HLY05-01 Cruise Report (June 13-26, 2005)

Chief Scientist, Dennis A. Darby (Old Dominion University), Principal Investigators: Leonid Polyak (Ohio State University), Margo Edwards (University of Hawaii), Greg Cutter (Old Dominion University), Jens Bischof (Old Dominion University), Glenn Berger (University of Nevada, Reno).

Introduction and Acknowledgements

The primary objective of this cruise was to obtain expanded sections of Holocene and older sediment from the North American continental slope between Barrow and the Northwind Ridge. These sections are important to the development of a pan-Arctic stratigraphy because this is the only area from which previous cores were obtained with higher sedimentation rates than a few cm/kyr that were beyond the shelf. Key to this effort was the use of multibeam and 3.5 kHz seismic profiles to locate cores in drift deposits or other scenarios that would provide the necessary sedimentation rates and hopefully preserve fossil biota. Despite the unfavorable ice conditions at this time of year that prohibited towing acoustical survey gear, the cruise was an outstanding success. The onboard acoustic system on USCGC Healy gave adequate sub-bottom data, especially when the ship was drifting in the packice, to locate several cores that should meet the objectives of high resolution. In addition to the coring objectives, plankton tows and CTD casts were made to determine needed oceanographic data to support the stratigraphic and paleoclimate goals ultimately driving this research.

Despite being beset for four days in a patch of multiyear ice, the Coast Guard crew on the USCGC Healy performed in a very professional and enthusiastic manner to accomplish the science mission. They were quick to learn from the tough ice conditions encountered, especially in the first week. Captain Dan Oliver, the officers and crew of the USCGC Healy are acknowledged for their facilitation of the cruise goals and for their expertise in accomplishing all tasks that the science required. In particular, we express our appreciation to Captain Dan Oliver, Executive Officer Jeffery Jackson, Operations Officer James Dalitsch, Engineering Officer John Reeves, Senior Chief Navigator Timothy Sullivan, and all of the helmsmen that negotiated some rather difficult ice conditions. A special thanks goes to the marine science technician (MST) crew lead by Chief Don Snider and consisting of Dan Gaona, Rob Olmstead, Erick Rocklage, Josh Robinson, Chad Klinestekaer, and Travis Corbet. LtJG Jessica Noel was instrumental in overseeing the MST crew and science operations and we are indebted to her for making the science operations a success. The aviation department led by Lt. Andrea Sacchetti played a key role in ice reconnaissance and the collection of dirty ice samples, as well as the transfer of personnel and equipment to and from the ship at Barrow.

The core tech, Pete Kalk and the logistic support from the University of Oregon (Nick Pisias and company) provided excellent support and the result was the recovery of quality piston core material totaling over 100 meters, plus multicores for the upper half meter and trigger cores. The science crew worked very hard to make up for the initial setback of four days lost at the outset due to being beset in multiyear ice. A total of eight jumbo piston cores (JPC) and six multicores (MC) were collected. This is more than the planned three each but without the towed seismic system and it's better resolution, we were forced to improvise and take cores without optimal imagery of the sub-bottom. In addition to the coring, a total of five plankton hauls in the upper 200 meters were successfully completed and several dirty ice sites were located by reconnaissance helicopter flights and a total of 15 ice samples containing entrained sediment were collected.

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Cruise Participants

Name	Institution	Position
Dennis Darby	Old Dominion University	Chief Scientist
Leonid Polyak	Ohio State University	Scientist
Margo Edwards	University of Hawaii	Scientist
Glenn Berger	Desert Research Institute	Scientist
Jens Bischof	Old Dominion University	Scientist
Greg Cutter	Old Dominion University	Scientist
Joseph Ortiz	Kent State University	Scientist
Guillaume St-Onge	Universite de Quebec	Scientist
Christine Theriault	GEOTOP, Universite de Quebec	Grad Student
Brian Meeks	Kent State University	Grad Student
Pete Kalk	Oregon State University	Coring Technician
Steven Marshall	Kings Fork High School, Suffolk, VA	TREC teacher
Mark Rognstad	University of Hawaii	Engineer
Steven Tottori	University of Hawaii	Engineer
Bob Anderson	SAIC	Engineer
Louis Whitcomb	Johns Hopkins University	Engineer
Paul Johnson	University of Hawaii	Scientist
Stefanie A. Brachfeld	Montclair State University	Scientist
Lyanne Yurco	Kent State University	Undergrad Student
Val Schmidt	Lamont-Doherty Earth Observatory	system engineer
Steve Roberts	Univ. Center for Atmos. Res.	comp system admin

HLY05-01 Cruise Track

The cruise track was originally designed to take advantage of the towed acoustical system from the University of Hawaii, the IMI system. This original track involved a zigzag transect across the continental slope off northern Alaska starting near the core site occupied in 2002 by the Keigwin cruise. The two cores taken at this site contained about 17 m of Holocene and the multibeam data was studied from this location to gain insight into the geologic context for this expanded Holocene section. From the available acoustic data, we determined that this site was located on the western flank of a small canyon system that either contained drift deposits from the west or overflow deposits from down-canyon flows.

This core site (HLY02-JPC16) was covered be heavy ice and ridging at the beginning of our cruise (HLY05-01) so targets farther to the west were a better option. Thus similar areas were located from the available multibeam bottom topography were located and surveyed by the Healy's onboard acoustic system. The revised cruise track (Fig. 1) traversed several small canyon systems to the west of Barrow Canyon.

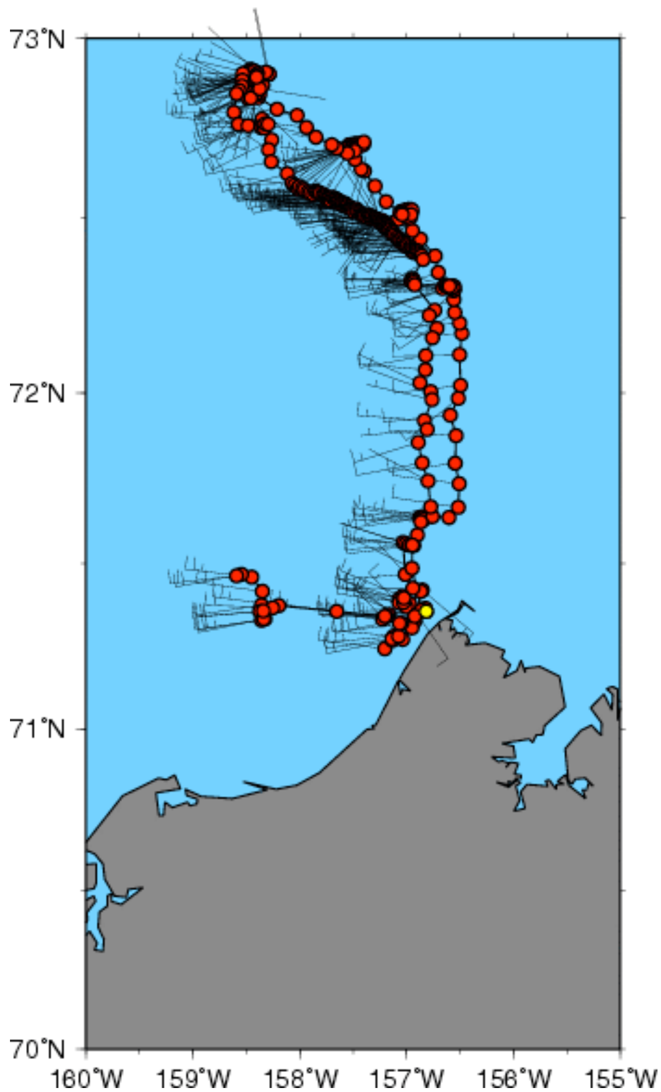


Figure 1. Cruise track for HLY0501 June 13-June 25, 2005. Track away from Barrow, Alaska is slightly offset to west from return track and the track essentially parallels the shelf margin. Red circles indicate ship position every six hours starting at yellow circle (start/end). Wind direction and strength was very constant from the east throughout.

