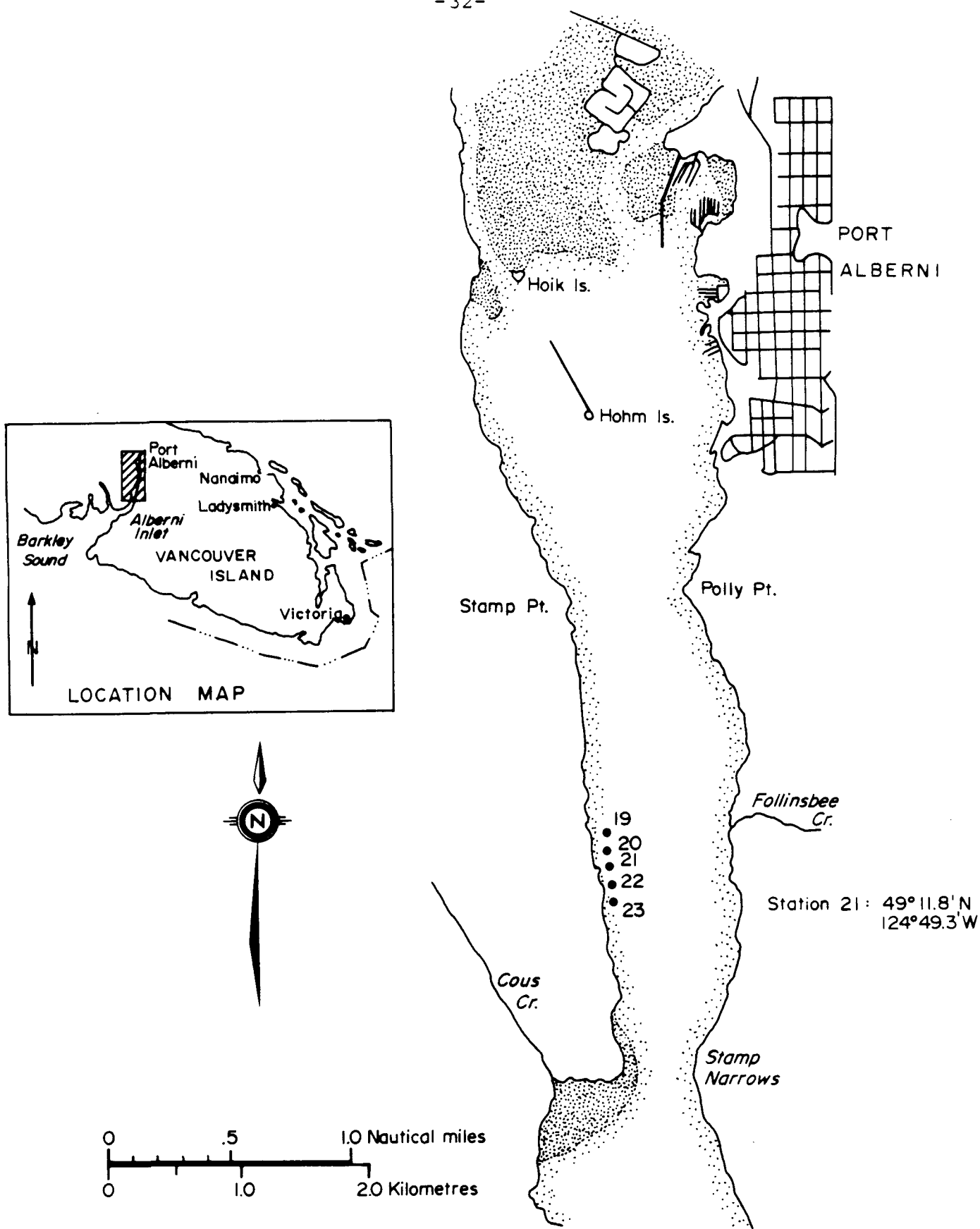


FIGURE 15 ALBERNI INLET OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

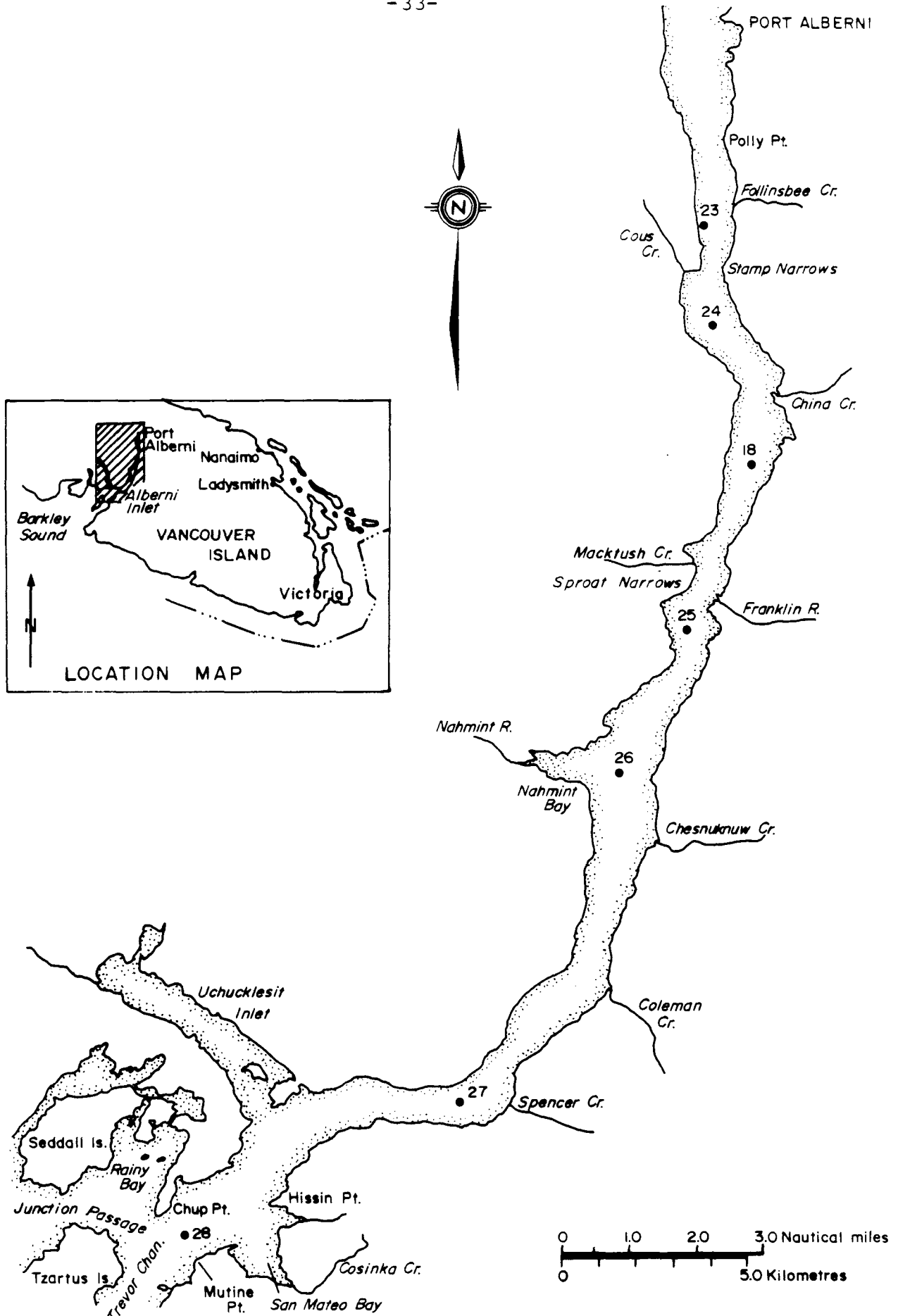


FIGURE 16 ALBERNI INLET - BENTHIC SEDIMENT SAMPLING STATIONS

TABLE 15

ALBERNI INLET AND DUMPSITE - STATIONS 18 -28

METALS: LAB# 900263: 4-36

DATE SAMPLED: JULY 17-18, 1989

PARTICLE SIZE: LAB# 900263

STN	DEPTH (m)	SAMPLE	SEDIMENT DEPTH (cm)	HG	UG/G DRY WEIGHT				ZN
					CD	PB	CU		
18	117	16	0-5	.286	.65	16	99.6	201.0	
		17	0-5	.306	.66	19	99.9	215.0	
		18	0-5	.265	7.30	10	97.4	183.0	
		MEAN	.286	2.87	15	99.0	199.7		
		STD DEV	.021	3.84	5	1.4	16.0		
19	44	22	0-5	.054	.26	ND(8)	69.7	89.9	
		23	0-5	.195	.68	10	62.8	203.0	
		24	0-5	.071	5.60	10	48.8	157.0	
		MEAN	.107	2.18	10	60.4	150.0		
		STD DEV	.077	2.97	0	10.6	56.9		
20	25	25	0-5	.175	1.10	19	62.6	196.0	
