NGA-LTER Seward Line CRUISE PLAN
June 29 – July 15, 2023
KM2307

Funding Source: NSF, NPRB, EVOS, AOOS, UAF

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Co-Chief Scientist: Caitlin Smoot, Zooplankton, IMS-UAF (casmoot@alaska.edu)

Scientific Personnel:

Surname	Name	Institution	Role	Team
Hopcroft	Russ	UAF	Chief Scientist	Zoop (Days)
Smoot	Caitlin	UAF	Co-Chief Scientist	Zoop (nights)
Aguilar-Islas	Ana	UAF	Scientist	Nutrients
Ballantine	Kaleigh	UAF	REU (Seth)	Physics/CTD
Blais	Jaime	WWU	Grad student	Phyto
Brauner	Megan	UAF	Grad student	Phyto
Busse	Hana	WWU	Scientist	Phyto
Cushing	Dan	UAF	Scientist	Seabirds
Hennon	Gwenn	UAF	Scientist	Phyto
Kelly	Tom	UAF	Scientist	Flux
Kepner	Hannah	UAF	Grad Student	Zoop (nights)
Lloyd	Sierra	UAF	Undergrad	Nutrients
Marvy	Asher	WWU	REU (Suzanne)	Phyto
Norgaard	Addie	UAF	Grad student	Ocean Acid
Owens	Ryan	UAF	Scientist	Ocean Acid
Roberts	Cara	UAF	REU (Jenn)	Zoop (nights)
Strom	Suzanne	WWU	Scientist	Phyto
Trout	Eris	UAF	REU (Gwenn)	Phyto
Van Pelt	Abigail	UAF	REU (Ana)	Nutrients
Warren	Xavier	UAF	REU (Kelly)	Flux
Webster	Nicole	UAF	Grad student	Physics/CTD
Williams	Katey	WWU	Grad student	Phyto
Wolff	Alexia	UAF	REU (Russ)	Zoop (nights)

Scientific Purpose:
The NGA is a highly productive subarctic Pacific marine biome where intense environmental variability has profound impacts on lower trophic level organisms and community dynamics that, directly or indirectly, support the iconic fish, crabs, seabirds and marine mammals of Alaska. In the NGA, a pronounced spring bloom and regions of sustained summer production support a stable base of energy-rich zooplankton grazers that efficiently transfers primary production up the food chain and a substantial sinking flux of organic matter that exports carbon to the sea bottom communities. The LTER research cruises examine features, mechanisms and processes that drive this productivity and system-wide resilience to understand how short- and long-term climate variability propagates through the environment to influence organisms.

This cruise represents a continuation of sampling begun in fall 1997 under the NSF/NOAA NE Pacific GLOBEC program, and subsequently a consortium of the North Pacific Research Board (NPRB), the Alaska Ocean Observing System (AOOS), and the Exxon Valdez Oil Spill Trustee Council's (EVOSTC) Gulf Watch. This is the sixth year of the NSF's Northern Gulf of Alaska Long-term Ecological Program (NGA-LTER). The scientific purpose of the core Seward Line project is to develop an understanding of the response and resiliency of this marine ecosystem to climate variability. This cruise marks the 26th consecutive year for the Seward Line in the NGA, including Prince William Sound (PWS), and the 53rd year of observations at GAK1.

Cruise Objectives

1. Determine thermohaline, velocity, light, and oxygen structure of the NGA shelf.
2. Determine macro- and micro-nutrient structure of the NGA shelf.
3. Determine particle structure and flux rates of the NGA shelf.
4. Determine phyto- and microzooplankton composition, biomass distribution, and productivity.
5. Determine the vertical & horizontal distribution and abundance of mesozooplankton species.
6. Determine the abundance and composition of macrojellyfish.
7. Conduct surveys of Seabirds and Marine Mammals
8. Conduct experimental work to better understand the NGA system
9. Determine carbonate chemistry (i.e. Ocean Acidification) at selected stations
10. Search for lost GEO mooring
11. Conduct full transect of Seward line with the undulating ISIIS-DPI imaging system.
12. *Provide at-sea experience for students within the UAF system*
13. *Provide at sea experience for 7 REU students in our 2023 cohort*
14. *Share the experience through outreach/media activities.*

SAMPLING

The overall approach of the cruise is to occupy the Seward Line, Kodiak Line and Middleton Line transects across the shelf and a string of stations within western PWS. Operations are generally divided into distinct day and night tasks, thus requiring each station to be occupied twice. This structure avoids each discipline needing to supply 2 shifts of scientists and ensures all organisms – especially larger diel-migrating zooplankton – are captured with minimal time-of-day bias. During each morning we will typically occupy a selected "intensive" station that involves a greater number and range of collections than the other stations occupied that day. Station profiles are supplemented by underway measurements.

