U.S.Department of the Interior
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STUDIES OF SEDIMENT TRANSPORT BY BEAUFORT GYRE PACK ICE, 1992: SEDIMENT, ICE & WATER DATA

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Abstract

Two separate expeditions were made in 1992 to study sediment contained in sea ice of the Beaufort Gyre. An examination of 197 ice-, 47 sea water-, and14 snow-filter-samples, and of 10 sediment/water interface slurries taken during the spring and fall show a wide range of sediment concentrations and particle composition. Particulate concentrations were highest in the ice samples which averaged 33 mg/L and had a high of 821 mg/L. Snow samples had sediment concentrations which averaged 3 mg/L and ranged up to 7 mg/L. Water samples were the cleanest, averaging 1.7 mg/L and ranging to a high of 7.9 mg/L. Almost all samples contained high algal components, and silt-sized mineral particles. Other conspicuous particles were diatoms, and metallic spherules. Rare samples contained quartz, other sand-sized lithofragments, foraminifera, shell fragments, and crustacean larvae. Visual observations and filter analyses of melted sea-ice show the highest, and coarsest concentrations in the gyre's southern fringe. This supports previous studies indicating that sediment is entrained into Beaufort Gyre sea ice in shallow water regions. The lack of turbid ice in a large region along the western fringe of the gyre, downdrift of the newly introduced dirty ice, implies episodic entrainment events.

Introduction

As part of a continuing effort to discern climate change in geologic history, and to understand the possible interrelationships between climate change, and the Arctic Ocean and its ice pack, the U.S. Geological Survey undertook two expeditions to the Beaufort Gyre in 1992 (Figure 1). The first, incidental to a study of methane gas concentrations in Beaufort shelf water and ice sampled ice, in April and May (Figure 2). The second used the US Coast Guard Cutter *Polar Star* as a base for ice sampling during the fall of 1992 (Figure 3). Operations included geophysical transects, piston and box coring, water mass sampling and analyses, and the investigation of physical characteristics of the ice pack. This report presents data concerning the last of these emphases.

Our study of the pack ice centered on three major research thrusts; First, the amount and type of sediment contained in the arctic ice pack and its method of entrainment. Second, the post-entrainment fate of the sediment due to Beaufort Gyre circulation patterns (Figure 1), and the metamorphosis of the ice/sediment mixture with age. Thirdly, the effect of the sediment on visible wavelength sprectral signals and the ice albedo. Related to the Beaufort Gyre, the first two questions have been addressed recently by Barnes et al. (1982), Osterkamp and Gosink, (1984), Kempema et al. (1986; 1989; 1993), Reimnitz et al. (1987; 1990; 1992; 1993; in press:a; in press:b), Reimnitz and Kempema, (1987), and Clayton et al. (1990). The effect of sediment on the albedo will be the subject of future publications.

Two decades of studies on the Beaufort Sea shelf have identified its shallow parts (0-30 m) as the source for modern ice rafted sediment in the deep basin (Reimnitz et al. 1992; in press:b). However, only two major sediment entrainment events producing *turbid ice* occurred during this time (Kempema et al., 1989; Reimnitz et al., in press:b). Two attempts to quantify the sediment load carried by the pack over the Canada Basin have found it to be highly variable (Reimnitz et al., in press:a, in press:b). Considering the observed variability and the small data base, our knowledge is insufficient to permit generalizations about sea-ice sediment transport during interglacial times. The present cruises were aimed at broadening that data

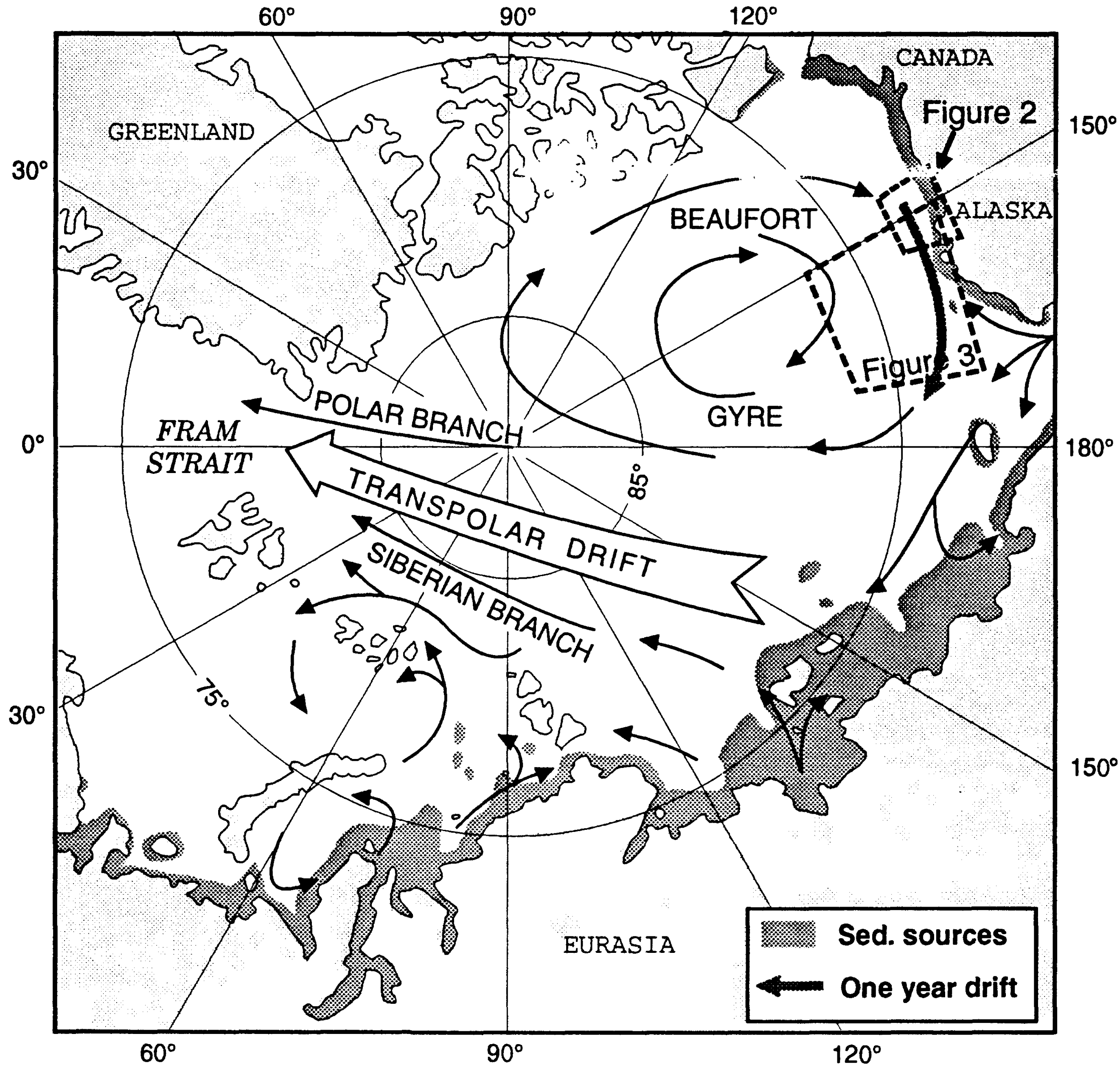

Figure 1: Map of Arctic Ocean showing major circulation patterns, and locations of cruises ABS92 (Fig. 2) and PS92 (Fig. 3) Sediment source areas shallower than 30 m are stippled. One year Beaufort Gyre ice-drift vector modified from Pritchard (1984).

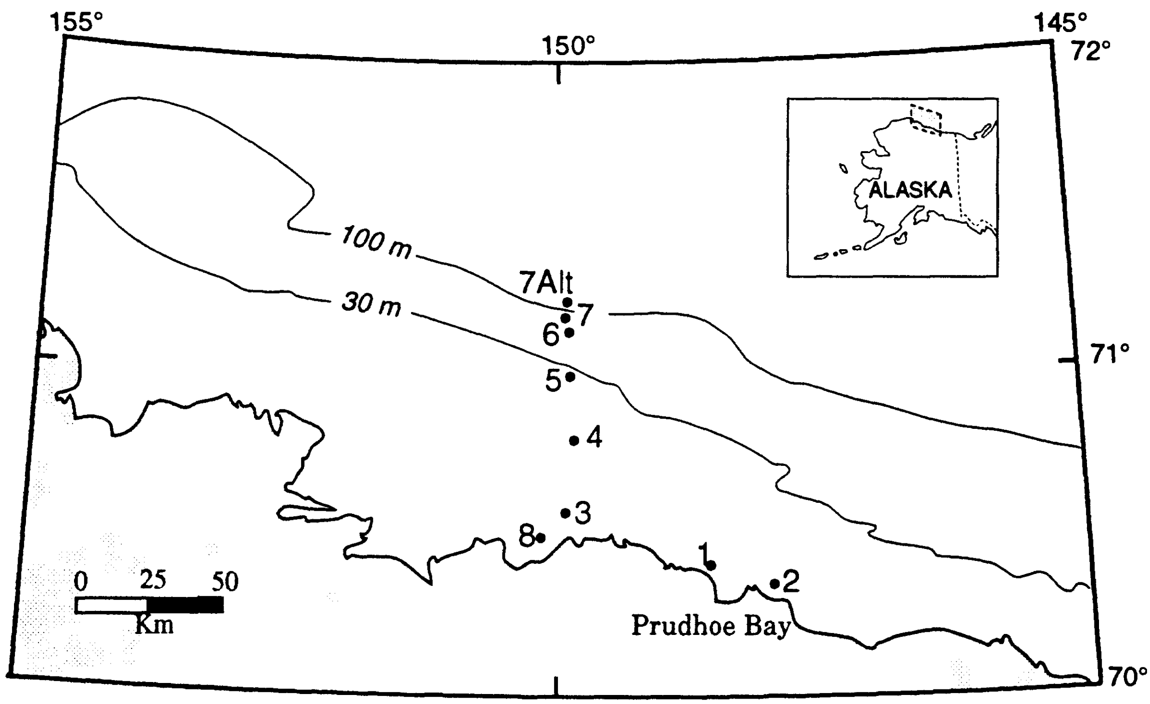

Figure 2: Map showing location of ABS92 stations, and local bathymetry.