Seismic Stratigraphy

Digital recordings of 3.5 kHz Knudsen sub-bottom profiler were recovered during most of the HLY05-01 track. The quality of the records on the transits was low because of numerous disturbances related to the ship's motion in heavy ice; a much better quality was obtained during intervals when the Healy was just drifting with the packice. Side echo artifacts in the areas with uneven seafloor topography (hummocks and channels) complicate the records; this effect was more pronounced with increasing water depth because of the wider footprint of the acoustic signal, i.e., the signal cone intersected a larger seafloor area in deeper water. Despite these complications, many records provide helpful information for understanding the geological and stratigraphic context for the upper ~20-30 m of sediment. This understanding, together with multibeam bathymetry data was critical for identifying coring locations and will be essential for further interpretation of recovered sediment cores.

At two locations the IMI acoustic system (Univ. Hawaii) including a chirp profiler was deployed. Although limited, the sub-bottom IMI records provide some additional information to the 3.5 kHz data.

HLY0501 Stations

Although the primary objective of the HLY0501 cruise is to collect high-resolution sediment cores, several other research objectives were accomplished as well. These include sampling dirty sea ice, plankton tows, CTD hydrocasts, and multibeam and 3.5kHz data processing (Table 1).

Table 1. Summary of all tasks performed during HLY05-01.

HLY0501 Event Log
Chief Scientist: Dennis Darby
June 13 - June 26, 2005

Event	Begin Date and Time local (+8hours GMT)	Cast Max Depth Time local (+8hours GMT)	End Date and Time local (+8hours GMT)	Operation	Lat**	Long**	Lat Long Code*	Depth Water
1	6/13/05 10:08	n/a	6/13/05 17:32	Helicopter PAX	71.275	-157.0933	A/B	~400
2	6/14/05 14:41	n/a	6/14/05 15:39	Helicopter Ice Recon	72.314399	-156.933053	A	200
3	6/14/05 20:30	n/a	6/18/05 18:50	Beset	72.392083	-156.868026	A	300
4	6/16/05 9:54	n/a	6/16/05 10:37	Helicopter Sci. Recon	72.487088	-157.243292	A	n/d
5	6/16/05 10:50	n/a	6/16/05 12:05	Helicopter Sci Recon	72.60833	-157.805	B	n/d
6	6/18/05 9:11	n/a	6/18/05 10:10	Helicopter Sci Recon	72.72763	-157.68328	B	n/d
7	6/18/05 10:26	n/a	6/18/05 11:30	Helicopter Sci Recon	72.95333	-156.87167	B	n/d
8	6/19/05 9:51	n/a	6/19/05 11:26	Helicopter Sci Recon	72.854204	-158.572572	A	290
9	6/19/05 16:50	17:23	6/19/05 18:16	JPC1A	72.905244	-158.42049	B	1163
10	6/20/05 8:32	9:29	6/20/05 10:05	MultiCore1	72.902348	-158.429415	B	1140
11	6/20/05 14:26	15:32	6/20/05 17:15	JPC2	72.893923	-158.286967	B	1422
12	6/20/05 21:19	n/a	6/20/05 21:42	VPT	72.894987	-158.310994	A	1325
13	6/20/05 22:47	23:00	6/20/05 23:14	CTD	72.895	-158.316667	B	1282
14	6/20/05 23:51	0:23	6/21/05 1:28	CTD	72.894242	-158.323586	B	1234
15	6/21/05 13:55	14:27	6/21/05 15:00	JPC3	72.85973	-158.422828	B	546
16	6/21/05 15:47	16:07	6/21/05 16:31	MultiCore3	72.86511	-158.447276	B	763
17	6/21/05 20:19	n/a	6/21/05 20:41	VPT	72.84319	-158.387264	A	505
18	6/22/05 11:07	11:21	6/22/05 12:35	JPC4	72.697876	-157.41761	B	538
19	6/22/05 13:16	n/a	6/22/05 18:00	Helicopter Emer.	72.698136	-157.439255	A	489
20	6/22/05 13:55	14:12	6/22/05 14:31	MultiCore4	72.698152	-157.453368	B	462
21	6/22/05 19:08	19:15	6/22/05 20:08	JPC5	72.694201	-157.517716	B	415
22	6/22/05 20:15	n/a	6/23/05 0:13	VPT	72.693923	-157.530932	A	435
23	6/23/05 0:52	n/d	6/23/05 1:53	CTD	72.687131	-157.5507	A	384
24	6/23/05 18:22	19:04	6/23/05 20:07	JPC6	72.511287	-157.032905	B	673
25	6/23/05 19:29	n/a	6/23/05 20:29	Small Boat Sci	72.513273	-156.941495	A	674
26	6/23/05 20:39	20:56	6/23/05 21:20	MultiCore6	72.510369	-157.053378	B	607
27	6/24/05 5:54	n/a	6/24/05 8:35	VPT	72.296815	-156.556875	A	352
28	6/24/05 9:30	9:49	6/24/05 10:40	CTD	72.297954	-156.585923	B	340
29	6/24/05 11:16	surface	6/24/05 12:45	EIMI	72.298177	-156.596804	A	347
30	6/24/05 13:43	14:10	6/24/05 14:27	Helicopter Sci Recon	72.38833	-156.365	B	347
31	6/24/05 14:15	14:36	6/24/05 15:11	JPC7	72.299326	-156.627917	B	321
32	6/24/05 15:45	15:54	6/24/05 16:09	MultiCore7	72.300246	-156.642828	B	348
33	6/25/05 10:14	10:20	6/25/05 10:29	MultiCore8	71.626781	-156.842053	B	87
34	6/25/05 11:46	11:50	6/25/05 12:43	JPC8	71.628034	-156.859142	B	90
35	6/25/05 14:19	n/a	6/25/05 15:25	VPT	71.543955	-156.927999	A	XXX

36	6/25/2005 16:07		6/25/05 0:00	CTD				

.at/Long Code: = Begin Time Location = Sample/Cast Depth Max Location = End Time Location	**Lat/Long from SCS/Aft p-code

Table 1 continued.

Event	Notes
1	25 PAX embarking,
2	Ops and AG1 Ice Recon
3	[158.068367 72.599874] Lat/Long of breakout
4	No landings or ice samples collected
5	4 Helicopter landings for ice sampling, Guilliam St. Onge
6	Ice sample collected, Joe Ortiz
7	Ice sample collected, Glenn Berger
8	No landings or ice samples collected
9	JPC Coupler Failure, (13.7m core length)
10	Lat/Long from SCS/Aft p-code
11	JPC bent at 30 feet (rigged at 70') sediment core (8.6m core length)
12	64 micron mesh, sampling forams, 1 m ring nut vertical tow
13	CTD aborted due to wire abrasion on bolts
14	CTD stopped data transmit at ~1100m depth, only bottom 2 bottles tripped (blown deck unit fuse)
15	Core length 13.4m, mud on JPC weight stand
16	7 tubes, 2 Niskin bottles, added 300lbs to weight stand, bottle 8 no trigger
17	64 micron mesh, sampling forams, 1 m ring nut vertical tow
18	14.8m core length recovered
19	Helicopter transfer of crew member to Barrow, death in family
20	8A no good, 4A did not trigger
21	16.64m core length recovered, sec 1 fell off holders
22	64 micron mesh, sampling forams, 1 m ring nut vertical tow
23	CTD
24	15.9m core length recovered,
25	Ice walk, Dirty Ice sampling, 5 samples collected, Jens Bischof
26	MulitCore 8 not deployed
27	64 micron mesh, sampling forams, 1 m ring nut vertical tow
28	CTD
29	EIMI test, surface reading only
30	1 dirty ice sample collected
31	**small core: 4.72m core length**
32	Average 59cm core lengths
33	**Tubes half full: 30cm avg.**

34	**15.19m core length**
35	64 micron mesh, sampling forams, 1 m ring nut vertical tow

Coring

In order to save wire time on station, a JPC was taken first and then a multicore. This allowed time to re-rig the JPC if needed for a second core while the multicore was deployed via the aft A-frame. The sites chosen for coring (Table 2) were as similar as possible to the site in 2002 where L. Keigwin recovered two cores with approximately 17 m of Holocene. Based on the available multibeam bottom topography maps of this site, it appears to be located on the west side of one of the many small canyon systems feeding into the Canada Basin. Our best speculation at this time is that the rapid accumulation at these sites resulted from either overflow suspension flows down the canyon or eastward flowing contour currents depositing fine sediment on the lee of the canyon sides. Thus we cored several sites in similar settings to the west whenever the Knutson 3.5 kHz showed 10 or more meters of transparent sediment at the surface (Holocene?).

