LA98-00

JOIS-98: Report on the Science Program aboard the "Sir Wilfrid Laurier"

Mission 9826 - Physical & biogeochemical oceanography: mooring program, acquisition of CTD data, and collection of water samples and sediment grabs aboard the CCGS "Sir Wilfrid Laurier", July 2 - 28 of 1998.

Summary

CRUISE DATES: 2-28 July 1998
IOS MISSION NUMBER: 9826
PLATFORM: Canadian Coast Guard Icebreaker "Sir Wilfrid Laurier"

PURPOSE: To collect hydrographic profiles, current data, water- and sediment samples from along the Canadian and American North-West and North Coasts to document the seasonal and inter-annual changes in their structure.

AREA OF OPERATION: West Coast of British Columbia and Alaska, Bering Sea, Chukchi Sea, Alaska's North Slope and the Beaufort Sea region of the Arctic Ocean.

SPONSORING AGENCY / GROUPS:
Institute of Ocean Sciences (IOS), Sidney, British Columbia, CA
Arctic Institute of North America, University of Alberta, Calgary, CA
U.S. National Science Foundation (NSF) Applied Physics Laboratories (APL), University of Washington, Seattle, USA
National Oceanic and Atmospheric Administration (NOAA)
Pacific Marine Environmental Lab (PMEL), Seattle, USA
U.S. Department of Interior, Minerals Management Service (MMS)
University of Alaska, Fairbanks (UAF), AK, USA
Japanese Marine Science & Technology Center (JAMSTEC), Japan
Department of Ecology and Evolutionary Biology, University of Tennessee (UTenn), USA
Central and Arctic Department of Fisheries and Oceans, Winnipeg, CA
and the Canadian Coast Guard

SCIENCE STAFF :

Science Coordinator:	Bon van Hardenberg (IOS)
CTD/Mooring Technician:	Reginald Bigham (IOS)
Benthic Science:	Jackie M. Grebmeier (UTenn)
Sediment/Chemistry:	Holly Kelly (UTenn)
Mooring Technician:	Andrew Roach (APL)
Mooring Technician:	Kyoshi Hatakeyama (JAMSTEC)
CTD/Mooring Supervisor:	William Parker (PMEL)
CTD/Mooring Technician:	Carol DeWitt (PMEL)

Description of the Science Program

The Canadian Coast Guard ice breaker "Sir Wilfrid Laurier" was equipped with a minimum of specialized gear and spaces to make her capable as a science platform. A-frames and winches were installed on the well-deck and boat deck and a shipping container was converted for use as a science lab/work space on the well-deck. The former radio room was converted into a data processing and chemistry lab. A Simrad EK-500 deep sounder was installed to provide accurate bottom depths for CTD profiling, sediment and water column sampling and for the deployment and recovery of instrumentation on oceanographic moorings. A multi-national and multi-disciplinary science program was conducted during the ship's transit to and from the Arctic. The cover page shows an overview of the program components and station locations as described in the Science plan for this mission.

CTD transects CTD profile data were collected along a number of cross-shelf transects, in a repeat occupation of stations where measurements were taken in the Spring and Fall of the previous year. This ongoing effort will help to characterize the distribution of water properties and currents in the upper layers that are of vital importance to the life cycle of the North Pacific fish stocks. The locations of the CTD stations as well as those of the oceanographic moorings are shown in Figure 2 below. (Figures not in email version)

Oceanographic Moorings All three current meter moorings which were deployed during the previous year off Cape St. Elias and the Seward Peninsula in the Gulf of Alaska were successfully recovered and re-deployed. The ship then stopped in Kodiak, Alaska to take on fuel and additional science mooring components shipped via the local U.S. Coast Guard base. Science team members J. Grebmeier and H. Kelly (University of Tennessee) and W. Parker and C. DeWitt (from PMEL) joined the ship in Kodiak, after which we completed the CTD transects in the North Pacific part of the program.