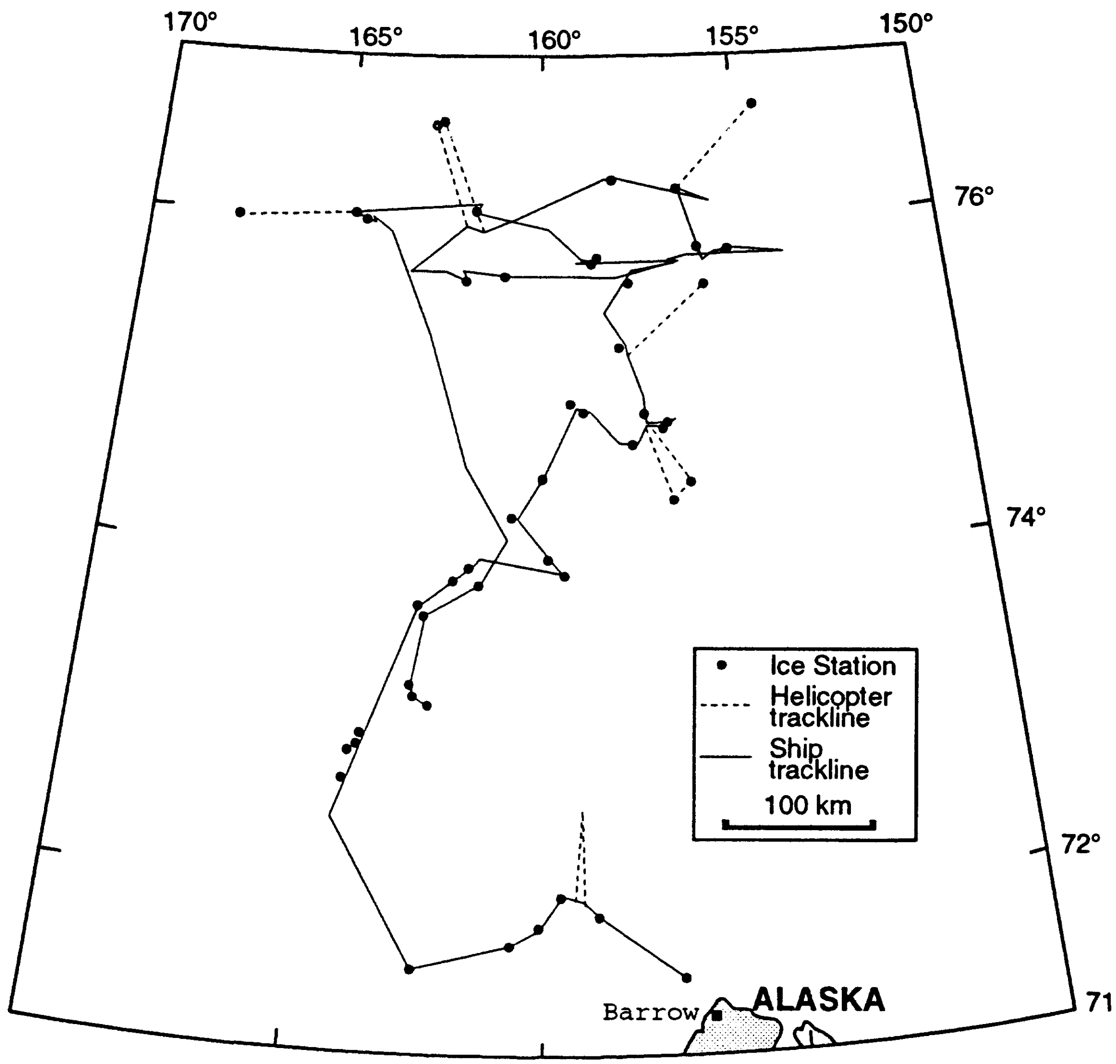

Figure 3: Map showing approximate trackline of USCGC *Polar Star* (PS92), ice sample locations, and helicopter flight lines.

base, to determine the character of ice rafted sediment in the water below the pack, and to compare this sediment with that accumulating on the sea floor today.

Methods

We took ice samples, snow samples and water samples wherever opportunities were provided during the two expeditions (Figures 2, 3; Appendix A). Global Positioning Satellites (GPS) provided navigation control for all tracklines and sample sites. A sample log is presented as Appendix B.

Ice samples were taken by a variety of methods. While cruising and breaking ice, small ice fragments were scooped out of the ocean using a dip net. When on the ice, ice cores were obtained to a depth of one meter using a hand-held corer. In some cases, the cores were split into 10 cm sections to determine the variability of particle content down section. Where sediment was abundant, we took bulk samples by scraping it off the ice pack, or by concentrating the particulates after melting of ice scrapings by flocculation using table salt. Melting of ice and snow samples was accomplished quickly in a microwave oven. Melt water and seawater samples were filtered through pre-weighed 0.4 µm polycarbonate filters using a vacuum pump. Filters were then reweighed in the laboratory to determine particulate concentration in the ice in milligrams per liter of meltwater. Filters were also examined under a binocular microscope. The density of selected ice cores was measured by comparing the volume of ice with the volume of meltwater. Two methods were employed to measure the salinity of the meltwater. Initially we used a temperature corrected refractometer. Later, we used a conductivity meter which provided more accurate data. This change in methodology is reflected in the results.

The snow was sampled to determine differences in particulate load between sea ice and snow. Care was taken during the snow collection to avoid contaimination by the ship or helicopter exhaust. These samples were treated identically to the ice samples.

Plumes of particulates could occasionally be seen in the water column as we broke ice. The characteristics of this sediment was examined by continuously sampling the water through a sea-water intake forward of the ship's discharge at about five meters depth. The water was pumped into a 20 L tank over periods of up to several hours where it was allowed to settle before being sampled, filtered and examined.

In order to study the differences between the sediment in the ice pack and that comprising the sediment/water interface on the sea floor, we collected samples of the surface water and upper millimeter of box and piston cores. These sediments are presumed to represent the most recent sedimentation and should contain any modern ice-rafted components.

The spring and fall expeditions use different conventions for station/sample numbers. The spring expedition's samples all have ABS92 (Alaska-Beaufort Sea 1992) as a preliminary modifier followed by a station number. The fall cruise's sample number's first modifier is PS92 representing *Polar Star* 1992. The second modifier is the Julian Day, followed by the station number for that day, and then the sample number. For example, sample 238-2-4 was taken on Julian Day 238, at station 2, and was the fourth sample at that station.

In addition visual observations were made of regional ice cover and types, percentages of discolored ice, thickness and extent throughout the cruises.

Results

The results of analyses are presented in Appendices C, D, E, and F, and are summarized in Table 1. Several general statements apply to the results as a whole. Some samples were taken as part of experiments, the results of which will be analyzed later, and therefore that data are not included. In addition some filters were used to evaluate the effect of contamination on our calculated sediment concentrations, and these weights are not shown.

Table 1. Summary of samples.

	Sediment concentration (mg/L)			Salinity (ppt)			Density		
	n	Avg.	Range	n	Avg.	Range	n	Avg.	Range
ABS92									
Ice	32	33.3	1.3-307.0	-	-	-	-	-	-
Snow	4	3.3	1.3-6.1	-	-	-	-	-	-
PS92									
Ice	165	33.7	1.2-821.0	121	0.6	0-8.0	31	0.8	0.40-0.98
Water	47	1.7	0.3-7.9	2	26.2	25.5-27	-	-	-
Snow	10	3.3	0.9-7.2	1	-	0	-	-	-

Ten broad categories of particulate matter were found on the filters. These are:

Algae (A): Seen as green silt-sized or finer particles, and white fluffy material.
Quartz (Q): Sand-sized quartz grains.
Foraminifera (F): Benthic or planktic foraminifera.
Diatoms (D):
Wood (W): Woody material distinct from algae and fibers (Fib.).
Metallic Spherules (MS): Silt to sand-sized, metallic beads.
Fibers (Fib): Fibrous plant material.
Sponge spicules (SS):
Lithofragments (L): Sand-sized material other than quartz.
Plastic (P): Results from contamination at various stages of processing. Sources include core liner used to transport cores, tray used while studying and cutting cores, and polypropylene clothing fibers. Also included are paint chips from the ship's hull and tool handles. Large fragments were removed before filter re-weighing, but some remaining contamination could not be avoided.