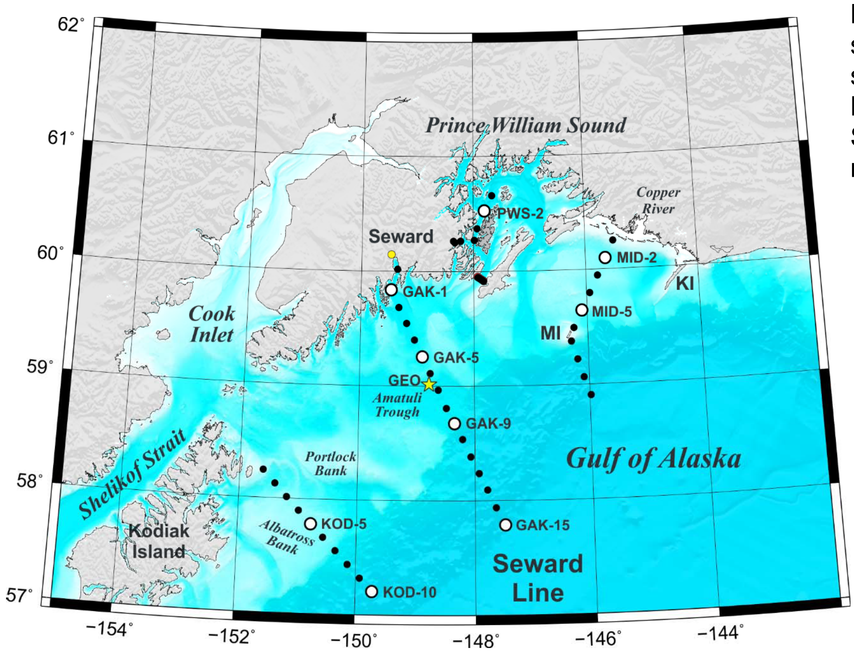
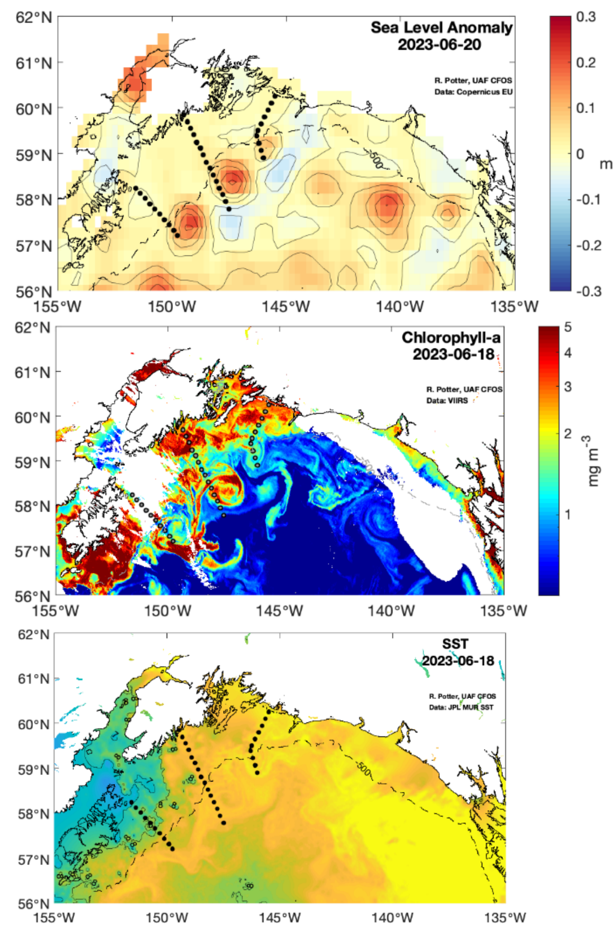


Figure 1. The LTER primary sampling stations. Intensive stations denoted by open symbols. Minor CTD stations not shown. Star shows position of LTER mooring.

