## ALPHA HELIX CRUISE HX260 Thursday 20<sup>th</sup> June 2002- Saturday 29<sup>th</sup> June 2002 BERING STRAIT CRUISE REPORT

**FUNDING SOURCE:** NSF-OPP-0125082 (Grebmeier, U of TN)

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#### SCIENTIFIC PERSONNEL:

APL, Moorings	(F, Chief Scientist)
APL, Moorings	(M)
UAF, Nutrients & Sampler	(M)
UAF, Nutrients & Sampler	(F)
UAF, Nutrients & Sampler	(M)
UAF, DMS sampling	(F)
	APL, Moorings UAF, Nutrients & Sampler UAF, Nutrients & Sampler UAF, Nutrients & Sampler

## SCIENTIFIC PURPOSE:

This cruise had two main scientific goals.

The first (and foremost) was the recovery and redeployment of moorings in the Bering Strait. These moorings are part of a multi-year time-series (currently over 10 years long) of measurements of the flow through the Bering Strait. The properties of this flow not only influence the Chukchi and Beaufort Seas, but can also be traced across the Arctic to the Fram Strait and beyond. The long-term monitoring of the inflow into the Arctic Ocean via the Bering Strait is important for understanding climatic change both locally and in the Arctic.

Three moorings (A2 and A4, in the eastern channel of Bering Strait, and A3, c.35nm north of Bering Strait), which were deployed from the Alpha Helix last year, were recovered and redeployed. All the moorings carry conventional instrumentation - current meters (RCM), temperature and salinity sensors (SBE16). In addition, moorings A2 and A3 carry Upward-Looking-Sonars (ULS). The new mooring A4 carries an upward-looking ADCP to study the coastal jet. Mooring A3 also supports a nutrient sampler from UAF, and the replacement mooring carries in addition a transmissometer, a fluorometer and a PAR sensor, all connected to the SBE16. The current meters and ULSes allow the quantification of the movement of ice and water through the strait. The nutrient sampler and the optical sensors should yield the first biophysical time series measurements in the region, greatly advancing our understanding of the biological system in the Bering Strait and Chukchi Sea.

The second aim of the cruise was to conduct a hydrographic and ADCP survey of the Bering Strait and the southern part of the Chukchi Sea, concentrating on sections in the vicinity of the moorings and the region north of the mooring sites. These CTD and nutrient measurements will be used to calibrate the moored instruments and to give a framework for the analysis of the data. The hydrographic lines repeated and extended the surveys from previous years, allowing an interannual comparison.

Our application to work in the Russian EEZ, submitted in December 2001, was turned down in June 2002. Thus, all section and mooring work was confined to the US EEZ or international waters.

In addition to maintaining the time series measurements in Bering Strait, this work will also act as a upstream boundary condition for the NSF SBI (Shelf Basin Interaction) program, which starts its field work sampling this year.

## **CRUISE OBJECTIVES:**

1. To recover moorings A2-01, A3-01 and A4-01 (see Table 1).

2. To deploy moorings A2-02, A3-02 and A4-02. As time/weather permits, to run hydrographic casts (CTD and nutrients) and ADCP sections in the vicinity of the moorings and in the southern region of the Chukchi Sea (see Table 2 and Figure 1).

Due to exceptionally good weather, all the cruise objectives were successfully accomplished. The moorings were recovered and redeployed, and a total of 98 CTD stations, and corresponding ADCP lines were run. Sampling details are provided below.

## **CRUISE SCHEDULE:**

(Times are generally to the nearest half hour, and are in AKDS time, i.e. GMT-8hrs. The map in Figure 1 gives the location of the CTD and ADCP lines.)