Silt was seen on all filters in varying amounts and thus is not listed, except where amounts were unusual. Other unusual clasts are noted.

ABS92

32 ice samples from 9 stations yielded sediment concentrations averaging 33.3 mg/L, ranging from 1.3-307.0 mg/L (Table 1). Four snow samples from four stations had sediment concentrations ranging from 1.3 - 6.1 mg/L, averaging 3.3 mg/L. Many filters had large amounts of well-sorted silts, with rare large quartz and rock clasts. Diatoms were quite common. The reader is referred to Appendix C for a listing of particle types on the filters.

We obtained ice samples from the upper two meters of thick first-year ice on a transect of the shelf from 3 m - 80 m water depth. Ice cores at stations 1-3 (Figure 2) had discernable zones of particulate discoloration in the upper 25 cm.

PS92

The 165 ice samples' sediment concentrations ranged from 1.2 to 821.0 mg/L with an average of 33.7 mg/L. (Table 1). Salinities measured on 121 samples varied from 0 to 8.0 ppt with an average of 0.6 ppt. The average may be a slight underestimate caused by the poor resolution of the refractometer. Some measurements of 0 ppt would probably have been a few tenths if read by the conductivity method. Ice densities in 31 measurements ranged from 0.40 to 0.98, averaging 0.80.

Sediment concentrations in 47 water samples ranged from 0.3 - 7.9 mg/L, averaging 1.7 mg/L. Concentrations in snow ranged from 0.9 - 7.2 mg/L, averaging 3.3 mg/L.

Algae were found on many ice-sample filters. Quartz and other sand-sized fragments rarely occurred. Diatoms were rather common, while foraminifera and other biogenic components were found infrequently. Particulate matter on snow-sample filters was primarily algae, but other components were seen. Water-sample filters contained similar particulates, but occurrences of diatoms were more frequent. Core top slurries primarily contained silts. Some had coarser material such as lithoclasts and foraminifera. Full results of the microscopic analyses can be found as Appendices C-F.

From the log of shipboard and aerial observations, three general ice zones can be defined for the fall of 1992. The southern edge of the pack ice northwest of Barrow consisted of a 50-km wide, east-west trending belt of broken, sediment-rich, turbid first-year ice extending up to 72° N (Figure 1). Proceeding west-northwest through this belt, the ship entered intensely discolored ice caused by an algae as determined visually and by filter analysis. According to our previous experiences in the Beaufort Sea and Canada Basin, the amount of algae seems very unusual. The discoloration was patchy on a scale of kilometers in first-year ice. Only at distances of 10 to 20 m was it possible to distinguish this algal discoloration by its greenish-reddish tinge from the greyish color of terrigenous sediment traversed along the southern ice fringe. In undisturbed ice, algal discoloration was prevalent below a 30-cm thick layer of clean, dense ice. The discolored ice characteristically was perforated by approximately 10-cm diameter "decay-voids". The northern-most areas traversed in the cruise were dominated by very-clean, multiyear ice. On the return trip southward, thickening snow cover made visual observations of discoloration increasingly difficult.

Discussion

The data and visual observations of the ice allow some broad interpretations, precluding complete sample analyses. Terrigenous clastics occurred in the southern fringe of the gyre similar to conditions observed from the *Polar Star* in 1988 and 1989. The ice in the interior of the Beaufort Gyre traversed or observed from the air in 1992 held only minute amounts of particulate matter when compared to those seen and measured in 1988 and 1989.

The dearth of terrigenous particulate matter in the interior and western parts of the Beaufort Gyre, and the abundance in the southern fringe near the source regions fits into an evolving understanding of sediment ice rafting in the Arctic Basin. Widely spaced seasonal pulses of sediment-laden turbid ice are introduced from the Beaufort Sea shelf into the slowly rotating gyre. Here, they become interspersed by long stretches of clean ice from successive years of calm freeze-up conditions. As the pulses move further along the fringe of the gyre, they become mixed with adjacent regions of clean ice. During the cruise we observed a pulse of new turbid ice entering the gyre along the southern fringe. The lack of terrigenous particulates in the ice of the interior of the gyre may be a permanent condition, suggesting that large-scale mixing of ice across the regional drift pattern is not effective. We hope that the regional algal discoloration can be detected spectrally and delineated in satellite images helping to resolve this question. In addition, such algal blooms may significantly influence rates and patterns of ice melting, as suggested by the internal decay features observed in discolored ice.

Acknowledgments

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APPENDIX A - STATION INFORMATION

Station #	Date	Time (Local)	Latitude (North)	Longitude (West)	Filter #s	Bulk sample
ABS92						
ABS92-1	30-Apr	1500	70°24.9	148°31.7	301,303/4, 306,308-314	
ABS92-2	30-Apr	1730	70°21.2	147°56.8	305/7	
ABS92-3	1-May	0900	70°35.8	149°53.7	318,320/4/5	
ABS92-4	1-May	1200	70°48.4	149°50.2	315-317,321	
ABS92-5	1-May	1500	71°00.5	149°52.7	314/9,322/3	
ABS92-6	2-May	0945	71°09.0	149°52.9	327-329,334	
ABS92-7	2-May	1500	71°12.1	149°54.8	332/3/7	
ABS92-7Alt	2-May	1400	71°13.6	149°55.0	336/8	
ABS92-8	2-May	1800	70°30.9	150°08.8	327,330/1/5	
PS92						
234-1	21-Aug	1600	71°27.8	157°16.5	700-705	Yes
235-1	22-Aug	0500	71°50.0	158°49.2	706	Yes
235-2	22-Aug	1130	71°57.4	159°39.8	707	
235-3	22-Aug	1310	71°46.5	160°02.3	708	
235-4	22-Aug	1500	71°39.9	160°38.5	710	Yes
235-5	22-Aug	2000	71°35.0	162°09.3	711	
92-AR-B1	23-Aug	0709	72°24.2	164°18.2	713	Yes
237-1	24-Aug	1440	72°38.7	164°03.5	714	
237-2	24-Aug	1345	72°48.8	163°57.0	715	
237-3	24-Aug	1750	72°51.9	163°48.5	716/717	
237-4	24-Aug	1915	72°54.5	163°46.2	718	
238-1	25-Aug	0530	73°40.9	162°38.6	736/737	
238-2	25-Aug	0900	73°42.2	162°44.6	719-735	Yes
238-3	25-Aug	1620	73°53.0	161°56.9	738	
238-4	25-Aug	1900	73°57.1	161°31.7	739	
239-1	26-Aug	1100-1145	73°59.9-73°59.1	159°57.7-159°51.0	744	
239-2	26-Aug	1300-1330	73°58.0-73°57.3	159°41.9-159°35.7	741	
239-3	26-Aug	1700	73°55.1	159°23.3	743	Yes
239-4	26-Aug	1900-2000	73°54.8-73°55.4	159°29.0-159°29.7	745	
240-1	27-Aug	0800	73°59.4	159°52.5	747-751	

240-2	27-Aug	1000-1100	73°58.6-74°03.5	159°51.3-160°03.3	752-753	
240-3	27-Aug	1115-1315	74°05.2-74°15.1	160°08.8-160°35.0	754-755	
240-4	27-Aug	1500	74°15.7	160°35.9	756	Yes
240-5	27-Aug	1700-1900	74°25.5-74°29.0	160°13.0-160°02.6	757-758	
241-1	28-Aug	0730	74°30.4	159°57.8	759-772	Yes
241-1-BC	28-Aug	0758	74°30.6	159°58.6		Yes
241-2	28-Aug	1600	74°58.2	159°17.5	774	
241-3	28-Aug	1700-1900	74°58.2-74°53.9	159°15.2-158°58.9	775-776	
242-1	29-Aug	0730-0930	74°47.7-74°47.3	158°35.1-158°15.1	777-778	
242-2	29-Aug	1100	74°54.5	158°59.5	779-797	Yes
242-3	29-Aug	2000	74°43.1	157°48.0	798-809	
243-1	30-Aug	0710-0815	74°49.7-74°49.0	157°25.8-157°17.3	811-812	
243-2	30-Aug	0136	74°49.2	157°33.5	813	
243-3	30-Aug	0634	74°49.4	157°25.5	814-815	
243-4	30-Aug	0950	74°49.5	157°12.3	816	
243-5	NO ST. 5					
243-6	30-Aug	1700	74°48.7	157°05.8	817-818	
243-7	30-Aug	1737	74°48.8	157°06.2	819	
243-8	30-Aug	0930-0950 1205-1230 1500-1525	74°49.2-74°49.2 74°49.6-74°48.9 74°48.4-74°48.8	157°16.5-157°13.1 157°11.5-157°10.0 157°07.9-157°07.6	820	
244-1	31-Aug	1330-1445	74°51.9-74°49.2	156°56.6-157°05.3	821	
245-1	1-Sept	1210-1310	74°49.3-74°49.2	157°16.6-157°26.1	822-823	
245-2	1-Sept	1540-1645	74°48.9-74°49.4	157°16.5-157°05.6	824	
245-3	1-Sept	1800	74°49.8	157°03.9	825-828	
246-1	2-Sept	1120	74°22.7	156°59.4	829-836	
246-2	2-Sept	1235	74°29.0	156°33.6	837-844	Yes
246-3	2-Sept	1455-1905	74°46.1-74°50.2	157°43.0-157°46.0	845	
246-4	2-Sept	1905-2105	74°50.2-74°52.6	157°46.0-157°41.9	846	
247-1	3-Sept	0439	74°59.3	157°38.8	847	Yes
247-2	3-Sept	0700-1120	75°03.3-75°15.4	157°44.1-157°59.0	848	
247-3	3-Sept	1447/1600	75°40.0-75°17.9	156°02.2-158°01.2	849-851	
247-4	3-Sept	1630	75°18.7	158°02.7	852	
248-1	4-Sept	0845-1340	75°36.4-75°36.6	158°17.7-158°17.1	853	
248-2	4-Sept	1000-1340	75°36.6-75°46.1	158°17.1-158°48.6	854	