DAYTIME ACTIVITIES:

1. Occupy the various hydrographic stations and collect vertical CTD-fluorescence-PAR and particle profiles (see **Figures** & **Tables)**.
2. Collect discrete bottle samples at these stations for nutrients, chlorophyll and microzooplankton. Chlorophyll Size Fractionation (20 µm) will be done at most stations. Macronutrients samples will be pre-filtered prior to freezing. Chlorophyll will be extracted on fresh filters without freezing.
3. Collect samples for dissolved carbonate chemistry along the Seward Line and within Prince William Sound from bottle casts at selected stations.
4. CalVet Net casts will be done (CalVet frame has 4 nets) after most the CTD casts to 100m, with duplicate casts at intensive stations.
5. At intensive stations an additional CTD cast will collect water to be used for primary production incubations and carbonate chemistry. A third cast may required at our deeper intensive stations
6. A trace-metal clean CTD cast will also be undertaken at all intensive stations, and other odd-numbered stations as time permits.
7. We will deploy a small metal tow-body for sampling near-surface iron during the day (and on long transits). Sampling will occur just prior arriving to or just after departure.
8. At intensive along the Seward Line plus PWS2 there will be a vertical/stationary deployment of the 150 µm Multinet to 200m. Some of this material will be used for live sorting as well as post-cruise molecular analysis.
9. We will do one deep vertical Multinet tow (to maximum 1200 m) near the end of the Seward Line and one at PWS2 (800m). This normally happens during days early enough that night team can assist.
10. We will attempt to deploy drifting sediment traps at a subset of the intensive stations, the number to be determined by how they fit into daily logistics. Traps will ideally be deployed for 24 (or 48) hrs.
11. We will search for the lost GEO mooring (~GAK 6i).



NIGHTTIME ACTIVITIES:

1. A towed 505-µm Multinet will be used to collected depth-stratified samples along the Seward Line, and at selected PWS Stations to 200m. Two multinet casts will be conducted at Intensive stations.
2. On the Middleton and Kodiak Lines bongo net collections will replace those of the Multinet.
3. A 5 m^2 Methot net will be towed for 20 minutes at each night station.

Sampling Strategy

The station order is highly dependent on weather and the weather models projections for 3-4 days out. If weather permits, we will begin with the Seward Line trying to sample a large mesoscale eddy passing over its offshore end.

Typically, we estimate 1.5-2 days for PWS and 4-5 days minimum for the Seward Line, 2-2.5 days for each of the Middleton and Kodiak transects – the Kodiak line is lowest priority. Historically we have completed one intensive station and 3 basic stations on the shelf each day, while GAK15 takes most of a day to complete due to its depth. An additional day has been needed for the remaining deep stations. Intensive stations must begin during morning to reduce biases in primary production incubations. It is likely that the process work proposed for this summer cruise will result in a slower pace that completes fewer stations per day, effectively turning what was historically one day of activities into 2 days to maintain our fixed intensive station locations.

The DPI transect takes ~30 hrs, but can be split into 2 or 3 large pieces to keep it close in time to traditional station sampling. The GEO mooring hunt could also consume 1-2 days of ship-time.

It is important that all towed Multinet collections be completed during darkness to allow comparison to prior years. We anticipate that 4 Multinets and/or Bongos stations can be conducted per night: sampling starts just after dusk and stops just before dawn, and can be extended slightly when overcast. There is always a typically a greater period of light available than of darkness, so execution of daytime stations and activities are designed around being in position to commence night sampling as soon as it is sufficiently dark.

Sediment traps are flexible in their deployment timing, but should be deployed ~24 hours once set.

Hazmat: (full list here)

Formaldehyde – 2x20L carboy
Ethanol – 40L
Acetone – 16L
Hydrochloric acid – 4L
Oxygen Fixation (Sodium hydroxide. Sulphuric acid, Manganous Chloride)

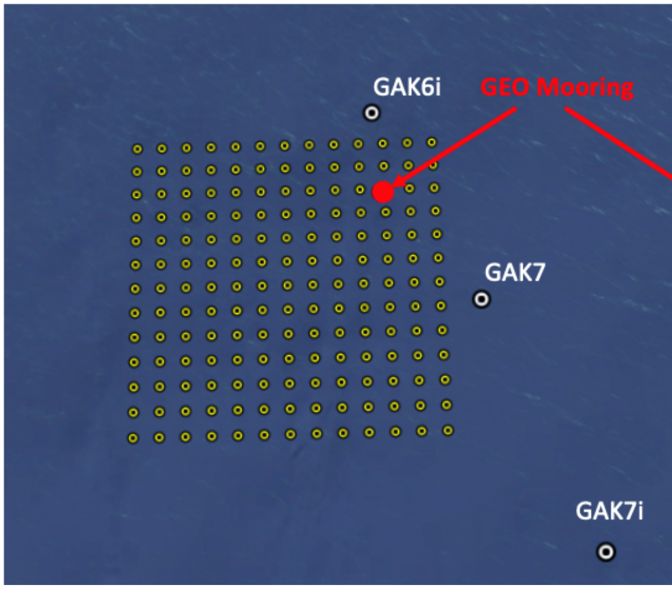
Paraformaldehyde (100ml)
Lugol's solution (1L)
Mercuric Chloride (for DIC fixation)
Glutaraldehyde (10%) – 500 ml
DAPI stain solution – 100 ml
Liquid N_2 – 20L and 35L dewars