After recovering and replacing the NOAA "Peggy" buoy in the Bering Sea, the PMEL team members (Parker and DeWitt) were taken ashore at Nunivak Island and we proceeded with the recovery and re-deployment of the two APL moorings in the Bering Strait. The release failed to operate on the second of these shallow moorings, but all gear surfaced after getting nudged by the ground tackle on a dragging cable and was successfully recovered.

The locations of mooring stations, benthic sampling sites and CTD stations in the Bering Strait and Chukchi Sea area are shown in Figure 3 (Figures not in email version)

Benthic sampling by the bio/geo/chemistry team (Grebmeier and Kelly) then proceeded with collecting sediment cores and surface grabs, and processing part of the samples in the chemistry lab facility on board as well as freezing others for later analysis in shore-based labs. They were enthusiastically assisted by interested crew members. CTD profiles and Niskin water samples were also obtained at each of the benthic stations. A brief report on the benthic program is provided in Appendix B. The benthic team were put ashore with part of their gear in Barrow, Alaska.

The helicopter joined the ship in Barrow, and brought aboard the Canadian Minister of Fisheries

and Oceans with his party including Marty Bergmann (DFO, Winnepeg) to observe the Coast Guard/DFO cooperation in this Northern and Arctic science program.

The ship proceeded to the Barrow Canyon site where attempts in the previous year failed to recover a JAMSTEC mooring in about 200 meters of water. During dragging attempts around the initial GPS position provided, an unusual echo was seen in the sounder about 300 meters from the target location. The initial triangular drag pattern was expanded to include this point. The mooring surfaced at the end of a final dragging attempt, while conditions were slowly deteriorating due to increased broken ice and decreasing visibility in the area, and all instrumentation was successfully recovered.

A new JAMSTEC mooring was deployed in broken ice conditions westward of the new cross-shelf section. Mooring operations were postponed after the train-wheel anchor was lost when a release opened shortly after hitting the side of the ship during a deployment attempt. We opted to get out of the ice to the alternate line of mooring locations. However, strong northeasterly winds caused some delay in the mooring program, and a day was spent surveying the steep depth contours near the proposed mooring locations and obtaining CTD profiles prior to the mooring deployments.

When the weather abated, the Fisheries Minister and his party left for Deadhorse (Alaska), and the helicopter went off to Tuktoyaktuk (NWT) to pick up parts for its emergency floats inflation system, while we completed the moorings along the Alaskan North Slope section. Initial casts at the last location with the new Carousel rosette proved that the set-up of the A-frame and winch on the boat deck are well suited for this use during the mild summer conditions.

Table 1 in Appendix **A** provides a chronological listing of the particulars of all science stations for JOIS-98 (mission 9826). The list includes cast number, station name, date and start time (UTC), GPS location, water depth, if salinity sample (S) was taken at maximum cast depth and comments for each science station on this part of the cruise.

CTD instrumentation, deployment and data collection

Instruments The main instrument used to collect CTD profile data was an internally recording Micro-CTD (S/N 1534) by Falmouth Scientific Inc (FSI). This instrument was setup to record conductivity, temperature and pressure data at approximately 6.8 Hz.

A Seabird SBE-19 (S/N 1030) was upgraded to operate in water up to 3400 meters deep. This CTD has a sample rate of 2 Hz, and served as backup for collecting profile data. Its other main function is to provide trigger pressures for the Auto Firing module that was setup to trigger Niskin bottles at programmed depths on the Carousel sampling rosette without requiring a conducting sea cable.