248-3	4-Sept	1600	75°42.3	157°46.7	855-857	
250-1	6-Sept	1000	75°52.8	156°07.6	858-866	
251-1	7-Sept	1215-1930	75°50.3-75°50.3	156°00.4-153°58.4	869	
252-1	8-Sept	1000	75°50.9	155°19.8	867	
253-1	9-Sept	1300	75°51.2	156°04.2	883-884	
253-2	9-Sept	1540-1740	75°51.1-75°50.8	155°30.1-155°28.2	870	
253-3	9-Sept	1900	75°54.9	156°15.0	871-873	
254-1	10-Sept	0800	76°15.5	156°33.1	874-882	
254-2	10-Sept	1448	76°45.6	154°21.6	886	
254-3	10-Sept	1500	76°15.79	156°34.14	887	Yes
256-1	12-Sept	0900	76°20.5	158°06.8	888	
256-2	12-Sept	1450-1930	76°19.4-76°22.8	158°29.6-159°11.9	889	
257-1	13-Sept	0755-1115	76°00.4-75°59.8	160°04.1-161°08.3	890	
257-2	13-Sept	1120-1530	75°59.8-76°01.1	161°10.2-162°03.3	891	
257-3	13-Sept	1330	76°40.9	162°45.6	892-899	
257-4	13-Sept	1540-2045	76°01.2-75°59.3	162°04.1-163°19.7	501	
258-1	14-Sept	0700-1000	75°45.6-75°43.4	162°17.7-161°48.6	502	
258-2	14-Sept	1113	75°44.1	160°51.6		Yes
258-3	14-Sept	1930	75°42.6	161°50.3	503-508	
259-1	15-Sept	0820	75°44.6	160°54.8	509	
260-1	16-Sept	0329	75°43.8	160°05.5	510	Yes
260-2	16-Sept	0700-1140	75°44.1-75°49.6	160°09.9-158°55.8	511	
260-3	16-Sept	1145-1330	75°49.6-75°49.5	158°55.8-158°41.7	512	
260-4	16-Sept	1400	75°49.4	158°41.9	513-522	
261-1	17-Sept	0800	75°50.6	158°38.9	523-525	
261-2	17-Sept	1755-2255	75°11.6-76°02.6	159°02.6-159°50.5	526	
262-1			No sample			
262-3	18-Sept	1510-1810	76°02.4-75°54.6	159°59.6-160°32.2	528	
262-4	18-Sept	1815-1939	75°54.2	160°33.7	529	
263-1	19-Sept	1050-1250	76°05.5- 6°04.5	160°40.6-161°05.8	531	Yes
263-2	19-Sept	1300-1525	76°04.7-76°07.9	161°08.4-161°44.1	530	
263-3	19-Sept	1800	76°07.2	161°40.1	532-533	
264-1	20-Sept	0945-1140	76°11.5-76°10.2	161°42.1-162°10.1	534	
264-2	20-Sept	1145-1445	76°10.3-76°07.1	162°11.3-162°47.7	535	
264-4	20-Sept	1630-1930	76°05.9-76°00.0	162°47.4-163°25.0	537	

APPENDIX A - STATION INFORMATION
CONTINUED

264-5	20-Sept	1930-2140	76°00.0-76°02.3	163°25.5-163°58.6	538	
265-1	21-Sept	0300	76°05.2	164°50.2	539	
265-2	21-Sept	0930	76°04.9	164°46.5	540-541,544	Yes
265-3	21-Sept	0901	75°59.8	167°45.9	542-543	
265-4	21-Sept	1300	76°03.8	164°28.4	545-546	
266-1	21/22-Sept	2230-0620	76°00.3-75°31.1	163°50.9-163°01.2	547	
266-2	22-Sept	0620-0850	75°31.1-75°23.8	163°01.2-162°48.6	548	
266-3	22-Sept	1030	75°22.8	162°46.4	549	
266-4	22-Sept	1120-1430	75°22.8-75°15.4	162°46.4-162°21.1	550	
266-5	22-Sept	1440-1820	75°15.7-74°55.7	162°18.2-162°23.3	401	
266-6	22-Sept	2130-2330	74°47.1-74°34.7	162°07.9-161°47.2	402	
267-1	22/23-Sept	2330-0655	74°34.7-74°08.5	161°47.2-160°49.6	403	
267-2	23-Sept	0700-0850	74°08.3-74°03.3	160°49.6-160°45.5	404	
267-3	23-Sept	1000-1640	74°03.6-73°52.0	160°45.9-161°51.2	406	
267-4	23-Sept	1400	73°50.7	161°24.9		Yes
267-5	23-Sept	2130	73°39.6	162°36.8	407-409	
267-6	23-Sept	1645-2245	73°52.0-73°32.4	161°52.6-162°50.9	410	
268-1	23/24-Sept	2255-0650	73°32.4-73°15.2	162°50.9-162°51.0	411	
268-2	24-Sept	0920	73°12.8	162°49.4	412	
268-4	24-Sept	1430	73°09.7	162°48.1		Yes
268-5	24-Sept	1715	73°06.6	162°27.5	415	

APPENDIX B - SAMPLE LOG

ABS92-Alaska Beaufort Sea 1992

Notes:
•Sample number format is: Cruise #(ABS92)-Station# Sample #.

April 30, 1992

Sample Number *Filter Number*
ABS92-1A 310,311,312,313
Representative split of 80 cm ice core. 0-10 cm composed of granular ice; 10-15 cm shows slight discoloration; 21-25 cm has a dirty band; 27-80 cm is clean ice.

ABS92-1A(65-70cm) 301
5 cm section of clean ice from core.

ABS92-1A(snow) 304
Snow sample from on top of core.

ABS92-1B 308,309
Representative split of core with granular surface ice and a dirty band at 24-28 cm. Clean below 33 cm.

ABS92-1C 306
Representative split of 80 cm core with increasing sediment to a band at 71-74 cm.

ABS92-1D 303
Representative split of 90 cm core. Dirty ice band at 27-32 cm.

ABS92-2A 307
Representative split of 85 cm core. 0-17 cm composed of granular surface ice. 17-35 cm dirty; 35-55 cm cloudy; 55-85 cm clean.

ABS92-2B 305
Representative split of clean ice core.

May 1

ABS92-3A 320
Representative split of 90 cm core; 0-25 cm 'cleaner' ice, 27-43 cm dirty ice, 47-90 cm clean ice. Core taken in area of flat, fast-ice.

ABS92-3A(snow) 318
Clean snow sample from same site.

ABS92-3B 324,325
Representative split of 80 cm core, 0-18 cm 'cleaner' ice; bands of dirty ice between 18-32 cm, 32-47 cm-cleaner, 47-51 cm-dirty ice, 52-80 cm -mostly 'cleaner' ice. Core taken in rubble field with 50-80 cm of surface relief.

ABS92-4A 321
Representative split of 85 cm clean ice core.

ABS92-4B 315,316
Center section of 90 cm very clean ice core.

ABS92-4C 317

Representative split of 90 cm core of very clean ice.

ABS92-5A 319
Section of 90 cm clean ice core.

ABS92-5A(snow) 314
Snow from same site.

ABS92-5B 322
Representative split of 90 cm clean ice core.

ABS92-5C 323
Representative split of 90 cm clean ice core.

May 2
ABS92-6A 334
Representative split of 90 cm clean ice core.

ABS92-6B 328
Representative split of 120 cm clean ice core.

ABS92-6C 329
Representative split of 120 cm clean ice core.

ABS92-7A 333
Representative split of 90 cm clean ice core.

ABS92-7B 332
Representative split of 100 cm clean ice core.

ABS92-7C 337
Representative split of 100 cm clean ice core.

ABS92-7Alt 336,338
Representative split of 90 cm clean ice core.

ABS92-8A 327
Representative split of 90 cm clean ice core.

ABS92-8A(snow) 335
10-20 cm of snow from on top of ice at above site.

ABS92-8B 330
Representative split of 70 cm clean ice core.