Table 2. Summary of Cores (JPC and MC).

		Core	**Lowering**		**Core Hit**	**Bottom**		
CORE No.	**DATE**	**TIME (UT)**	**DEPTH (m)**	**TIME (UT)**	**Latitude (deg.)**	**Longitude (deg.)**	**Water Depth (m)***	**Site Physiography**
JPC1	2001-06-19	00:48	1193	01:23	72.90567	158.42243	**1163**	Canyons
JPC2	2001-06-19	22:48	1397	23:32	72.89438	158.28497	**1422**	Canyons
JPC3	2001-06-20	22:11	546	22:27	72.86030	158.42132	**546**	Mid-slope
JPC4	2001-06-21	19:03	548	19:21	72.69815	157.41995	**538**	Upper mid-slope
JPC5	2001-06-22	03:04	410	03:15	72.69463	157.52007	**415**	Shoals
JPC6	2001-06-23	02:45	682	03:04	72.51182	157.03472	**673**	Lower mid-slope
JPC7	2001-06-23	22:15	322	22:36	72.30000	156.62883	**322**	Upper Slope
JPC8	2001-06-24	19:46	89	18:20	71.6298	156.882	**90**	Barrow Canyon
MC1	2001-06-19	16:30	1136	17:29	72.90277	158.42735	**?**	Canyons
MC3	2001-06-20	23:45	685	0:07	72.86567	158.44530	**763**	Mid-slope
MC4	2001-06-21	21:57	462	22:12	72.69890	157.45367	**462**	Upper mid-slope

MC6	2001-06-23	4:38	625	4:56	72.51092	157.05512	**607**	Lower mid-slope
MC7	2001-06-23	23:45	305	23:54	72.30095	156.64358	**305**	Upper Slope
MC8	2001-06-24	18:15	90	18:20	71.62743	156.84302	**87**	Barrow Canyon

Table 2 continued. (*discrepancy with core lowering depth due to drift during lowering).

UT=Greenwich time or local Barrow time plus 8 hours.

CORE No.	Length of Core Pipe (m)	Core Diam. (cm)	Pull out (lbs)	Estimated Core Length (m)	Trigger core Length (cm)
JPC1	15	10	11000	13.72	202.5
JPC2	22	10	16010	8.58	110
JPC3	15	10	10800	13.39	237
JPC4	18	10	11080	14.60	228.5
JPC5	18	10	10300	16.73	259
JPC6	18	10	10890	15.78	269.5
JPC7	15	10	19500	4.72	225
JPC8	22	10	16130	15.19	306
MC1	71 cm	10	2200	50 cm	
MC3	71 cm	10	?	10 cm	
MC4	71 cm	10	2200	60 cm	
MC6	71 cm	10	1920	65 cm	
MC7	71 cm	10	2060	58 cm	
MC8	71 cm	10	1620	30 cm	

The cores were cut into 1.5 m segments numbered initially with Roman Numerals (I, II, etc.) from the core bottom as they were extruded and later renumbered during logging from the top with Arabic numerals (1, 2, etc.), sealed and stored until logging and splitting (Table 3). Measurements of each core segment are based on the core liner length but plastic foam rods inserted into the ends are noted where they occur (Table 3). There were problems with the first two cores (JPC 1 & 2). The core barrel separated, probably on pullout due to stress elongation of the coupling holes in the barrel allowing the segments to separate. Only about 1.5 meter of sediment core washed into the ocean from between segments 8 and 9 when the PVC core liner bent and then broke as it was hauled out of water. Also segment 2 of this core (JPC-1) contained only water due to the piston core dragging sediment up the core on pullout. The second core, JPC2, hit a very hard surface of largely sand with stiff clay beneath. While the core penetrated about 6-7 m, the stiff clay containing rather large IRD clasts stopped the core and caused the core barrel to bend at sections 3 and 4. No sediment was lost due to this bending, although extrusion from the core barrel required considerable pounding on the core liner.

Table 3. Details of JPC sections.

HLY05-01
JPC1

JPC_ section	length_cm	Depth below sea floor (cm)	Cum. Length _cm	Comments
1	150	0	150	
2	150.5	150	300.5	
3	151.5	300.5	452	Core barrel separated &
4	54.5	452	506.5	PVC broke with loss of ~1.5m (sec3-4)
5	149.5	506.5	656	
6	131.5	656	787.5	
7	150.5	787.5	938	
8	151	938	1089	
9	50	1089	1139	
10	81	1139	1220	no sediment, only water
11	152.5	1220	1372.5	
Total Length cm:	1372.5			

TC1_ section	length_cm	Top_ cm	Cum. Length _cm
1	101.5	0	101.5
2	101	101.5	202.5

HYL05-01
JPC2

JPC_ section	length_cm	Top_ cm	Cum. Length _cm	
1	94	0	94	
2	94	94	188	Sand & gravel in bottom of section
sediment between sections	10	188	198	Sediment recovered and bagged.

3	53	198	251	Mud in clam shells, disarticulated
4	132	251	383	Core bent at coupling with section 5
5	150	383	533	
6	94	533	627	
sediment between sections	8.5	627	635.5	Sediment recovered and bagged.
7	127	635.5	762.5	
8	95	762.5	857.5	
TOTAL LENGTH cm:	857.5			

TC_ section	length_cm	Top_ cm	Cum. Length _cm
1	110	0	110

HLY05-01 JPC3

JPC_section	length_cm	Top_ cm	Cum. Length _cm
1	135.5	0	135.5
2	150.5	135.5	286
3	150.5	286	436.5
4	150.5	436.5	587
5	150	587	737
6	151	737	888
7	150	888	1038
8	151	1038	1189
9	150	1189	1339
TOTAL_cm	1339		

TC_sec.	length_cm	Top_ cm	Cum. Length _cm
1	121	0	121
2	116	121	237

HLY05-01 JPC4

JPC_sec	length_cm	Top_ cm	Cum. Length _cm
1	99	0	99
2	148.5	99	247.5
3	149.5	247.5	397
4	150	397	547

5	151.5	547	698.5
6	150	698.5	848.5
7	150.5	848.5	999
8	150	999	1149
9	69.5	1149	1218.5
sediment between sections			
10	92		
11	150		
Total_length_cm:	1460.5		
Trigger			
1	77.5		
2	151		
	228.5		

HLY05-01 JPC5

JPC_sec	length_cm	Top_cm	Cum. Length_cm
1	105.5	0	105.5
2	150.5	105.5	256
3	151	256	407
4	149.5	407	556.5
5	154.5	556.5	711
6	150.5	711	861.5
7	150.5	861.5	1012
8	150.5	1012	1162.5
9	125	1162.5	1287.5
10	151	1287.5	1438.5
Bagged separately	6.5	1438.5	1445
11	141	1445	1586
12	66	1586	1652
Cutter_	20.5	1652	1672.5
Total length_cm:	1672.5		
Trigger Core			
2	150		
1	109		

HLY05-01 JPC6

JPC_section	length_cm	Top_cm	Cum. Length_cm
1	99	0	99
2	151	99	250
3	151	250	401
4	149.5	401	550.5
5	152	550.5	702.5
6	150	702.5	852.5
7	150.5	852.5	1003
8	150	1003	1153
9	123.5	1153	1276.5
10	150	1276.5	1426.5
11	151	1426.5	1577.5
Total_length_cm:	1577.5		
Trigger Core			
1	119		
2	150.5		
Total TC cm	269.5		

HLY05-01 JPC7

JPC_section	length_cm	Top_cm	Cum. Length_cm
1	151	0	151
sediment between sections	8	151	159
2	83.5	159	242.5
sediment between sections			
3	78.5	242.5	321
4	150.5	321	471.5
Total_length_cm:	471.5		

Trigger Core		
1	73.5	has packing rod on both ends
2	151.5	

Cutter sed. in a ziploc bag

HLY05-01 JPC8

JPC_section	length_cm	Top_cm	Cum. Length_cm
1	52	0	52
2	150.5	52	202.5
3	151	202.5	353.5
4	151	353.5	504.5
5	151	504.5	655.5
6	150.5	655.5	806
7	150.5	806	956.5
8	151.5	956.5	1108
9	73	1108	1181
10	150	1181	1331
11	34	1331	1365
12	151	1365	1516

Total_length_cm:	1516

Trigger Core	Length	
1	58	tube length = 62 cm, but foam insert on top. Mud length is 58.
2	148	tube length = 152, but foam insert on bottom. Mud length is 148.