Deployment The CTD was lowered by hydraulic winch on a non-conducting cable from the A-frame on the boat deck aft of the Science Lab (former radio room). At CTD stations, the following operating procedure was adopted: after the ship came to a stop (based on GPS coordinates provided), a cast-iron weight was lowered from A-frame on the boat deck down to the water surface. The CTD was then clamped to the wire, and a Niskin bottle clamped above this on casts where a water sample was collected for post-cruise calbration cross-checks. The CTD was turned on and lowered into the water,

then down to 25 meters and back to the surface to acclimatize the sensors. The CTD was then lowered to the sounder depth provided by the bridge, which is about 6 meters less than the depth from the surface. A messenger was sent down the wire to trip the Niskin bottle (when attached), after which the CTD (and sample) were brought back up on deck. The wire was spooled out and back in at a constant rate slightly less than one meter per second. One of the ship's officers used a portable radio link to supervise deck activities and assist in station keeping by relaying to the bridge the fore-and-aft or in-/outboard wire angle from the A-frame. The first CTD transect (off Baranoff) was done to full depth, but to reduce station time subsequent casts along transect lines were done to no more than 600 meters since the focus is on the variation in structure and properties of the surface layers. When Niskin bottles were used, duplicate water samples were drawn from them and stored for later analysis.

Data collection Entries were made in the science logbook at each station to record the position coordinates and UTC time/date from a Trimble GPS instrument. Following each cast, the data from the CTD were downloaded to a PC and preliminary plots of temperature and salinity were produced from the raw data to insure that the sensors were functioning properly. A spread sheet file was updated with the cast information from the log book, and some of the results were worked up into contour plots of properties along the transects when time permitted.

Moorings

The container on the well-deck that was fitted with benches, lights and electrical power formed an excellent work space to prepare most of the instruments deployed and to service or dismantle after recoveries. There were some initial difficulties in controlling the boom motion when handling fragile mooring instrumentation with the tall well-deck boom. The following table provides details of the mooring station date and time of recovery and (re-)deployment, GPS coordinates, water depth and comments. All objectives of the mooring component of the science program were successfully completed.

Station	Date	Recov (UTC)	Redepl (UTC)	Lat	min	Lon	min	Depth (m)	comments
CS-01	7-Jul	14:30	17:52	59	55.361	144	0.559	52	IOS
CS-02	7-Jul	20:52	23:18	59	38.261	144	0.020	158	IOS
CS-03	8-Jul	15:53	17:30	59	49.889	148	50.044	180	IOS
F-BSM-2b	13-Jul	?	17:02	56	52.50	164	3.00	67	PMEL
APL-A2	15-Jul	20:25	20:46	65	46.753	168	34.848	47	APL / UW
APL-A3	16-Jul	04:57	5:23	66	17.684	168	58.119	52	" "
CB-E-96	20-Jul		no	71	45.73	155	13.5		JAMSTEC
BF-K-98	21-Jul		17:54	71	23.406	152	5.136	128	JAMSTEC
NS-B1	23-Jul		15:30	70	54.451	146	40.753	92	UA/APL
BF-S-98	23-Jul		16:32	70	57.267	146	42.287	501	JAMSTEC
NS-B3	23-Jul		22:57	71	0.691	146	39.129	1280	UA/APL
NS-B4	26-Jul		1:11	71	3.013	146	38.444	1621	UA/APL
NS-B5	27-Jul		22:10	70	35.788	139	57.337	1100	UA/APL

Recommendations

The "Sir Wilfrid Laurier" formed an excellent vessel for the scope of the science program undertaken this summer. She provided a very stable platform, and the protected mid-ships location for CTD and benthic gear deployment, close to the science lab, greatly contributed to this. The converted shipping container on the well-deck served as a necessary work space for the storage, set-up and preparation of instrumentation during the deployment and recovery of the oceanographic moorings. The science lab space in the former radio room was adequate for the scope of the data processing, instrument set-up and chemical analysis program.

Recommendations for improvements for future use are:

- Install a readout for the Simrad sounder and the GPS in the science lab and deck container,
- Provide clean UPS power for the science electronics (computers, printers, etc.)
- Install a sink in the science lab with hot & cold water lines and a proper drain,
- Replace carpeting in the lab with floor tiles to reduce static and facilitate cleaning,
- Provide hooks and/or a rack for boots and for hanging wet weather gear,
- Install a telephone in the container lab.