PS92-Polar Star 1992

Notes:

•Sample number format is: Cruise #(PS92)-Julian Day (Alaskan Time)-Station #-Sample #.
•Some samples resulted from experiments unrelated to this Open-File Report, and are thus not listed in this log.

August 21, 1992

Sample Number	*Filter Number*
PS92-234-1-1	701
234-1-1	702
234-1-1	703
234-1-1	704

Selected pieces of clean, granular first-year (FY) ice.

234-1-2 705
Selected pieces of dirty FY ice. A bulk sample was also taken.

August 22

235-1-1 706
A composite of 8 randomly selected ice pieces representative of the FY ice. A bulk sample was also taken.

235-2-1 707
Single piece of clean-looking multiyear (MY) ice with orange algal discoloration.

235-3-1 708
A composite of four pieces of dirty-looking MY ice.

235-4-1 710
A composite of three pieces of dirty-looking MY ice. A bulk sample was also taken.

235-5-1 711
A composite of four ice pieces from a clean-looking floe.

August 23

P1-92-AR-B1 713
Filtration of water from the top of a box core. A bulk sample was also taken.

August 24

237-1-1 714
Several pieces of turbid FY ice.

237-2-1 715
Representative split of 25 pieces of slightly turbid ice collected over 20 minutes.

237-3-1 716
717
5 pieces representative of turbid ice. The total weights of sediment on these two filters has been added to calculate particulate concentrations (Table 1).

237-4-1 718
Sample of dense, massive MY ice appearing clean with some algal discoloration.

August 25

238-1-1 736
238-1-2 737
Sample 1 was taken of ice probably discolored by algae. Sample 2 was taken at the same location and was an attempt to sample ice discolored by sediment, in order to compare with sample 1.

238-2-1
A bulk sample of sediment scraped from submerged ice ram fringing floe. Sieved through a 125 µm screen. Treated with chlorine bleach.

238-2-2(0-90cm) 735
Representative split of 90 cm long ice core taken from discolored surface of 50 m granular floe.

238-2-3(0-90cm) 734
Representative split of 90 cm long ice core taken from discolored surface of 50 m granular floe.

238-2-4(0-10cm) 719
238-2-4(10-20) 720
238-2-4(20-30) 721
238-2-4(30-40) 722
238-2-4(40-50) 723
238-2-4(50-60) 724
238-2-4(60-70) 725
238-2-4(70-82) 726
Core 238-2-4 taken of discolored ice surface. Core split into 10 cm increments to see down core variations. Radiometer measurements were taken.

238-2-5(0-10cm) 727
238-2-5(10-20) 728
238-2-5(20-30) 729
238-2-5(30-40) 730
238-2-5(40-50) 731
238-2-5(50-60) 732
238-2-5(60-70) 733
Core 238-2-5 taken of same discolored ice as core 238-2-4 but the ice was overlain by a clean, firm, 10 cm thick, old snow layer. Core split into 10 cm increments to see down core variations. Radiometer measurements were taken.

238-2-PC1
Surface slurry from piston core 1.

238-3-1 738
Two pieces of ice appearing to be discolored by algae.

238-4-1 739
Four pieces of discolored ice.

August 26

239-1-1 744
239-2-1 741
239-1-1 and 239-2-1 were attempts to try to find some terrigenous sediment in MY ice. These samples appear to contain mostly algae, although some other pieces of ice looked to contain sediment but could not be sampled.

239-3-1
Bulk sample of discolored matter scraped off ice's surface. Contains very little, if any terrigenous detritus.

239-3-2(0-90cm)
Representative split of 90 cm ice core.

239-4-1 745
Water sample collected while travelling through clean-looking ice.

August 27
240-1-1(0-90cm) 747
Representative split of 90 cm ice core taken from area of low relief on clean, hummocky floe. No apparent structure beyond surface granular layer.

240-1-2(0-75cm) 748
Representative split of 75 cm ice core taken from 1.5 m hummock. No apparent structure beyond surface granular layer.

240-1-3(0-10cm) 749
240-1-3(10-20) 750
240-1-3(20-70) 751
Core through faintly discolored, rough ice surface in area of low relief. 2 mm diameter dark specks seen at 15 cm depth.

240-2-1 752
753
Water sample collected while steaming through MY, 6/10ths dirty ice.

240-3-1 754
755
Water sample collected while steaming through MY, 6/10ths dirty ice.

240-4-1 756
Water from the top of piston core P6. Also collected bulk sediment sample.

240-5-1 757
758
Water sample collected while steaming through MY, surficially discolored ice.

August 28
241-1-1
Bulk sample of surface soup from piston core P7.

241-1-2
Bulk sample of surface scrapings from top of relief features in vicinity of pressure ridge. Not filtered. Partly consists of pellets, that have a slight grittiness. Preserved in alcohol.

241-1-3(0-10cm) 759
241-1-3(10-20) 760
241-1-3(20-30) 761
241-1-3(30-40) 762
241-1-3(40-50) 763
241-1-3(50-83) 765

Clean snow surface ice core. Radiometer readings were taken.

241-1-4(0-10cm)	764
241-1-4(10-20)	766
241-1-4(20-30)	767
241-1-4(30-40)	768
241-1-4(40-50)	769
241-1-4(50-76)	770

Discolored surface ice core at base of pressure ridge. Radiometer readings were taken.

241-1-5(0-90cm)	771

Representative split of ice core from top of pressure ridge.

241-1-6(0-93cm)	772

Representative split of core from hard ice surface in lee of pressure ridge.

241-1-7

Bulk sample of surface soup from Box core #5.

241-2-1(0-35cm)	774

Upper 35 cm of 80 cm core taken through clean MY floe.

241-3-1	775
	776

Water sample collected while travelling through open water leads and 70% MY ice.

August 29

242-1-1	777
	778

Water sample collected while travelling through clean 40% FY ice.

242-2-1

Bulk sample of pellets collected from top of pressure ridge near hummocky floe where radiometer measurements were taken.

242-2-2(0-78cm)	779

Representative split of ice core taken on pellet covered pressure ridge. Top 40 cm was very slushy, then hard and dense. Radiometer measurements were taken.

242-2-3(0-10cm)	780
242-2-3(10-20)	781
242-2-3(20-30)	782
242-2-3(30-40)	783
242-2-3(40-50)	784
242-2-3(50-90)	785

Core from clean ice where radiometer readings were taken.

242-2-4(0-10cm)	786
242-2-4(10-20)	787
242-2-4(20-30)	788
242-2-4(30-40)	789
242-2-4(40-50)	790
242-2-4(50-72)	791

Core from discolored ice where radiometer readings were taken.

242-2-5(0-10cm) 792
242-2-5(10-20) 793
242-2-5(20-30) 794
242-2-5(30-40) 795
242-2-5(40-50) 796
242-2-5(50-80) 797
Core from discolored ice where radiometer readings were taken.

242-3-1(0-10cm) 798
242-3-1(10-20) 799
242-3-1(20-30) 800
242-3-1(30-40) 801
242-3-1(40-50) 802
242-3-1(50-85) 803
Ice core of discolored ice in area of hummocky ridges. Radiometer readings taken.

242-3-2(0-10cm) 804
242-3-2(10-20) 805
242-3-2(20-30) 806
242-3-2(30-40) 807
242-3-2(40-50) 808
242-3-2(50-88) 809
Ice core of clean ice at same station as 242-3-1. Radiometer readings taken.

August 30
243-1-1 811
812
Water sample.

243-2-1 813
Box core #7 water above top sediment layer.

243-3-1 814
815
Box core #8 water above sediment surface.

243-4-1 816
Surface water from Box core #9.

THERE IS NO STATION 243-5

243-6-1(0-10cm) 817
243-6-1(0-85) 818
Core of very faintly discolored ice on a >100m diameter floe of very clean looking, slightly hummocky MY(?) ice covered by 10 cm of snow. Radiometer readings were taken.

243-7-1 819
Surface water from Box core #10.

243-8-1 820
Water sample collected over three times (0930-0950, 1205-1230, 1500-1525).

August 31

244-1-1	821

Water sample.

September 1

245-1-1	822
	823

Water sample.

245-2-1	824

Water sample.

245-3-1(0-10cm)	825
245-3-1(10-30)	826
245-3-1(30-50)	827
245-3-1(50-84)	828

Core of discolored ice with a rough surface. Ice is about 5 m thick. Radiometer readings taken.

September 2

246-1-1(0-10cm)	829
246-1-1(10-30)	830
246-1-1(30-50)	831
246-1-1(50-74)	832

Core of clean ice taken on large floe after helicopter landing. Radiometer readings taken.

246-1-2(0-10cm)	833
246-1-2(10-30)	834
246-1-2(30-50)	835
246-1-2(50-90)	836

Core of discolored ice taken on large floe after helicopter landing. Core appeared clean just below the surface. Radiometer readings taken.

246-2-1(0-10cm)	837
246-2-1(10-30)	838
246-2-1(30-50)	839
246-2-1(50-90)	840

Core of clean ice taken on large floe after helicopter landing. Radiometer readings taken.

246-2-2(0-10cm)	841
246-2-2(10-30)	842
246-2-2(30-50)	843
246-2-2(50-90)	844

Core of discolored ice taken on large floe after helicopter landing. Radiometer readings taken.