Table 4A. Details of multicore tubes. The slot for tube 7 was used for a water bottle and thus the 8 slot tube became number 7 in all multicores.

Core/Tube	**Length before Extrusion (cm)**	**Length after Extrusion (cm)**	**Comments**
MC-1			
1	**50.0**	**49**	

2	**49.0**	**44.5**	**Lost 2cm from bottom**
3	**blackened**	**G. Berger**	**Luminescence dating**
4	**blackened**	**G. Berger**	**Luminescence dating**
5	**50.0**	**G. Cutter**	**Used for porewater**
6	**50.3**	**G. Cutter**	**Used for porewater**
7	**49.5**	**50**	
MC3			
1	**10.6**		
2	**10.1**		
3	**blackened**	**G. Berger**	**Luminescence dating**
4	**blackened**	**G. Berger**	**Luminescence dating**
5	**13.1**		
6	**18.5**		
7	**Did not trigger**		
MC4			
1	**60.0**		
2	**58.0**		
3	**blackened**	**G. Berger**	**Luminescence dating**
4	**blackened**	**G. Berger**	**Luminescence dating**
5	**61.5**		

6	**61.5**		
7	**Bottom paddle did no seat**	**No core**	
MC6			
1	**64.0**		
2	**62.0**		
3	**blackened**	**G. Berger**	**Luminescence dating**
4	**blackened**	**G. Berger**	**Luminescence dating**
5	**62.5**		
6	**61.5**		
7	**65, top 2cm spilled out**	**during extrusion**	
MC7			
1	**58.7**		
2	**57.3**		
3	**blackened**	**G. Berger**	**Luminescence dating**
4	**blackened**	**G. Berger**	**Luminescence dating**
5	**59.2**		
6	**60.0**		
7	**59.5**		
MC8			
1	**26.5**		
2	**26.0**		
3	**blackened**	**G. Berger**	**Luminescence**

			dating
4	**blackened**	**G. Berger**	**Luminescence dating**
5	**30.0**		
6	**26.5**		
7	**28.0**		

Table 4B. Location, times, water depths, and average length of multicores.

e HLY05-01 Multicore Data

ordinates are for core on the bottom (i.e. triggered)
E: Seabeam not working. All lat/long from GPS on bow. Water depths from Knudsen 3.5 kHz
n unless otherwise indicated.
E: All times are local, Barrow AK time. No GMT or UTC display in Aft Control.
ordinates are for core on the bottom (i.e. triggered)
Out = meters of wire paid out of winch #2 when MC triggered. Winch operator paid out an extra
eters of cable after triggering.

n/Core#	Date_local	Julian_Day	Time_on_bottom_local	Water_depth_m	Depth_recorder	*WireOut_m	Pullout_tension_lbs	**Average_core_length_cm
1	20-Jun-05	171	9:29	?	none active	1120	2200	50
3	21-Jun-05	172	16:07	763	3.5 kHz	721	?	10
4	22-Jun-05	173	14:12	462	3.5 kHz	446	2200	60
6	23-Jun-05	175	20:56	607	Seabeam	594	1920	65
7	24-Jun-05	176	15:54	305	Seabeam	295	2060	59
8	25-Jun-05	177	18:20	87	Seabeam	85	1620	30

INDIVIDUAL PROJECT PROGRESS REPORTS

Geochemical Studies on HOTRAX Leg 1

The goals of the biogeochemical studies on Leg 1 of HOTRAX were to acquire high resolution (high sedimentation rate) cores (multi- and piston corers), process the multicorer samples in the field to preserve (via freezing) iron sulfides and carbonates, and take porewater samples for trace metals and nutrients. During Leg 1, a total of 4 (out of 6) multicores were obtained for biogeochemical studies (core lengths ranging from 30 to 65 cm). From one of the multicore tubes held in a sectioning table under a nitrogen atmosphere, the upper 5 cm were sectioned at 1 cm intervals and at 2 cm below this. All samples were immediately frozen at –70 °C after removal from the nitrogen glove bag. A whole core squeezer (e.g., Zhang et al., Mar. Chem., 61, 127-142, 1998) was used to obtain porewaters (0.4 µm filtered) from another multicorer tube at ca. 1 mm intervals in the upper 1 cm (interval depths to be determined after sediment porosity is measured). These porewater samples were also immediately frozen at –70 °C. The sediment and porewater samples were returned frozen to the ODU laboratory. In addition to the piston core samples (Table 3), the multicorer samples will be used for the following determinations if funding can be obtained: porosity; dry sediment density; organic carbon, nitrogen, and sulfur; inorganic (carbonate) carbon; mackinawite (FeS), griegite, and pyrite; biogenic silica; bulk trace elements (Al, Ti, Mo, Fe, Mn, Cd, Zn); and Cd/Ca in benthic and planktonic forams. Porewater samples will be analyzed for nutrients (nitrate, phosphate, silicate), trace elements (Cd, Fe, Mn), and chlorinity.

Reflectance Studies and Plankton Tows

Joseph D. Ortiz, Kent State University, 7-12-2005

Introduction-

The Kent State University Department of Geology participants in the HOTRAX Leg 1 Cruise (June 2005) included: Associate Professor Joseph Ortiz, and his two students, Lyanne Yurko, and Brian Meeks. Primary responsibilities of the KSU team included measurement of diffuse spectral reflectance on the Multicore-collected sediment recovered during the cruise, and operation of the Vertical Plankton Tow system (VPT). In addition, the KSU science party members assisted in all aspects of the science operations including: jumbo piston coring, underway watches, and helicopter ice recon and sediment recovery from “dirty ice”.

Diffuse Spectral Reflectance Measurements-

During the cruise, sediment color was quantified through measurement of diffuse spectral reflectance (DSR) using a Minolta CM-2600d spectrophotometer. Measurements were conducted on a 3mm spot-size with the instrument set to exclude the specular reflectance component. Two separate measurement protocols were followed depending on the pre-processing of the multicore tube to be studied (Table 5). Multicores that were split and exposed to air, were scraped lightly to create a smooth surface and were then covered with a single layer of a commercial plastic wrap (Gladwrap™ was used for consistency with ODP DSR reflectance measurements). The split cores were measured at 0.5 cm intervals along the core surface, taking care to avoid disturbed areas and sediment burrows. Multicore tubes that were sectioned by G. Cutter in a glovebag under a nitrogen atmosphere and then stored in Ziplock bags were measured directly through the plastic bag to preserve the nitrogen atmosphere and prevent exposure to air.

A total of 101 DSR measurements were generated from the glovebag samples, while 689 measurements were obtained from the surfaces of the split cores, yielding a total of 799 DSR measurements generated during the cruise. Replicate measurements of homogenized sediment scraped from the split surface of MC1-7 indicate the reproducibility of the raw reflectance values ranged from 0.028 to 0.054 % (n=10) with no significant wavelength-dependant trends. Shipboard analysis of the reflectance data focused on study of the CIELab colorspace parameters L* (lightness), a* (red-green contrast), and b* (blue-yellow contrast).

Values of L* for the glovebag samples ranged from approximately 20 to 60, with L* trends or oscillations that decreased in amplitude down-core (Figure 2). The measurements from the split cores showed similar variability (Figure 3). Cores grouped into samples with L* that increased in value down-core (e.g. MC-1, MC-4 and MC-6), and those with brighter core-tops and which demonstrated no trend, or large amplitude fluctuations throughout the core. This separation of cores into two groups was also apparent in the a* (Figure 4 and 5) and b* (Figure 6 and 7) parameters. Values of a* and b* tended to decrease down-core, with a series of reversals in b* which appear to define specific layers that may be of use as stratigraphic markers.

To test this, we aligned the b* records from MC 1.6 and MC 3.6 by stretching the depth record from core MC 3.6 by a factor of 1.85. This simple stratigraphic adjustment which implies sedimentation rates varied by a factor of 2 between the two sites produces a good fit in terms of both a* and b* values (Figure 8). Comparison of glovebag and splitcore surface measurements from Core MC-4 provides a potential means of quantifying yearly diagenesis within the cores in responses to oxidation of the split core surface (Figure 9). In most cases, split core measurements were completed as soon after core splitting as possible. In the case of core MC 4.5, however, measurements could not be completed until several hours later due to a conflict with the operation of the VPT. These measurements indicate that DSR provides a potentially useful stratigraphic tool in Arctic settings, and that measurements should be completed as soon after core splitting as possible.