		26	0-5	.057	1.20	10	58.7	133.0	
		27	0-5	.097	.54	10	54.2	123.0	
		MEAN	.110	.95	13	58.5	150.7		
		STD DEV	.060	.36	5	4.2	39.6		
21	44	28	0-5	.110	.84	9	52.2	161.0	
		29	0-5	.110	1.10	17	45.0	132.0	
		30	0-5	.150	3.40	10	50.3	162.0	
		MEAN	.123	1.78	12	49.2	151.7		
		STD DEV	.023	1.41	4	3.7	17.0		
22	35	31	0-5	.150	.91	9	33.3	234.0	
		32	0-5	.160	.90	ND(8)	42.8	204.0	
		33	0-5	.192	.98	10	41.6	228.0	
		MEAN	.167	.93	10	39.2	222.0		
		STD DEV	.022	.04	1	5.2	15.9		
23	42	34	0-5	.100	.44	ND(8)	37.1	186.0	
		35	0-5	.081	.36	ND(8)	34.9	134.0	
		36	0-5	.089	.47	10	29.6	137.0	
		MEAN	.090	.42	10	33.9	152.3		
		STD DEV	.010	.06		3.9	29.2		
24	93	19	0-5	.297	5.20	20	102.0	237.0	
		20	0-5	.240	.97	10	94.0	193.0	
		21	0-5	.279	3.50	10	98.8	212.0	
		MEAN	.272	3.22	13	98.3	214.0		
		STD DEV	.029	2.13	6	4.0	22.1		