246-2-3

Bulk sample of surface scrapings of snow.

246-3-1	845

Water sample.

246-4-1	846

Water sample.

247-1-1	847

Surface water and sediment slurry from top of Box core 13. Also took a bulk sample.

247-2-1 848
Water sample collected while traversing clean, MY ice with little relief.

247-3-1&2a 849
247-3-1&2b 850
Representative samples of two cores taken from clean, 4 m thick, MY floe at helicopter station.

247-3-3 851
Snow from helicopter station.

247-4-1(0-70cm) 852
Representative split of ice core through clean MY ice covered with 2-3 cm snow.

248-1 853
Sea water sampled while traversing an area of mostly small MY floes.

248-2 854
Sea water sampled while traversing an area of "rotten" FY floes and large MY floes.

248-3-1(0-10cm) 855
248-3-1(10-30) 856
248-3-1(30-90) 857
Ice core of MY floe at a radiometer measurement site. Surface covered with a glazed, crusted snow pack. No discoloration seen.

September 5
No samples taken.

September 6
250-1-1(0-10cm) 858
250-1-1(10-29) 859
250-1-1(20-30) 860
250-1-1(30-40) 861
250-1-1(40-50) 862
250-1-1(50-60) 863
250-1-1(60-70) 864
250-1-1(70-87) 865
Core from disjointed MY floe several hundred meters in extent. Radiometer readings taken.

250-1-2 866
Fluffy new snow.

250-1-3
Brackish water sample of greenish-blue shallow melt pond with algal debris on ponds bottom. 10 cm thick ice covered the pond's surface. Sampled for salinity measurement (29.00 ppt)

September 7
251-1-1 869
Sea water sampled while traversing spotty algal discolored ice.

September 8
252-1-1 867

Representative split of an entire core from small, clean FY floe 1.3 m thick.

September 9
253-1-1 883
253-1-2 884
2 samples of new congelation ice sampled from a lead.

253-2-1 870
Water sampled while traversing area of clean MY ice up to 5 m thick.

253-3-1(0-70cm) 871
872
Representative split of core. Contamination suspected due to many particles and a rim around the melt-bucket

253-3-2 873
New clean snow sample from below surface crust.

September 10
254-1-1(0-10cm) 875
254-1-1(10-20) 876
254-1-1(20-30) 877
254-1-1(30-40) 878
254-1-1(40-50) 879
254-1-1(50-60) 880
254-1-1(60-70) 881
254-1-1(70-83) 882
Core of clean-looking ice from MY floe, 80 m in diameter, 2-3 m thick. Surface snow scraped off. Radiometer readings taken.

254-1-2 874
Sample of clean snow taken from just below surficial snow covering.

254-2-1(0-80cm) 885
Core of extensive flat floe.

254-2-2 886
Snow sample.

254-3-1 887
Sample from sediment/water interface of Box core 14. Also took a bulk sample.

September 11
No samples taken.

September 12
256-1-1 888
Small piece of algae-laden ice.

256-2-1 889
Water sample taken while steaming through leads and MY ice with occasional algal discoloration.

September 13
257-1-1 890

Water sample taken while steaming through leads and MY ice. Algal discoloration seen on 50% of floes.

257-2-1 891
Water sample taken while steaming through leads and MY ice. Algal discoloration seen on 50% of floes.

257-3-1 892
Representative split of core taken at helicopter station of rafted FY ice with a grayish tint.

257-3-2(0-10cm) 893
257-3-2(10-20) 894
257-3-2(20-30) 895
257-3-2(30-40) 896
257-3-2(40-50) 897
257-3-2(50-57) 898
Core taken at helicopter station of rafted FY ice with a grayish tint.

257-3-3 899
Clean snow sample from helicopter station.

257-4-1 501
Water sample collected while travelling through algae-rich 50% MY and 50% FY ice.

September 14
258-1-1 502
Water sample collected while travelling through leads and MY ice.

258-2-1
Bulk sample of sediment/water interface of box core 15.

September 15
259-1-1(0-85cm) 509
Representative split of clean ice core taken below the snow cover on a MY floe.

September 16
260-1-1 510
Water from the top of box core 16. Also took bulk sample.

260-2-1 511
Water sample collected while traversing 50% MY and 50% FY floes with some algal discoloration.

260-3-1 512
Water sample collected while traversing 50% MY and 50% FY floes with some algal discoloration.

260-4-7 517
Clean snow sample.

September 17
261-1-1 523
Very clean, new snow.

261-1-2(0-30cm) 524
261-1-2(30-90) 525
Ice core from 1.2 m thick floe.

261-2-1 526
Sea water sample.

September 18
There is no station. #1

262-3-1 528
Water sample collected while travelling through leads and algae discolored ice.

262-4-1 529
Water sample collected while travelling through leads and algae discolored ice.

September 19
263-1-1 531
Sea water sampled in area of clean ice.

263-2-1 530
Sea water sampled in area of clean ice.

263-3-1(20-30cm) 532
263-3-2(0-20,30-80) 533
Ice core of 2.6 m thick MY floe, with a 4 cm layer of 1 mm dark specks at 20-30 cm (lesser amounts at 10-20) that was treated as 263-3-1.

September 20
264-1-1 534
Sea water sampled in area of clean ice.

264-2-1 535
Sea water sampled in area of clean ice.

264-4-1 537
Sea water sampled in area of clean ice.

264-5-1 538
Sea water sampled in area of clean ice.

September 21
265-1-1 539
Sample of water from top of box core 17.

265-2-1(0-30cm) 541
Core of new ice.

265-2-2 544
Snow sample.

265-2-3 540
Bulk sediment sample concentrated from hummocky outcrop of dirty ice by flocculation.

265-3-1 542
Representative split of core of MY ice from helicopter flight.

265-3-2 543
Sample of clean snow.

265-4-1(0-20cm) 545
Ice core of 20 cm thick new ice.

265-4-2 546
Sample of new snow.

September 22
266-1-1 547
Water sampled while traversing algae discolored ice.

266-2-1 548
Water sampled while traversing algae discolored ice.

266-3-1(0-70cm) 549
Representative split of FY ice core. Upper 20 cm of core was solid, underlain by rotten ice.

266-4-1 550
Water sample collected while traversing areas of clean ice with occasional dirty-loooking hummocks.

266-5-1 401
Water sample collected while traversing areas of clean MY ice (80%) and new ice (20%). Some algal discoloration present, with increasing amounts of sediment discoloration.

266-6-1 402
Water sample collected while traversing through an area of increasing amounts of sediment in the ice.

September 23
267-1-1 403
Water sample collected while traversing areas of new ice. Evidence of sediment inclusions in old ice, and snow.

267-2-1 404
Water sample collected while traversing areas of new ice. Evidence of sediment inclusions in old ice, and snow.

267-3-1 406
Water sample collected while traversing areas of new ice.

267-4-1
Bulk sample of various ice pieces collected while breaking algae/sediment laden ice. Decanted algae.

267-5-1(0-30,35-90cm)407
267-5-1(30-35) 408
Ice core separated into two major ice types: clean ice from 0-30 cm & 35-90 cm, and an algal layer from 30-35 cm.

267-5-2 409
Snow sample.

267-6-1 410
Water sample collected while traversing areas of new ice.

September 24
268-1-1 411
Water sample collected in area of heavy MY ice.

268-2-1(10-21cm) 414
Algae from 12-21 cm in ice core.

268-2-2 412
Snow sample.

268-4-1
Bulk sample of ?algae collected from MY ice. Occurred as layers in ice.

268-5-1(0-80cm) 415
Representative split of ice core drilled into discolored ice in area of pressure ridging.

APPENDIX C - ICE SAMPLE FILTERS

Filter #	Sample #	Sed. con. (mg/L)	Salinity (ppt)	Ice density	Notes
					KEY A=algae, Q=quartz, F=foraminifera, D=diatoms, W=wood, MS=metallic spherules, Fib=fibers, SS=sponge spicules, L=lithofragments, P=plastic
	ABS92				
301	ABS92-1A (65-70cm)	1.91			P,A,W,Q
303	ABS92-1D	36.62			L,Fib,A,F
305	ABS92-2B	3.35			P,L,Q
306	ABS92-1C	48.27			Fib,A,
307	ABS92-2A	115.68			L,W,Q
308	ABS92-1B	125.84			W,F,L,Q
309	ABS92-1B	199.52			Q,W,L
310	ABS92-1A	256.60			silt
311	ABS92-1A	270.88			A,Fib,D,Q
312	ABS92-1A	277.00			Q,Fib,A
313	ABS92-1A	306.96			Q,Fib,A
315	ABS92-4B	3.87			SS,D,L
316	ABS92-4B	3.71			D,L
317	ABS92-4C	1.96			D,Fib,MS
319	ABS92-5A	2.05			SS,P,Q,L
320	ABS92-3A	45.70			Q,L,P
321	ABS92-4A	2.68			P,Q,D,F,SS,A,L
322	ABS92-5B	3.20			P,SS,Q,D,MS
323	ABS92-5C	2.12			P,L,Q,D
324	ABS92-3B	51.40			A,D
325	ABS92-3B	71.09			F,D,Fib,ostracod
327	ABS92-8A	24.36			Q,L
328	ABS92-6B	3.17			L,P,MS
329	ABS92-6C	3.00			L,Fib
330	ABS92-8B	9.74			Fib,L,D
331	ABS92-8C	11.16			Q,L
332	ABS92-7B	3.81			Q,L,Fib