Table 5. Reflectance Sample Log for Cruise

Multicore	Measurement	Number of Samples	Comments
MC 1-	Glovebag [1]	24	
MC 1-	Split Core [2]	0	
MC 3-	Split Core	39	
MC 4-	Split Core	121	
MC 4-	Glovebag	31	
MC 6-	Split Core	130	Measurements of 2nd half of MC 6-tube1 occurred several hours after sampling
MC 6-	Split Core	129	
MC 6-	Glovebag	31	
MC 7-	Split Core	123	
MC 8-	Split Core	53	
MC 8-	Glovebag	15	
	Subtotal Glovebag	101	
	Subtotal Split Core	595	
	Total	**696**	

Measurement
1. Split core surface @ 0.5 cm resolution
2. Glovebag subsamples under nitrogen atmosphere

Vertical Plankton Tow Stations-

Plankton samples were collected from various depths at a total of five stations during HOTRAX I using a vertical plankton tow system consisting of a 63 µm mesh plankton net attached to a 1-m diameter ring. The net was constructed with a 5:1 length to mouth-area towing ratio, and closed using a messenger and quick release as needed. The volume of water filtered was measured using a mechanical flow meter mounted in the throat of the net. Preliminary estimates indicate that the net filtered between 6 and 38 m^3 of water per net tow depending on the depth interval sampled and number of times the net was towed through the interval. This yielded estimated bio-volume concentrations that ranged between 3 and 63 ml/m^3. These numbers are preliminary as some of the bio-volume estimates are yet to be completed.

Table 6. Vertical Plankton Tow Summary

HLY0501 VPT	Depth Range (m)	Flowmeter Haul Volume (m^3)	Plankton Biovolume[1] (ml/m^3)
Tow 1 Net 1	0-50	38	11
Tow 1 Net 2	0-100	67	3
Tow 2 Net 1	0-50	9	63
Tow 2 Net 2	0-100	38	12
Tow 3 Net 1	0-50	12	19
Tow 3 Net 2	50-100	22	n/a
Tow 3 Net 3	100-150	38	n/a
Tow 3 Net 4	150-250	32	5
Tow 4 Net 1	0-50	8	38
Tow 4 Net 2	50-100	26	n/a
Tow 4 Net 3	100-150	36	4
Tow 4 Net 4	150-250	29	7
Tow 5 Net 1	0-50	17	n/a
Tow 5 Net 2	50-100	6	n/a
Tow 5 Net 3	75-100	9	n/a

Note: 1. Samples marked n/a have yet to have their biovolume estimated.