20 <sup>th</sup> June 2002	Join Alpha Helix at 9am, sail from Dutch Harbor at 1125
21 <sup>st</sup> June 2002	Transit to Bering Strait
	0705 Primary productivity station at site M2
22 <sup>nd</sup> June 2002	Transit to Bering Strait
23 <sup>rd</sup> June 2002	Arrive Bering Strait at 1410
	1410 Primary Productivity Station at site A2
	1530-2100 CTD section along BS line
	2100-2400 ADCP section along BS line
24 <sup>th</sup> June 2002	0100-0400 ADCP section along MBS line
	0400-0830 CTD section along MBS line
	0900-1100 Recover and redeploy A4
	1200-1330 Recover and redeploy A2
	1730-1930 Recover and redeploy A3
	1930-0230 CTD section along A3L line
25 <sup>th</sup> June 2002	0230-1000 ADCP line along A3L line
	0947 Primary Productivity Station at site A3
	1500-0530 CTD and ADCP along PHL line
26 <sup>th</sup> June 2002	0530-1130 ADCP out to CCL line
	1130-2400 CTD section along CCL line, including
	1656 Primary Productivity Station at CCL15
27 <sup>th</sup> June 2002	0000-1000 ADCP section along CHUK and EEXT lines
	1000-2030 CTD section along EEXT and CHUK lines
	2030-0230 CTD section along CCL line (continued)
28 <sup>th</sup> June 2002	0230-0900 ADCP section along NBS line
	0900-1700 CTD section along NBS line
	1700-1930 CTD section along CCL line (continued)
	1930 Close of science, steam for Nome
29 <sup>th</sup> June 2002	arrive Nome ca.0700 and disembark

## SAMPLING:

Due to the exceptionally good weather we encountered, we were able to complete the mooring work and an extended CTD and ADCP plan.

#### Mooring Work:

All three moorings (see Table 1) were successfully and smoothly recovered and redeployed. Releases functioned well. All instrumentation was recovered in good condition. Unlike in previous years (when mooring recoveries took place in the autumn), the moorings were not badly fouled and the rotors and salinity cells were reasonably clear of biological growth.

Of the three RCMs, two gave good data. The third (A2) developed a battery short before deployment and recorded no data. The three SBEs appear to have run well. The ULSes were still working on recovery and binary data was successfully downloaded. Although both records were complete, one ULS (A2) did not record any echo returns after January. The nutrient analyzer ran for ca. 1 month before a mechanical plunger jammed. (The unused chemicals from the analyzer were still in good condition after a year in the water.)

#### CTD and ADCP section work:

See Figure 1 and Table 2 for the CTD and ADCP sections ran. A total of 98 CTD casts were taken. (Three profiles were recast since the CTD acquisition software crashed part-way through the up-cast.) Preliminary section plots are given in an Appendix. Bottles were fired at standard depths (bottom, bottom-2m, 50m, 40m, 30m, 20m, 10m, 5m, surface) and samples were taken for nutrients, DMS, chlorophyll, O18 isotopes, nitrogen isotopes and salinity. With the exception of the PHL and CCL lines, ADCP sections were run as dedicated sections at a speed of 7 knots.

#### Nutrient Analysis work (Whitledge, Thornton, Lee):

A total of 536 nutrient samples were taken and analyzed on board for silicate, phosphate, nitrate, nitrite and ammonia by Whitledge, Thornton and Lee. Preliminary section plots are included as an appendix. In addition, at many stations samples were taken at surface, mid water column and bottom for chlorophyll, and at some stations samples were taken for size-fractionated chlorophyll, fractionated on 20um, 5um and GF/F filters. At the four sites M2, A2, A3 and CCL15, primary productivity stations (stable isotope nutrient enrichment primary productivity experiments with 15N-labeled nitrate and ammonia and 13C-labeled carbon) were also run.

#### DMS Analysis work (Deal):

DMS sea water profiles were taken at 18 stations, namely June 23: A2-P June 24: A4, A2, A3 June 25: PHL1, PHL6, PHL11 June 26: CCL12 June 27: EEXT3, CHUK10, CHUK7, CHUK2, CCL08 June 28: A3, NBS11, NBS7, NBS2, NBS1. These samples were analyzed on board by Deal.

#### Oxygen isotope sampling (Woodgate for Cooper, Tennessee):

A total of 379 water samples were taken for O18 sampling. Samples were taken at all stations except some of the productivity stations (see bottle list in an appendix). These samples were sealed with parafilm and shipped to Lee Cooper at the University of Tennessee for later analysis. To ensure the integrity of the bottle samples, when possible salinity samples (ca. 200) were taken from the bottles used for O18 samples.