333	ABS92-7A	2.97			Q,L,Fib,P,D,MS
334	ABS92-6A	1.29			P,Fib,L,Q
336	ABS92-7 Alt.	1.52			P,L,Fib
337	ABS92-7C	1.73			P,Q,L,Fib
338	ABS92-7 Alt.	3.69			P,Fib,Q,L
	PS92				
701	PS92-234-1-1	11.58			Fib,P,A,L,MS,D,SS
702	234-1-1	10.41			Fib,A,P
703	234-1-1	14.8			D,Fib,P,A,Q,W
704	234-1-1	27.22			L,Fib,P,Q,A,D
705	234-1-2	316.26	0		Q,D,A,Thick sediment layer obscures filter
706	235-1-1	71.16	0		A,Q,Fib,D,SS,L
707	235-2-1	821.04	0		A,Thick sediment layer obscures filter
708	235-3-1	317.55	0		A,D,?F,Fib
710	235-4-1	563.89	0		A,L,Crustacean larvae,D,SS,Fib
711	235-5-1	9.72	0		P,L,Fib,A,MS
714	237-1-1	175.41	0.5		A,SS,P,D,Q
715	237-2-1	75.71	4		A,SS,Fib,P,L,D,MS,Q
716	237-3-1				Same sample as #717;Olive green color,A,Fib,P
717	237-3-1	108.04	1		Q,same sample as #716
718	237-4-1	75.84	0		A,Shiny fibers,Fib.,MS
719	238-2-4 (0-10cm)	7.3	0		MS,Fib,Q,L,P,SS,A,?D
720	238-2-4 (10-20)	4.19	0		D,A,Fib,L,Q,P
721	238-2-4 (20-30)	5.95	0		MS,P,Fib,D,A
722	238-2-4 (30-40)	5.63	0		P,A,Fib,D,MS,L
723	238-2-4 (40-50)	4.58	0.5		P,A,Fib,MS
724	238-2-4 (50-60)	6.97	0		MS,P,Fib,A,L,D
725	238-2-4 (60-70)	7.84	2		P,A,Fib,Q,MS,D
726	238-2-4 (70-82)	7.43	1		A,Fib,P,metallic flake,MS,L,D
727	238-2-5 (0-10)	24.37	0		A,P,MS,Fib,L
728	238-2-5 (10-20)	9.83	0		P,MS,L,Fib,Q
729	238-2-5 (20-30)	6.72	0		Fib,P,MS,L
730	238-2-5 (30-40)	7.18	0		Fib,A,MS,P
731	238-2-5 (40-50)	4.63	0		P,MS,L,A,Fib
732	238-2-5 (50-60)	3.98	0		P,A,Fib,MS

733	238-2-5 (60-70)	8.33	0		A,Fib,P,Silicaflagellate,MS
734	238-2-3 (0-90)	12.32	0		A,L,Fib,MS,P,D
735	238-2-2 (0-90)	11.87	0		A,Fib,P,MS,D
736	238-1-1	644.5	2		A,P,D,Thick sediment layer obscures filter
737	238-1-2	30.57	0.5		A,D,Silicaflagellate,P
738	238-3-1	147.81	2		A,P,Crustacean larvae,
739	238-4-1	184.38	0		A,Q,Mold,
741	239-2-1	3.71	1		A,D,P,
743	239-3-2 (0-90)	2.29	0		P,A,MS,Fib,
744	239-1-1	93.94	2		A,Fib,MS,P,Thick sediment layer obscures filter
747	240-1-1	2.68	0		A,P,Fib
748	240-1-2	1.21	0		Fib,P,A,MS,Q
749	240-1-3 (0-10)	8.22	0		A,P,Fib
750	240-1-3 (10-20)	8.37	0		A,Fib,P,Q,L,MS
751	240-1-3 (20-70)	4.49	0		P,A,Fib,MS,L
759	241-1-3 (0-10)	6.42			Fib,A,L,MS,P
760	241-1-3 (10-20)	4.93			P,Fib,A,L,Q,MS
761	241-1-3 (20-30)	4.71		0.84	P,Fib,MS
762	241-1-3 (30-40)	4.83			A,Fib,P,MS,Q
763	241-1-3 (40-50)	4.96		0.83	P,Fib,A,MS,L
764	241-1-4 (0-10)	26.53			A,Fib,Ms,P,L
765	241-1-3 (50-83)	5.04	0		P,A,Fib
766	241-1-4 (10-20)	22.71	0		A,Fib,P,MS
767	241-1-4 (20-30)	8.05	0	0.87	MS,Fib,A,D,P
768	241-1-4 (30-40)	5.06	0		P,Fib,A,
769	241-1-4 (40-50)	2.45	0	0.72	P,Fib,A,L
770	241-1-4 (50-76)	4.56	0		P,Fib,A,MS
771	241-1-5	4.78	0		P,Fib,A,MS
772	241-1-6	4.9	0		Fib,P,A
774	241-2-1	4.98	0		A,Fib,L,Q
779	242-2-2	24.95	0		A,Fib,P
780	242-2-3 (0-10)	6.42	0		Q,P,Fib,MS,D
781	242-2-3 (10-20)	3.36	0		Q,black ?tektites,P,Fib
782	242-2-3 (20-30)	4.25	0		Q,Fib,P,black ?tektites
783	242-2-3 (30-40)	3.04	0	0.89	Q,Fib,P

APPENDIX C - ICE SAMPLE FILTERS
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784	242-2-3 (40-50)	3.91	0		Q,Fib,P
785	242-2-3 (50-90)	2.88	0		Fib,P,Q
786	242-2-4 (0-10)	88.26			A,P,MS,L,Pellets
787	242-2-4 (10-20)	27.11	0		P,A,Fib
788	242-2-4 (20-30)	29.33	0		P,A
789	242-2-4 (30-40)	20.6	0		A,P,Fib,black grains
790	242-2-4 (40-50)	14.06	0		MS,A,P
791	242-2-4 (50-72)	11.39	0		Fib,A
792	242-2-5 (0-10)	152.99	0	0.54	Pellets,A
793	242-2-5 (10-20)	28.27	0		Pellets,A,P,Fib,Q
794	242-2-5 (20-30)	17.2	0		P,Fib,A
795	242-2-5 (30-40)	25.9	0		Pellets,P,A
796	242-2-5 (40-50)	11.61	0		A,P,Fib
797	242-2-5 (50-80)	8.68	0		MS,A,P
798	242-3-1 (0-10)	59.53	0	0.79	A,P,Fib
799	242-3-1 (10-20)	21.57	0		A,P!!!, (lots)
800	242-3-1 (20-30)	8.27	0		P,Fib,A,Q,L
801	242-3-1 (30-40)	4.76	0		P,MS,Fib,A
802	242-3-1 (40-50)	5.18	0		P,A,Fib,MS
803	242-3-1 (50-85)	4.54	0		P,Fib
804	242-3-2 (0-10)	3.09	0	0.72	Fib,P
805	243-3-2 (10-20)	1.38	0		P,D
806	243-3-2 (20-30)	2.1	0		P,Fib,D
807	243-3-2 (30-40)	2.01	0		P,Fib
808	243-3-2 (40-50)	2.04	0		P,Fib,MS
809	243-3-2 (50-88)	2	0 +		P,Fib,MS,?black tektites
817	243-6-1 (0-10)	8.87	0	0.4	Fib,MS,P,A,red glass beads
818	243-6-1 (10-85)	3.2	0		P,A,Fib
825	245-3-1 (0-10)	28.98	0	0.48	A,P,Pellets,D
826	245-3-1 (10-30)	13.86	0		D,Fib,A
827	245-3-1 (30-50)	3.6	0		A,Pellets,P
828	245-3-1 (50-84)	5.41	0		P,A,Fib,D
829	246-1-1 (0-10)	5.6	0.03	0.56	P,A
830	246-1-1 (10-30)	3.21	0.03		P,Fib,MS
831	246-1-1 (30-50)	1.79	0.03		P,Fib