Figure 2 HYL05-01 L* for MC glovebag measurements

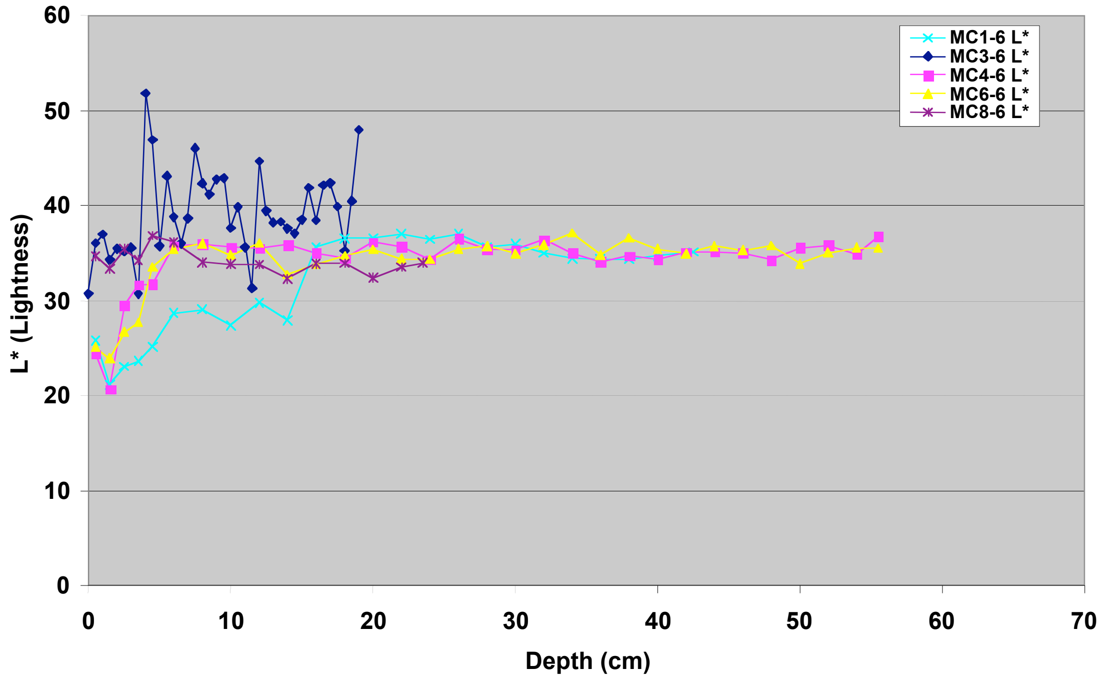


Figure 3 HYL05-01 L* for MC splitcore measurements

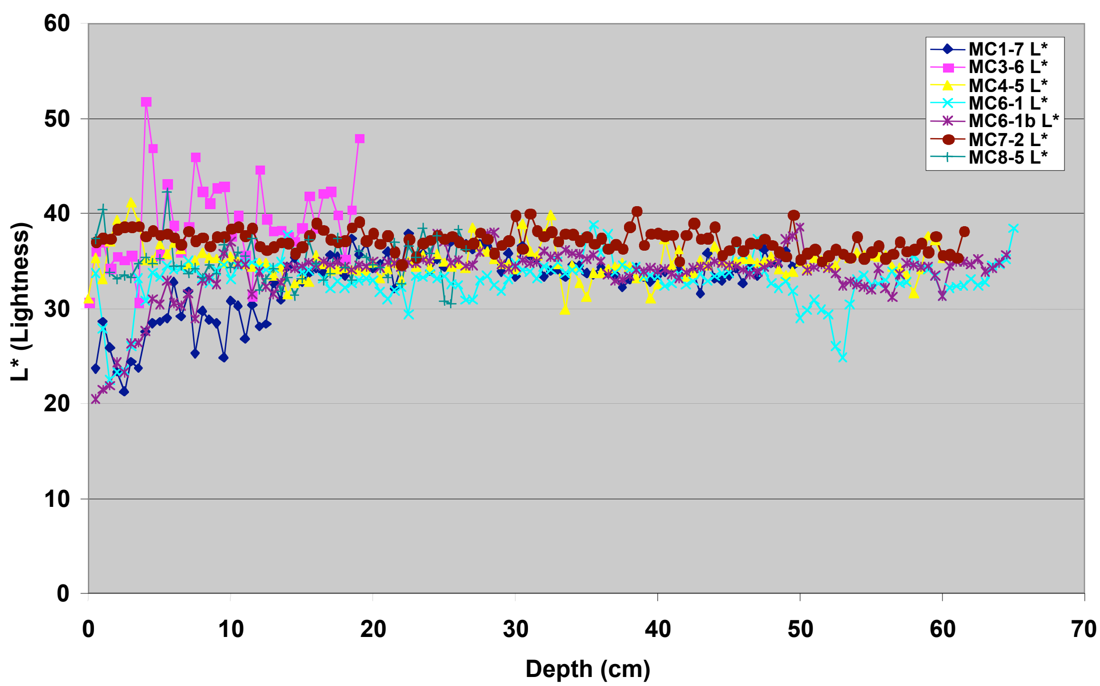


Figure 4. HYL05-01 a* for MC glovebag measurements

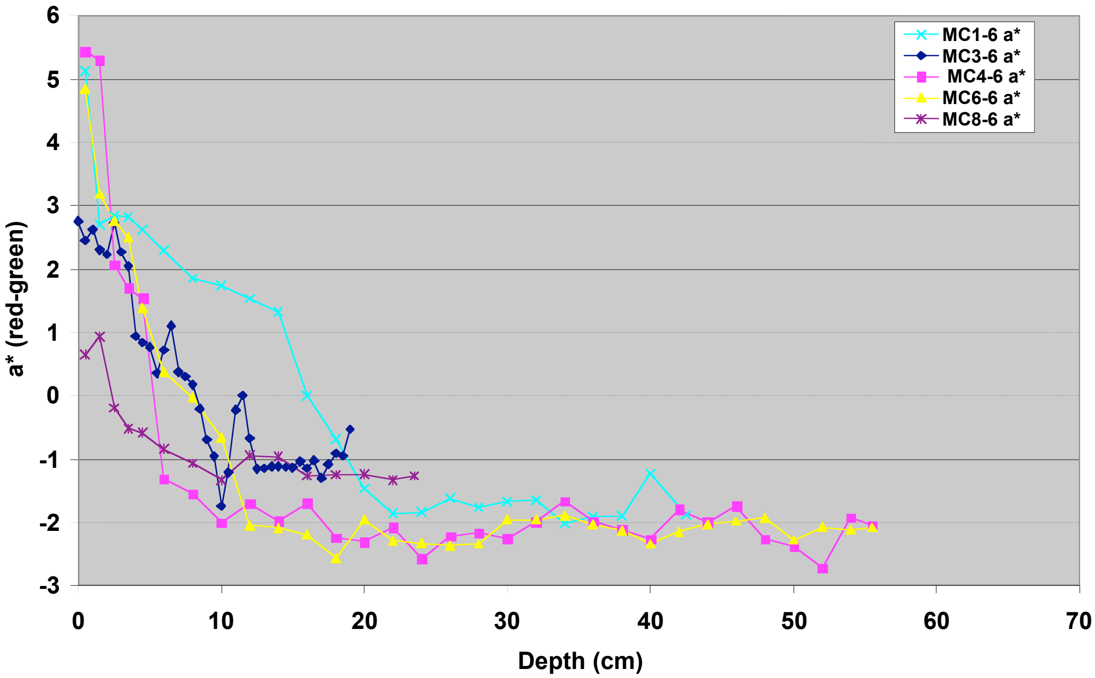


Figure 5. HYL05-01 a* for MC splitcore measurements

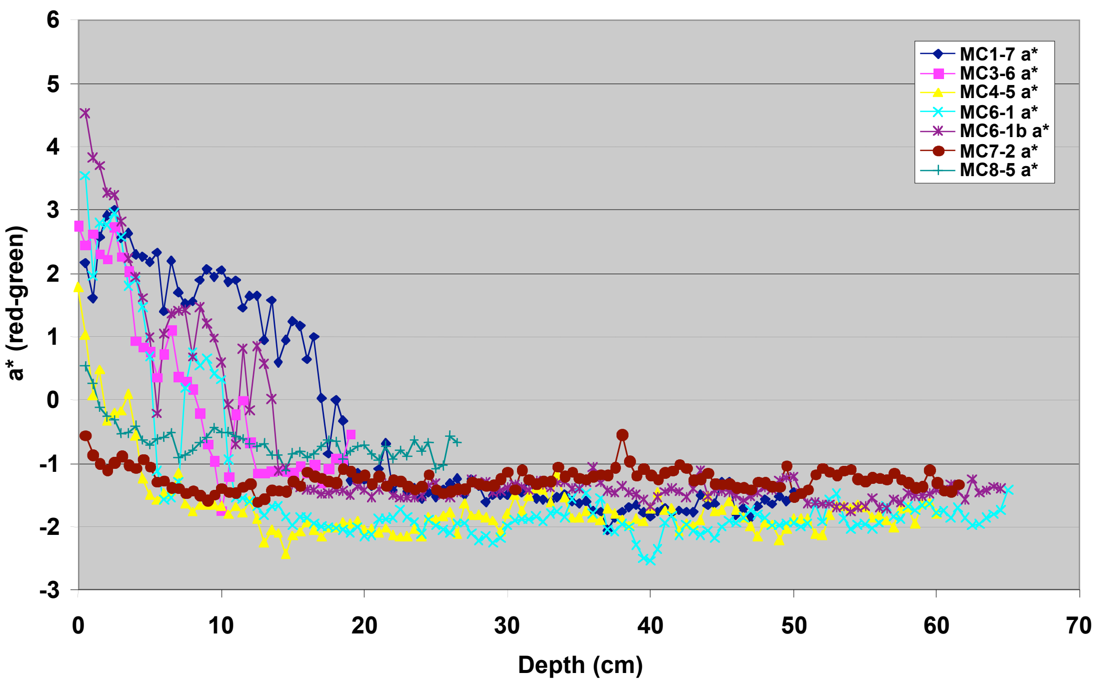


Figure 6. HYL05-01 b* for MC glovebag measurements

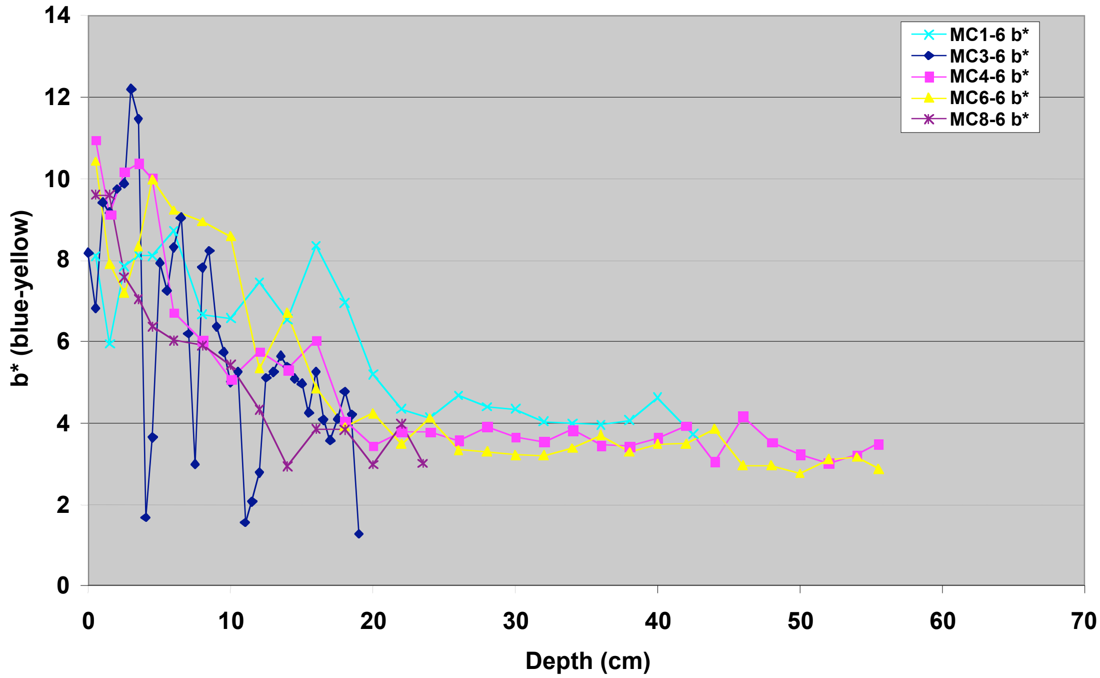


Figure 7. HYL05-01 b* for MC splitcore measurements

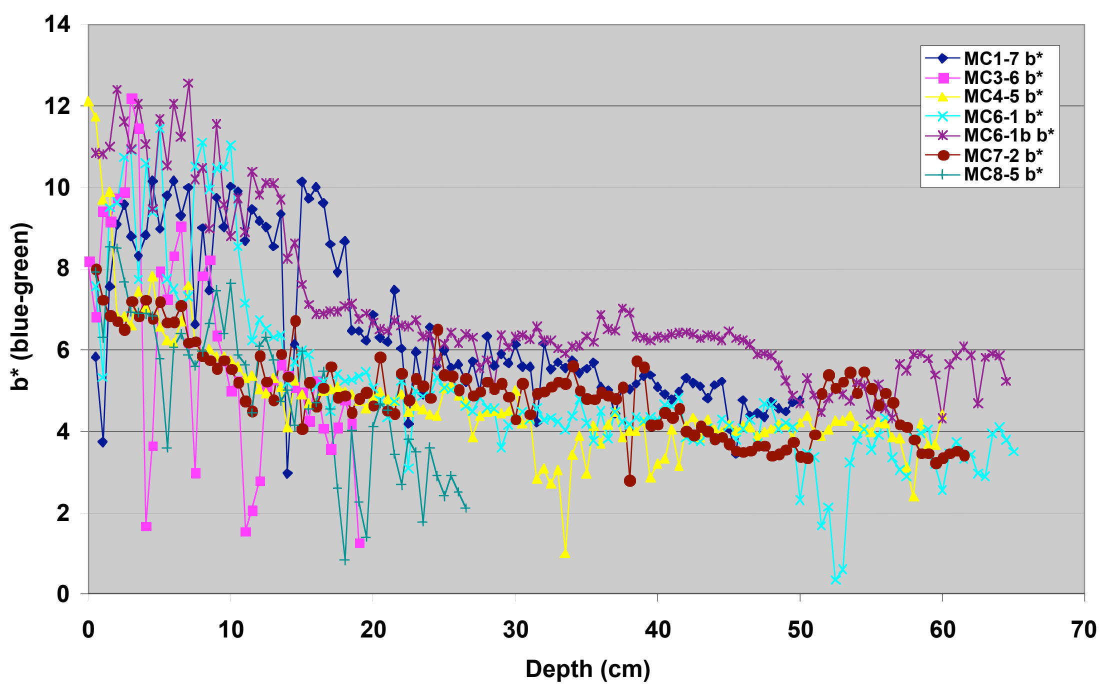


Figure 8. HLY-05-01 MC1.7 and MC 3.6 (on depth = 1.85*z)

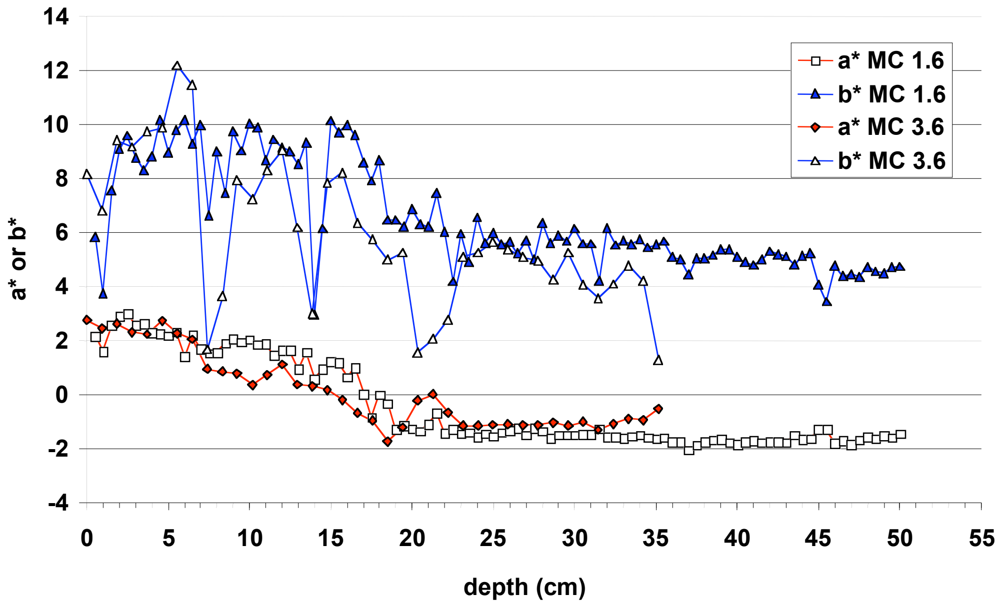
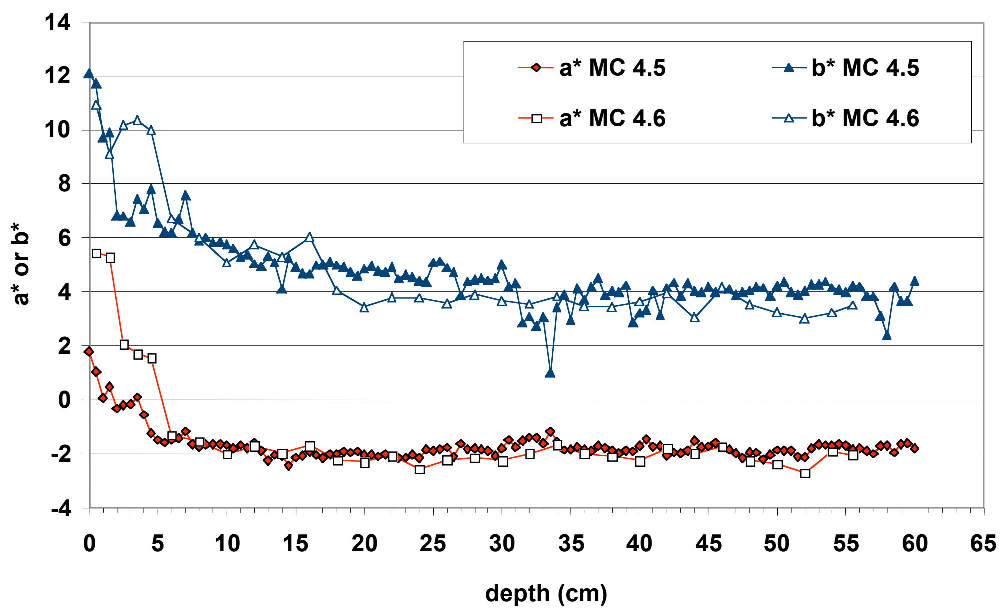


Figure 9. HLY-05-01 MC 4.5 and MC 4.6 (sectioned)



Core and water processing for radioisotopes and isotope analysis of foraminifera in multicore tube samples (upper 50+ cm of sediment column).

Guillaume St-Onge (University of Quebec at Rimouski and GEOTOP)
Guillaume St-Onge (UQAR and GEOTOP), Claude Hillaire-Marcel and Anne de Vernal (UQAM and GEOTOP) and Stefanie Brachfeld (MSU)

The following on board processing and/or measurements were done on the following multicores and water masses. Unless otherwise noted, all the below sediments and water samples will be shipped back, further processed and curated at GEOTOP (Montreal, Canada).

HLY05-01-MC1

<u>Multicore Tube 2</u>: 44.5 cm after extrusion and 49 cm before extrusion from the multicore tube into presplit plastic liners for storage. Approximately 2 cm was lost at the base, compaction: 2.5 cm

1) Eh measurements (1 cm intervals)
2) 5-cm thick slices were sub-sampled for radium analysis of the pore waters

<u>Multicore Tube 7</u>: 49.5 cm after extrusion and 50.5 cm before extrusion. Compaction and/or loss: 1 cm

1) Splitting, core photography and description of one half
2) Spectrophotometer (J. Ortiz) of the described half
3) Sub-sampling of both halves at 0.5 cm intervals for: -Forams and dinocysts;
   -Radiogenic isotopes