ALBERNI INLET AND DUMPSITE - STATIONS 18 -28 (cont'd)

STN	DEPTH (m)	SAMPLE	SEDIMENT DEPTH (cm)	HG	UG/G DRY WEIGHT			ZN
					CD	PB	CU	
25	90	13	0-5	.178	1.00	20	94.3	160.0
		14	0-5	.181	8.40	9	90.8	137.0
		15	0-5	.180	.32	10	96.1	141.0
		MEAN		.180	3.24	13	93.7	146.0
		STD DEV		.002	4.48	6	2.7	12.3
26	251	10	0-5	.256	.89	24	70.7	192.0
		11	0-5	.254	.76	23	72.9	180.0
		12	0-5	.252	.72	21	72.6	187.0
		MEAN		.254	.79	23	72.1	186.3
		STD DEV		.002	.09	2	1.2	6.0
27	255	7	0-5	.164	.32	20	46.6	176.0
		8	0-5	.164	.44	21	48.9	180.0
		9	0-5	.168	.44	19	49.1	171.0
		MEAN		.165	.40	20	48.2	175.7
		STD DEV		.002	.07	1	1.4	4.5
28	233	4	0-5	.140	4.10	23	37.2	157.0
		5	0-5	.130	.23	19	37.1	159.0
		6	0-5	.130	.23	23	38.0	149.0
		MEAN		.133	1.52	22	37.4	155.0
		STD DEV		.006	2.23	2	.5	5.3

PRECISION DATA

10	.256	.89	24	70.7	192.0
43	.274	.73	24	73.0	196.0
44	.275	.82	20	72.4	194.0
45	.276	.76	24	71.8	193.0
46	.308	.90	20	72.1	190.0
MEAN	.278	.82	22	72.0	193.0
STD DEV	.019	.08	2	.9	2.2
20	.240	.97	10	94.0	193.0
47	.319	1.10	10	104.0	217.0
48	.307	1.10	10	103.0	220.0
49	.301	.91	10	97.9	205.0
50	.312	1.10	10	101.0	221.0
MEAN	.296	1.04	10	100.0	211.2
STD DEV	.032	.09	0	4.1	12.0
30	.240	.97	10	94.0	193.0
51	.319	1.10	10	104.0	217.0
52	.307	1.10	10	103.0	220.0
53	.301	.91	10	97.9	205.0
54	.312	1.10	10	101.0	221.0
MEAN	.296	1.04	10	100.0	211.2
STD DEV	.032	.09	0	4.1	12.0

NOTE: numbers in brackets are limits of detection.
 ND - not detected.
 Particle size data in appendix II.

cf:SCPAI&D89

APPENDIX I

ACCURACY DATA

ACCURACY DATA

LAB #900261

	Hg	Cd	Pb	Cu	Zn
<u>MESS-1</u>					
CERTIFIED:	0.171	0.59	34.0	25.1	191
	+/-	+/-	+/-	+/-	+/-
	0.014	0.10	6.1	3.8	17
FOUND:	.234	.63	38	24.5	188.0
	.243	.68	31	27.0	196.0
	.320	.63	32	23.5	182.0
	.220	.67	33	23.6	183.0
	.241	.64	35	24.7	184.0
MEAN	.252	.65	34	24.7	186.6
STD DEV	.039	.02	3	1.4	5.7

BCSS-1

CERTIFIED:	0.129	0.25	22.7	18.5	119
	+/-	+/-	+/-	+/-	+/-
	.012	.04	3.4	2.7	12
FOUND:	.140	.21	24	16.4	105.0
	.140	.20	25	16.0	106.0
	.150	.17	23	16.0	110.0
	.160	.19	27	16.0	109.0
	.140	.22	28	16.0	114.0
MEAN	.146	.20	25	16.1	108.8
STD DEV	.009	.02	2	.2	3.6

(cf:AC900261)

APPENDIX II

RAW DATA