For operation in cold and wet weather it is recommended

- that a protective shelter be provided for the rosette area to prevent contamination of samples,
- that a weather shelter also be provided for the winch operator near the rail, and
- that the boat-deck A-frame be extended to increase the clearance from the ship's side as the Carousel is lowered to and raised from the water.

Acknowledgements

The successful completion of the science program of this oceanographic cruise was made possible by the enthusiastic support from the officers and crew of the "Sir Wilfrid Laurier".

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Appendix A

Table 1. Science stations for JOIS-98 (mission 9826): cast number, station name, date and start time (UTC), GPS location, water depth, salinity sample from maximum cast depth, and comments for each science station on this part of the cruise.

Cst	Stn	Date	UTC	Lat	min	Lon	min	Depth	S	Description
1	BA-09	5-Jul	16:00	56	18.011	137	17.065	2595	X	Max 2600m wire
2	BA-08	5-Jul	18:31	56	22.787	137	6.711	2480		Simrad sounding
3	BA-07	5-Jul	20:52	56	27.848	136	57.063	2367		Drizzle
4	BA-06	5-Jul	22:44	56	33.786	136	47.720	2240		2 dark albatrosses
5	BA-05	6-Jul	0:34	56	38.904	136	38.845	2128		
6	BA-04	6-Jul	2:15	56	43.735	136	29.453	2060		Mild, grey good visibil.
7	BA-03	6-Jul	3:59	56	48.945	136	19.081	1845		
8	BA-02	6-Jul	5:38	56	54.775	136	9.260	945		Light breeze, rain
9	BA-01	6-Jul	6:48	56	59.865	136	0.168	112		Light rain, fast cast
Cst	**Stn**	**Date**	**UTC**	**Lat**	**min**	**Lon**	**min**	**Depth**	**S**	**Description**
10	KY-01	7-Jul	15:10	59	54.779	144	1.892	52		After recovery of CS-01
11	KY-01b	7-Jul	16:00	59	55.375	144	0.587	52		MCTD+SBE at anchor
12	KY-02	7-Jul	19:01	59	46.835	144	0.032	102		
13	KY-03	7-Jul	19:48	59	38.839	143	59.873	125		
14	KY-04	7-Jul	0:00	59	32.037	144	0.011	1345		Cast to 600m
15	KY-05	7-Jul	1:02	59	25.181	143	59.797	2400		To 600 m
16	KY-06	7-Jul	2:10	59	17.063	144	0.003	?		To 600 m
17	KY-07	7-Jul	3:12	59	10.193	144	0.515	?	X	to 600 m
Cst	**Stn**	**Date**	**UTC**	**Lat**	**min**	**Lon**	**min**	**Depth**	**S**	**Description**
18	SW-01	8-Jul	18:03	59	50.066	148	59.179	123		nice views of glacier
19	SW-02	8-Jul	19:07	59	41.270	148	48.465	180		& shore, photos/video
20	SW-03	8-Jul	20:10	59	33.009	148	38.328	88		
21	SW-04	8-Jul	21:10	59	24.989	148	28.018	113		sun,wind rising, cooler
22	SW-05	8-Jul	22:07	59	16.589	148	17.570	107		
23	SW-06	8-Jul	23:02	59	8.161	148	7.454	137		puffins
24	SW-07	8-Jul	23:58	59	59.981	147	57.560	312		
25	SW-08	9-Jul	0:58	59	50.978	147	46.565	1200		600m cast max
26	SW-09	9-Jul	2:09	59	42.814	147	36.494	?	X	600m
Cst	**Stn**	**Date**	**UTC**	**Lat**	**min**	**Lon**	**min**	**Depth**	**S**	**Description**
27	KD-01	10-Jul	17:02	57	29.831	152	0.276	47		no data first 2 tries,
28	KD-02	10-Jul	17:57	57	24.930	151	49.984	63		New batteries in MCTD
29	KD-03	10-Jul	18:45	57	18.846	151	40.110	57		(14hrs cumul. ON time
30	KD-04	10-Jul	19:29	57	13.980	151	31.163	63		In spread sheet)
31	KD-05	10-Jul	20:20	57	8.001	151	21.096	129		flat calm–drizzle warm
32	KD-06	10-Jul	21:06	57	3.044	151	11.063	511		sunny, dozens of birds
33	KD-07	10-Jul	22:09	56	57.980	151	0.917	790		600 m cast
34	KD-08	10-Jul	23:12	56	52.947	150	51.097	?		600 m
35	KD-09	11-Jul	0:41	56	47.014	150	40.051	?	X	600 m
Cst	**Stn**	**Date**	**UTC**	**Lat**	**min**	**Lon**	**min**	**Depth**	**S**	**Description**
36	UN-07	12-Jul	15:47	53	48.017	163	47.963	188	X	