4) Sub-sampling at 1 cm intervals of the described half for rock-magnetism analysis (will be processed and curated by S. Brachfeld at MSU)

HLY05-01-MC3

<u>Multicore Tube 8</u>: 14 cm, bottom flap on this tube was open during recovery, length before extrusion not measured.

1) Eh measurements (1 cm intervals)
2) 5-cm thick slice were sub-sampled for radium analysis of the pore waters

<u>Multicore Tube 6</u>: 19 cm after extrusion, before extrusion: 18.5 cm, 0.5 cm expansion

1) Splitting, core photography and description of one half
2) Spectrophotometer of the described half (both Minolta and X-rite Colortron II, G. St-Onge and J. Ortiz)
3) Sub-sampling of both halves at 0.5 cm intervals for: -Forams and dinocysts

-Radiogenic isotopes

4) Sub-sampling at 1 cm intervals of the described half for rock-magnetism analysis (will be processed and curated by S. Brachfeld at MSU)

HLY05-01-MC4

Multicore Tube 1: 56 cm after extrusion, 60 cm before extrusion, compaction and/or lost: 4 cm

1) Eh measurements (1 cm intervals)
2) 5-cm thick slices were sub-sampled for radium analysis of the pore waters

Multicore Tube 5: 62 cm after extrusion, 61.5 cm before extrusion; 0.5 cm expansion

1) Splitting, core photography and description of one half
2) Spectrophotometer (J. Ortiz) of the described half
3) Sub-sampling of both halves at 0.5 cm intervals for: -Forams and dinocysts
   -Radiogenic isotopes
4) Sieving between 10 and 106 μm of about 5-6 cc of the upper first 2.5 cm at 0.5 cm intervals (to prevent foram dissolution)
5) Sub-sampling at 1 cm intervals of the described half for rock-magnetism analysis (will be processed and curated by S. Brachfeld at MSU)

HLY05-01-MC6

Multicore Tube 5: 59 cm after extrusion, 62.5 cm before extrusion, compaction and/or lost: 3.5 cm

1) Eh measurements (1 cm intervals)
2) 5-cm thick slices were sub-sampled for radium analysis of the pore waters

Multicore Tube 1: 64.5 cm after extrusion, 64 cm before extrusion; 0.5 cm expansion

Note: while splitting the core, one half was disturbed (labeled MC6-disturbed). This half was not sub-sampled.