832	246-1-1 (50-74)	2.12	0.03		A,P
833	246-1-2 (0-10)	33.7	0	0.74	A,MS,pellets,Fib,P
834	246-1-2 (10-30)	5.79	0		A,MS,P
835	246-1-2 (30-50)	7.61	0		pellets,A,P,Fib
836	246-1-2 (50-90)	9.35	0.03		Q,A,Fib
837	246-2-1 (0-10)	4.08	0.85	0.66	P,A
838	246-2-1 (10-30)	2.82	0.42		P,A,?Q
839	246-2-1 (30-50)	2.29	0.26		P,A,Fib
840	246-2-1 (50-90)	3.01	0.58		Q,P,A
841	246-2-2 (0-10)	81.08	0.03	0.61	pellets,A,P,D,Fib
842	246-2-2 (10-30)	11.93	0.02		L,A,P,pellets
843	246-2-2 (30-50)	14.76	0.03		D,P,Fib
844	246-2-2 (50-90)	8.93	0.03		D,A,P,pellets,MS
849	247-3-1&2a	13.9			P,A,black silt,Fib
850	247-3-1&2b	13.04			A,Fib,P,D
852	248-4-1	5.2			Fib,A,P
855	248-3-1 (0-10)	8.87	0.02	0.76	Weird black and white conglomerates made of black silts cemented with ?salt,and/or organic fibers,A,P
856	248-3-1 (10-30)	2.35			same as above but far fewer B & W grains
857	248-3-1 (30-90)	1.72			F,Fib,A,P
858	250-1-1 (0-10)	5.81	0.02	0.63	L,A,Fib,Q
859	250-1-1 (10-20)	6.69	0.02	0.82	A,Fib,L,P
860	250-1-1 (20-30)	12.76	0.02	0.89	A,Fib
861	250-1-1 (30-40)	8.01	0.4	0.93	W,L,Fib,P,MS
862	250-1-1 (40-50)	8.03	0.5	0.87	Fib,A,P,MS,F
863	250-1-1 (50-60)	6.33	0.6	0.8	MS,Fib,P,W,F
864	250-1-1 (60-70)	5.69	0.7	0.91	Q,A,L
865	250-1-1 (70-87)	4.16	1.2	0.88	MS,P,A,Fib
867	252-1-1	2.8	2		A,Fib,MS,L,Q,F
871	253-3-1	3.44			?contamination; B & W grains (see#855),Fib
872	253-3-1	3.71			?contamination; B & W grains (see#855),Fib
873	253-3-2	1.54			B & W grains,D,A,Q
875	254-1-1 (0-10)	3.51		0.88	A,Fib,P,red glass beads,L
876	254-1-1 (10-20)	4.62		0.94	A,Fib,P,?shell fragment

877	254-1-1 (20-30)	3.79		0.96	Fib,A,MS
878	254-1-1 (30-40)	3.28		0.92	A,MS,Fib,P
879	254-1-1 (40-50)	3.9		0.95	A,MS,P,Fib
880	254-1-1 (50-60)	3.16		0.92	MS,Fib,A,P
881	254-1-1 (60-70)	3.33		0.97	A,P,Fib,MS
882	254-1-1 (70-83)	2.08		0.98	MS,A,Fib
883	253-1-1	1.41	7.4		MS,P,Fib
884	253-1-2	1.9	8		Fib,P,Q
885	254-2-1	2.33			Fib,P,A
888	256-1-1	283.14			A,P
892	257-3-1	6.38			A,D,Fib
893	257-3-2 (0-10)	19.44	4.8		A,Fib,very silty
894	257-3-2 (10-20)	21.7	2.8		A,Fib,silty,P,L
895	257-3-2 (20-30)	10.1	0.6		A,P,Fib
896	257-3-2 (30-40)	7.22	3.5		A,P,Fib,Q
897	257-3-2 (40-50)	6.86	4.8		A,P,Fib,Q
898	257-3-2 (50-57)	9.35	4.6		A,P,Fib
899	257-3-3	1.93	0		Fib
509	259-1-1	2.24	2		Silicaflagellate,Q,P
524	261-1-2 (0-30)	3.22			A,Fib,MS
525	261-1-2 (30-90)	4.74			A,Fib,P,F
532	263-3-1	21.58			Black & White lithofragments
533	263-3-2	2.65			Fib,L,F
537	264-4-1	4.56			A
538	264-5-1	3.12			A,D,
540	265-2-3				Silty
541	265-2-1	5.93			A,Fib,P,D
542	265-3-1	3.45			A,Fib,P,D,Q
545	265-4-1	5.61	7		A,Fib.
549	266-3-1	4.34			Fib,D,A,
407	267-5-1 (0-30) (35-90)	7.07	3		A
408	267-5-1 (30-35)	81.46	0		A
409	267-5-2	4.4			L,Fib
414	268-2-1	20.53			D,L,A,Q,

APPENDIX C - ICE SAMPLE FILTERS
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415	268-5-1	22.46			A,Q

APPENDIX D - WATER SAMPLE FILTERS

Filter #	Sample #	Sed. con. (mg/L)	Notes
			A=algae, Q=quartz, F=foraminifera, D=diatoms, W=wood, MS=metallic spherules, Fib=fibers, SS=sponge spicules, L=lithofragments, P=plastic
	PS92		
745	239-4-1	0.57	Fib,L,A,D,MS
752	240-2-1	3.83	Net weights of 752 and 753 added for sediment conc.; D,rust chips,MS
753	240-2-1		see above; D,rust chips,A
754	240-3-1	3.02	Nets weights of 754 and 755 added for sediment conc.; MS,P,D,L
755	240-3-1		MS,P,D,L
757	240-5-1	3.62	D,rust,A,Silicaflagellate
758	240-5-1	4.46	D,rust,A
775	241-3-1	3.8	D,Fib,A
776	241-3-1	3.04	D,A,Q
777	242-1-1	2.04	MS,D,A
778	242-1-1	1.52	D,Fib,A
811	243-1-1	0.66	D,Q
812	243-1-1	0.65	A,D,Q,P
820	243-8-1	0.65	F,A,P,MS
821	244-1-1	0.52	Fib,A,P,D
822	245-1-1	0.3	A,Fib,D
823	245-1-1	0.48	A,Fib,D
824	245-2-1	0.5	D,A,Fib
845	246-3-1	0.92	D,A,Fib
846	246-4-1	0.84	A,D,Fib,P
848	247-2-1	0.98	yellow stain,P,MS
853	248-1-1	0.76	Fib,A
854	248-2-1	0.69	A,Fib,Q,P
869	251-1-1	0.65	A,Fib,MS,Q
870	253-2-1	0.8	A,Q,D,Fib
889	256-2-1	0.52	A,Fib,D,Q,P
890	257-1-1	2.03	rust colored,MS,P,L
891	257-2-1	0.55	A,P,Fib
501	257-4-1	2.32	Fib,P,D
502	258-1-1	0.88	Fib
511	260-2-1	0.43	Fib,SS,P
512	260-3-1	0.64	Fib,SS,P
526	261-2-1	0.43	Fib,A
528	262-3-1	0.56	Fib,A
529	262-4-1	0.88	Fib,A,P,D
530	263-2-1	7.9	L,F., Q,D
531	263-1-1	2.95	L,Q,A,F

534	264-1-1	1.33	Fib,A
535	264-2-1	0.97	
547	266-1-1	1.72	A,P,D (abundant),Fib
548	266-2-1	3.79	A,P,D (abundant),Fib
550	266-4-1	2.27	A,D,Fib
401	266-5-1	1.69	A,D,Fib,P
402	266-6-1	2.69	A,D,Fib,P
403	267-1-1	1.31	A,D,Fib,P
404	267-2-1	1.39	A,D,Fib,P,F
40[illegible]	267-3-1	1.62	A
410	267-6-1	1.45	A,Fib
411	268-1-1	2.51	L,Fib,D

APPENDIX E - SNOW SAMPLE FILTERS

Filter #	Sample #	Sed. con. (mg/L)	Salinity (ppt)	Notes
				KEY A=algae, Q=quartz, F=forams, D=diatoms, W=wood, MS=metallic spherules, Fib=fibers, SS=sponge spicules, L=lithofragments, P=plastic
	ABS92			
304	ABS92-1A	4.38		A,Fib,L
314	ABS92-3A	1.40		Fib,L
318	ABS92-5A	1.35		A,D,Q,?F
335	ABS92-8A	6.11		Q,P,L, ?glass spherule
	PS92			
851	PS92-247-3-3	5.98		MS,Fib,A,
866	250-1-2	3.05	0	P,L,Fib
874	254-1-2	0.99		A
886	254-2-2	2.82		A,silt,Q
517	260-4-7	2.2		Q,silt,L,Fib,P,A,MS
523	261-1-1	2.16		A,silt
543	265-3-2	1.48		MS,Fib,P
544	265-2-2	7.17		Salt & Pepper flakes,D,A
546	265-4-2	0.92		
412	268-2-2	5.92		A, L, Fib

APPENDIX F - BOX/PISTON CORE SAMPLE FILTERS

Filter #	Sample #	Notes
		KEY A=algae, Q=quartz, F=forams, D=diatoms, W=wood, MS=metallic spherules, Fib=fibers, SS=sponge spicules, L=lithofragments, P=plastic
	PS92	
713	92-AR-B1	BC1; Q,D,Crustacean larvae,very fine grained
756	PS92-240-4-1	PC6; MS,silty,L,Q
813	243-2-1	BC7; F,Q,L,D,SS,Fib
814	243-3-1	BC8; silty
815	243-3-1	BC8; silty,Fib,P
816	243-4-1	BC9; Fib,A,Q,F,silty
819	243-7-1	BC10; silty,F,P
847	247-1-1	BC13; very silty,P
887	254-3-1	BC14; MS,?F,D,Q, shell fragments
510	260-1-1	BC16; F,silt,Fib
539	265-1-1	BC17; silty,F