## Nitrogen Isotope sampling (by Deal for Tanaka, IARC/UAF)

Nine water samples (3 each at sites A2, A3 and A4) were taken for nitrogen isotope analysis. These samples will be analysed post cruise by Dr Tomoyuki Tanaka, IARC/UAF.

## Underway sampling:

Seachest data showed evidence of some remarkable fronts during transit and in the work area. For example, passing St Lawrence Island in the early evening, we encountered a few remaining small pieces of ice and a remarkably strong front in surface temperature and salinity.

The flow through Bering Strait was generally towards the south, reflecting the southward winds. For the first few days in Bering Strait, the coastal jet was not easily identifiable (though a more comprehensive check of the ADCP data is required to confirm this). For the latter part of the cruise, although the general flow was still southward, there did appear to be some evidence of the boundary current.

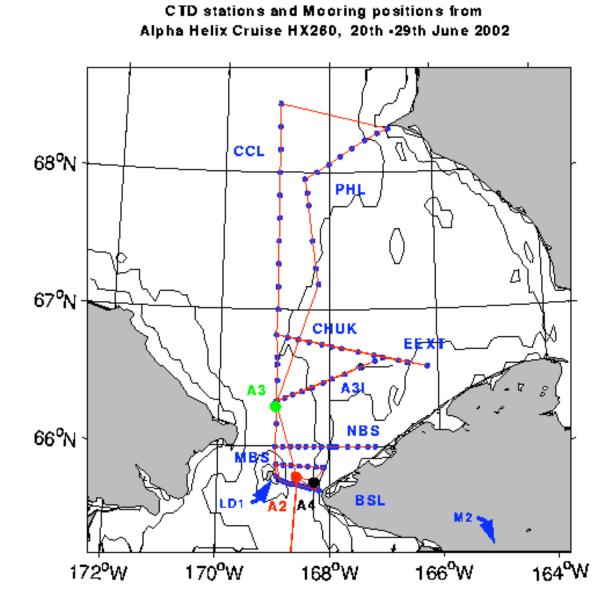


FIGURE 1: Overview Map of the Work Area

ID	LATITUDE (N)	LONGITUDE (W)	WATER DEPTH /m	INST.
Recover ed				
A2-01	65° 46.76'	168° 34.52'	56	ULS RCM7 SBE16
A3-01	66° 19.58'	168° 58.03'	57	ULS RCM9 SBE16 NAS-2E
A4-01	65° 44.73'	168° 15.83'	48	RCM7 SBE16
Deploye d				
A2-02	65° 46.77'	168° 34.53'	56	ULS RCM7 SBE16
A3-02	66° 19.56'	168° 58.03'	57	ULS RCM11 SBE+TF NAS-2E
A4-02	65° 44.70'	168° 15.78'	49	ADCP SBE16

## **TABLE 1: Mooring Positions and Instrumentation**

ULS = APL Upward Looking Sonar RCM7 = Aanderaa Mechanical Recording Current Meter RCM9 = Aanderaa Acoustic Recording Current Meter SBE16 = Seabird CTD recorder SBE+TF = Seabird CTD recorder with transmissometer, fluorometer and PAR sensor NAS-2 = Nutrient Analyzer ADCP = RDI Acoustic Doppler Current Profiler