1) Splitting, core photography and description of the undisturbed half
2) Spectrophotometer (J. Ortiz) of the undisturbed half
3) Sub-sampling of the undisturbed half at 0.5 cm intervals for: -Forams
   -Radiogenic isotopes
4) Sub-sampling at 1 cm intervals of the undisturbed half for rock-magnetism analysis (will be processed and curated by S. Brachfeld at MSU)

Multicore Tube 4: This core was secured and will be processed at GEOTOP for forams, dinocysts and radiogenic isotopes

.

HLY05-01-MC7

Multicore Tube 2: 56 cm after extrusion, 57.3 cm before extrusion; compaction and/or lost: 1.3 cm

1) Eh measurements (1 cm intervals)
2) 5-cm thick slices were sub-sampled for radium analysis of the pore waters

Multicore Tube 1: 61.5 cm after extrusion, 59 cm before extrusion. 2.5 cm expansion

1) Splitting, core photography and description of one half
2) Spectrophotometer of the described half (J. Ortiz)
3) Sub-sampling of both halves at 0.5 cm intervals for: -Forams and dinocysts
   -Radiogenic isotopes
4) Sub-sampling at 1 cm intervals of the undisturbed half for rock-magnetism analysis (will be processed and curated by S. Brachfeld at MSU)

HLY05-01-MC8

Multicore Tube 8: 26 cm before extrusion, 28 cm, compaction and/or loss: 2 cm

1) Eh measurements (1 cm intervals)
2) 5-cm thick slices were sub-sampled for radium analysis of the pore waters

Multicore Tube 5: 28 cm after extrusion, 30 cm before extrusion. Compaction and/or loss: 2 cm

1) Splitting, core photography and description of one half
2) Spectrophotometer of the described half (J. Ortiz)
3) Sub-sampling of both halves at 0.5 cm intervals for: -Forams and dinocysts
   -Radiogenic isotopes
4) Sub-sampling at 1 cm intervals of the undisturbed half for rock-magnetism analysis (will be processed and curated by S. Brachfeld at MSU)

Multicorer bottom water sampling

4.5 L of water (2 x 250 ml and 1 x 4 l) were taken from a Niskin bottle attached to the multicorer at every multicorer sampling location (MC1, MC3, MC4, MC6, MC7, MC8)

Water column sampling (CTD Casts)

Water column sampling was done at the following stations:

Station 2 CTD1: A fuse was blown and data were only collected going down. Only the bottom water could be collected and no water samples were taken on assent (8.5L: 2 x 250 ml and 2 x 4 l) at 1219 m

Station 5 CTD2: 8.5 L was collected at 384m, 156m, 100m, 36m and the surface (2 m)

Sea Ice Sampling for Entrained Sediment

The two legs of HOTRAX '05 provide a unique opportunity to resample the Beaufort Shelf and Slope as well as the central Arctic for dirty seaice. The Arctic Ocean Section (AOS94), the first crossing of the central Arctic Ocean by two surface vessels, the USCGC Polar Star and the Canadian Louis St. Laurent, in 1994. Several dirty seaice samples were collected by this historic expedition and now the HOTRAX '05 provided the opportunity to replicate these samples 11 years later. The HLY0501 cruise provided sea ice sediment samples from five different sites near Alaska that will provide an important reference point for comparison with samples that will hopefully be collected during the HLY0503 crossing of the central Arctic Ocean (Table 8).

All but one of these dirty seaice samples were taken during helicopter reconnaissance flights extending as much as 20 miles from the ship. One of the sample sites was reached by small boat during a coring station. The objective for collecting these samples of dirty ice is to determine the source area for the sediment using Fe oxide chemical fingerprint matches of these seaice sample to the Circum-Arctic Fe oxide mineral chemical composition database (Darby, 2004). This source matching provides the net drift of the sea ice from the shallow source area to where they were sampled. Such data reveals new insights into the entrainment process and the transport of sediment into the Arctic by this important process.

Table 7. Summary of sea ice samples collected for sourcing the entrained sediment.

mple No.	Latitude	Longitude	Date	Time (Alaska Time)	Collected Using	Notes:
Y0501-ICE1A)	72° 36.5'	157° 48.3'	6/16/05	10:50-12:05:00 PM	Helicopter	pressure ridge ice, few melt ponds; sample collected by Guilluame St-Onge
Y0501-ICE1B)	72° 37.7'	157° 43.8'	6/16/05	10:50-12:05:00 PM	Helicopter	~100 m distance from #1; sample collected by Guilluame St-Onge

Y0501-ICE1C)	72° 37.7’	157° 43.3’	6/16/05	10:50-12:05:00 PM	Helicopter	~100 m distance from #2; sample collected by Guilluame St-Onge
Y0501-ICE1D)	72° 37.5’	157° 39.0’	6/16/05	10:50-12:05:00 PM	Helicopter	~300+ m distance from #3 Fairly good recovery of sediment. sample collected by Guilluame St-Onge
Y0501-ICE2A)	72° 43.8’ N	157° 41’W	6/18/2005	9:11-10:10	Helicopter	Opaque bag sample by Joe Ortiz. Lat & Long listed incorrectly as decimal degree on bags
Y0501-ICE2B)	72° 43.8’N	157° 41’W	6/18/2005	9:11-10:10	Helicopter	Collected by Joe Ortiz.
Y0501-ICE2C)	72° 43.8’N	157° 41’W	6/18/2005	9:11-10:10	Helicopter	Collected by Joe Ortiz.
Y0501-ICE3A)	72° 57.2’N	156° 52.3’ W	6/19/2005	10:26-11:30	Helicopter	Collected by Glenn Berger (Samples in black container for lumine
Y0501-ICE3B)	72° 57.2’ N	156° 52.3W	6/19/2005	10:26-11:30	Helicopter	Collected by Glenn Berger (Samples in black container for lumine
LY0501-)	72° 30.662’N	157° 3.033’W	6/23/2005	19:35	Small Boat	Collected by Jens Bischof
LY0501-)	72° 30.662’N	157° 3.033’W	6/23/2005	19:41	Small Boat	Collected by Jens Bischof
LY0501-)	72° 30.662’N	157° 3.033’W	6/23/2005	19:47	Small Boat	Collected by Jens Bischof
LY0501-)	72° 30.662’N	157° 3.033’W	6/23/2005	19:55	Small Boat	Collected by Jens Bischof
LY0501-)	72° 23.3’N	156° 21.9’W	6/24/2005	13:43-14:27	Helicopter	Collected by C. Therault
LY0501-)	72° 23.3’N	156° 21.9’W	6/24/2005	13:43-14:27	Helicopter	Collected by C. Therault
HLY0501-)	72° 23.3’N	156° 21.9’W	6/24/2005	14:10	Helicopter	Collected by C. Therault

Flight Operations

The aviation wing onboard USCGC Healy consisted of two 65 helicopters, four pilots and four helicopter mechanics. The helicopters were equipped with wheels and skis for landing in shallow snow. The purpose of the helicopters was to fly ice reconnaissance, assistance in the science mission (landing people on the ice for observations and sampling), and for emergencies. During this cruise they performed all three and most of the dirty ice sampling was done from the helicopters. One emergency flight was to transport a crew member into Barrow due to a death in the family.

Summary of Flights

Science: Sorties=6, Hours=7.2

Ice Recon: Sorties=1, Hours=1.0

Logistics (flight in/out of Barrow that were Science related): Sorties=12, Hours=19

Recommendations

All recommendations for changes will be made in the HLY0503 Cruise Report so as to avoid redundancy.

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