37	UN-08	12-Jul	16:48	53	43.044	163	38.235	1495	X	Gebco coastline errors
38	UN-06	12-Jul	18:30	53	52.981	163	56.991	75		renumber to 7-8-6-5..1
39	UN-05	12-Jul	19:26	53	58.015	164	5.082	65		
40	UN-04	12-Jul	20:15	54	2.947	164	14.028	84		Overcast - mix of sun &
41	UN-03	12-Jul	21:07	54	8.944	164	22.937	78		Cloud - snowy volcano
42	UN-02	12-Jul	22:00	54	13.942	164	31.815	118		cloud lifting
43	UN-01	12-Jul	23:03	54	19.000	164	42.010	65		Sudden bank of fog
Cst	**Stn**	**Date**	**UTC**	**Lat**	**min**	**Lon**	**min**	**Depth**		**Description**
44	F-BSM2	13-Jul	17:18	56	52.944	164	3.252	67		PMEL mctd+Sbe1030
45	APL-A2	15-Jul	20:52	65	46.893	168	35.102	47		Bering Str APL/UW
46	APL-A3	16-Jul	5:30	66	17.693	168	58.365	52	X	" " " "
Cst	**Stn**	**Date**	**UTC**	**Lat**	**min**	**Lon**	**min**	**Depth**	**S**	**Description**
47	UTN-1	16-Jul	14:22	66	42.541	168	24.059	30		U. Tenn sediment stns
48	UTN-2	16-Jul	17:12	67	0.047	168	40.013	39		Veen grab, Haps corer
49	UTN-3	16-Jul	20:45	67	20.070	168	59.956	47		Bering Str/Chukchi Sea
50	UTN-4	17-Jul	14:27	67	30.079	168	54.938	44		
51	UTN-5	17-Jul	16:42	67	39.969	168	57.348	46		
52	UTN-6	17-Jul	20:08	67	44.256	168	26.405	47		bowhead whales !
53	UTN-7	18-Jul	0:40	67	59.827	168	54.809	54	X	MCTD+SBE then Corer
Cst	**Stn**	**Date**	**UTC**	**Lat**	**min**	**Lon**	**min**	**Depth**	**S**	**Description**
---	CB-E96	20-Jul	20:22	71	45.730	155	13.500	?		Recover JAMSTEC
---	BF-K98	21-Jul	17:54	71	23.406	152	5.136	128		Deploy JAMSTEC
Cst	**Stn**	**Date**	**UTC**	**Lat**	**min**	**Lon**	**min**	**Depth**	**S**	**Description**
54	NS-B1	23-Jul	15:30	70	54.451	146	40.753	92	X	CTDs along Mooring
55	NS-B2	23-Jul	16:32	70	57.267	146	42.287	501	X	Line before deployment
56	NS-B4	23-Jul	21:20	71	3.013	146	38.444	1621		(stormy, seas too high)
57	NS-B3	23-Jul	22:57	71	0.691	146	39.129	1280	X	
58	NS-B2a	25-Jul	19:47	70	56.595	146	37.393	498		after mooring deploy
59	NS-B5	27-Jul	22:10	70	35.788	139	57.337	1100	X	CTD/rosette after last N.Slope mooring