# **TABLE 2: CTD Positions**

TABLE 2: CTD Positions					
Name	#	Time (GMT)	Stat	Lat(N) Long(W)	D P- P+
hx2600001	1	Jun 21 2002 15:05	m2	57 5.83 165 5.22	72 3.1 69.8
hx2600002	2	Jun 23 2002 22:13	a2p	65 45.80 168 34.09	57 2.2 52.2
hx2600003	3	Jun 23 2002 23:42	bsl6	65 40.93 168 10.89	26 1.6 28.3
hx2600004	4	Jun 24 2002 00:17	bsl5	65 41.37 168 15.22	42 2.0 45.1
hx2600005		Jun 24 2002 00:46		65 41.78 168 19.52	51 2.5 53.7
hx2600006		Jun 24 2002 01:23		65 42.15 168 24.01	54 1.1 51.3
hx2600007		Jun 24 2002 01:49		65 42.62 168 28.20	51 2.2 52.5
hx2600008		Jun 24 2002 01:43		65 43.05 168 32.38	54 1.9 54.8
hx2600009		Jun 24 2002 02:46		65 43.50 168 36.98	54 1.4 51.0
		Jun 24 2002 02:40		65 43.72 168 40.86	50 1.7 51.4
		Jun 24 2002 03:22		65 44.12 168 45.04	50 2.2 52.8
		Jun 24 2002 03:40		65 44.75 168 48.65	50 2.2 52.8
		Jun 24 2002 04:45		65 45.49 168 52.12	40 2.2 42.6
		Jun 24 2002 12:03		65 52.09 168 57.04	43 2.0 41.8
		Jun 24 2002 12:40		65 51.88 168 49.05	50 2.1 50.3
		Jun 24 2002 13:14		65 51.69 168 40.94	51 2.1 51.4
		Jun 24 2002 13:48		65 51.55 168 31.92	55 1.9 51.8
		Jun 24 2002 14:37		65 51.37 168 23.01	50 2.2 51.3
		Jun 24 2002 15:13		65 51.13 168 13.92	50 2.3 46.7
hx2600021	21	Jun 24 2002 15:45	mbs7	65 50.96 168 6.93	40 2.3 38.5
		Jun 24 2002 16:05		65 50.93 168 5.04	32 2.6 30.7
hx2600023	23	Jun 24 2002 17:44	a4-01	65 44.68 168 15.94	45 2.1 46.5
hx2600024	24	Jun 24 2002 20:49	a4	65 46.74 168 34.36	54 2.1 53.8
hx2600025	25	Jun 25 2002 02:18	a3	66 19.58 168 58.18	54 2.5 53.4
hx2600026	26	Jun 25 2002 04:14	A3L2	66 21.26 168 48.38	57 2.5 53.6
hx2600027	27	Jun 25 2002 04:49	A3L3	66 22.75 168 39.81	59 2.4 55.5
hx2600028	28	Jun 25 2002 05:31	A3l4	66 24.13 168 30.22	55 2.0 52.1
hx2600029	29	Jun 25 2002 06:35	A3L5	66 25.89 168 18.67	50 2.4 47.1
hx2600030	30	Jun 25 2002 07:16	A3L6	66 28.09 168 6.35	30 2.4 27.7
hx2600031	31	Jun 25 2002 07:51	A3L7	66 29.71 167 56.77	
		Jun 25 2002 08:32		66 31.71 167 42.82	27 2.6 25.0
		Jun 25 2002 09:25		66 34.75 167 25.32	32 2.2 29.7
		Jun 25 2002 10:13		66 37.41 167 9.23	35 2.6 30.5
		Jun 25 2002 17:51		66 20.17 168 56.15	54 2.2 53.8
		Jun 25 2002 23:19		67 11.04 168 11.90	36 2.1 36.7
		Jun 26 2002 00:14	•	67 18.07 168 14.93	45 2.1 42.2
		Jun 26 2002 01:34	•	67 30.08 168 18.93	50 2.2 45.9
		Jun 26 2002 03:21	•	67 45.60 168 23.69	53 2.4 47.6
		Jun 26 2002 04:18		67 51.02 168 24.95	54 2.5 50.8
		Jun 26 2002 05:30		67 57.13 168 28.16	60 2.2 56.6
		Jun 26 2002 05:30	•	68 0.15 168 14.05	60 2.3 56.5
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		Jun 26 2002 07:42		68 3.55 168 0.05 68 7.05 167 47 04	58 2.6 53.9
		Jun 26 2002 08:51	•	68 7.05 167 47.04	
		Jun 26 2002 09:55		68 10.48 167 33.54	
		Jun 26 2002 11:05		68 14.02 167 17.98	48 2.3 44.7
		Jun 26 2002 12:10		68 17.06 167 3.11	41 2.3 37.0
		Jun 26 2002 13:07		68 19.03 166 50.69	
nx2600049	49	Jun 26 2002 19:33	CCI19	68 29.98 168 56.98	55 2.1 51.5

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(D = approximate water depth in m) (P-, P+ = min/max pressure of CTD in dbar)