Appendix B

CRUISE REPORT FOR "SIR WILFRID LAURIER" CRUISE 9-19 JULY 1998
(Kodiak to Barrow, Alaska)

Jackie M. Grebmeier (PI), "Bering Strait: A Vital Ocean and Ecosystem Connection
Component C. Benthic Productivity and Carbon Cycling"
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The goal of the research undertaken was to study changes in the benthic community structure and carbon cycling in the Western Arctic. The combined physical and biological investigations will be used to document natural variability in the system and allow testing the hypothesis that present physical variability (K.Aagaard and T. Weingartner's component) in the ocean is accompanied by broadly based biological change. For the benthic field program we occupied 7 stations north of Bering Strait in the region of past high benthic biomass and sediment oxygen uptake to investigate the spatial extent of changes in benthic biomass, community composition and sediment tracers. The data collected will be compared to past stations occupied in the region over the last 20 years.

Scientific Approach

We occupied 7 stations north of Bering Strait near 67°30N, 169°W to measure benthic productivity in a region that has historically maintained the highest benthic faunal biomass of the entire Bering/Chukchi system. Samples for surface sediment grain size, total organic carbon, C/N, delta-13C of the organic fraction in sediments, and chlorophyll content were collected at each station using a 0.1 m2 van Veen grab and frozen for land-based analyses. Sediment from four additional 0.1 m2 van Veen grabs were collected and sieved through 1 mm sieve screen to obtain benthic fauna for biomass and community structure determinations. Fauna was preserved in 10% buffered seawater formalin for subsequent faunal analyses on land. In addition, two sediment cores were collected for shipboard incubations using a 133 cm2 HAPS benthic corer for sediment flux measurements (dissolved oxygen, alkalinity, pH, and nutrients). Enclosed sediment cores and overlying water were maintained in the dark at in situ bottom temperatures for approximately 12 hours. Bottom water for these experiments was collected using a 5 L niskin bottle triggered on the same wire used for CTD data collection at the start of each station. Finally, one additional sediment core was collected for downcore determination of sediment carbon parameters to investigate temporal changes at these localities.

Comments and Recommendations

The goals of the biology component were successfully obtained during the cruise due to the competency of both the Canadian Coast Guard officers and crew of the Sir Wilfrid Laurier and onboard personnel associated with the IOS, Canada. The current location of the science laboratory in the previous radio room forward of the IOS-installed winch on the port side of the ship was an excellent location for the biogeochemical-type work that I undertake. All sampling equipment was easily deployed and retrieved from the winch location and the immediate access to the science lab was valuable for the experimental chamber work undertaken for this study. In addition, the location of the laboratory provided a stable platform for setting up the experimental chambers with a minimum of disturbance to the cores along with undertakking the chemical measurements made

(dissolved oxygen and pH titrations). Due to the short time between stations in my program, there were two stations that required I use space in the ship's cold room in addition to my small refrigerator in the lab. Although I started the experiments in the science lab, I had to carry the sediment cores down two decks to the ship's cold room, which could have been tedious had we had any weather problems. I appreciated the location of the science lab in the radio room even more after the down and up excursion to start and stop these experiments. Thus, I highly recommend maintaining the current location of the science lab and winch for biogeochemical studies.

Overall the science lab was adequate for my sampling protocols, although the planned installation of a sink with water in the lab will be an asset. IOS and the CCG might consider installing a small fume hood in the lab for use during chemical studies.

Acknowledgments

The Captain and crew of the Sir Wilfrid Laurier provided excellent support for the scientific objectives of the biological component of this oceanographic cruise. Special thanks to Bon van Hardenberg, Reg Bigham, Holly Kelly and bosun Mel Hill for deck support during stations that enabled smooth and efficient sampling and deck processing of samples. Finally, I would like to thank Eddy Carmack for supporting participation by the biological component on this cruise.