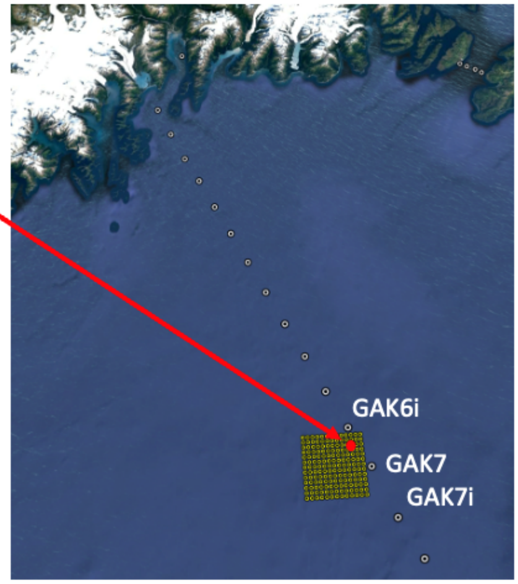
CRUISE ACTIVITY SCHEDULE

6/25 – Advance Science team (~8), heads to Seward sleeps on *Kilo Moana* overnight.
6/26 – Advance Science team begin warehouse staging and movement of gear to KM at ~8am.
– Remainder of science heads to Seward.
6/27-28 – Setup on KM continues; science teams familiarize themselves with ship
6/29 – KM underway by 8am (if not the prior evening)
7/15 – KM returns to dock by 4pm – packup and demob begin.
7/16 – Demob continues, part of science party may depart by early afternoon. Remainder of science team sleeps aboard KM
7/17 – Remainder of science team Demob departs early morning – KM underway for Hawaii ~8 am.

Transportation: Detailed breakdown can be found on the NGA-LTER google drive

GEO-2 Mooring Search Grid





The GEO2-22 mooring was not located on the spring 2023 NGA LTER cruise. We believe that the mooring likely moved west (downstream) or south (downslope) from the deployment site. The attached grid covers approximately 150 square km with stations spaced ~1 km apart. The acoustic releases should be able to transmit 1 km, so the mooring should have about 4 chances to be heard if this grid is completed.

GEO2 deployment location: -148.69340, 59.015283

Instructions:

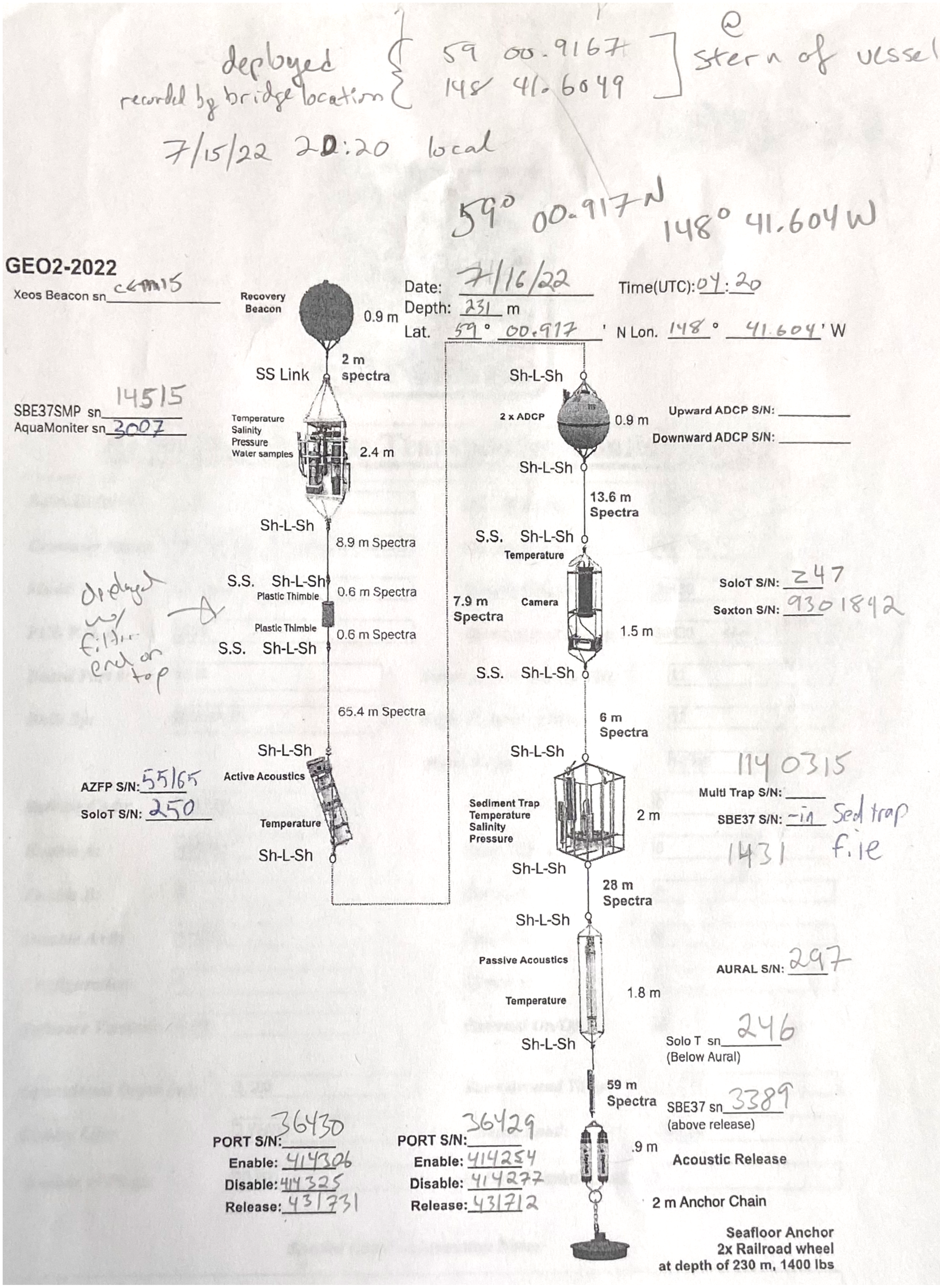
- Please send only the "Disable" codes while searching for the mooring. (The releases respond to both Enable and Disable commands.
- Send the Disable codes twice for each release while on a station (e.g., 4 attempts)

If you do hear back from a release:

- Record your position!
- You may send an "Enable" command and then send some chirps to measure your range.
- Try to get two more distance ranges from locations that are a 200-300 meters away from the initial fix. Record your GPS coordinates each time. Three fixes will allow us to geolocate the mooring.
- IMPORTANT: Send the "Disable" command when you are done and before leaving the vicinity.

Acoustic Release Codes:

- PORT 36429: Disable = 414277
- PORT 36430: Disable = 414325
- *See the attached sheets for the Acoustic release Enable and Release codes.*


deployed
recorded by bridge location
59 00.9167
148 41.6049
@ stern of vessel
7/15/22 20:20 local
59° 00.917 N
148° 41.604 W
GEO2-2022
Xeos Beacon sn C4M15
Recovery Beacon
0.9 m
Date: 7/16/22
Time(UTC): 04:20
Depth: 231 m
Lat. 59 ° 00.917 ' N Lon. 148 ° 41.604 ' W
SS Link
2 m spectra
SBE37SMP sn 14515
AquaMoniter sn 3007
Temperature
Salinity
Pressure
Water samples
2.4 m
Sh-L-Sh
8.9 m Spectra
S.S. Sh-L-Sh
Plastic Thimble
0.6 m Spectra
Plastic Thimble
S.S. Sh-L-Sh
0.6 m Spectra
deployed w/ filter end on top
65.4 m Spectra
Sh-L-Sh
Active Acoustics
AZFP S/N: 55165
SoloT S/N: 250
Temperature
Sh-L-Sh
Sh-L-Sh
2 x ADCP
0.9 m
Upward ADCP S/N:
Downward ADCP S/N:
Sh-L-Sh
13.6 m Spectra
S.S. Sh-L-Sh
Temperature
Camera
7.9 m Spectra
SoloT S/N: 247
Sexton S/N: 9301842
1.5 m
S.S. Sh-L-Sh
6 m Spectra
Sh-L-Sh
Multi Trap S/N: 1140315
Sediment Trap
Temperature
Salinity
Pressure
2 m
SBE37 S/N: -in Sed trap file 1431
Sh-L-Sh
28 m Spectra
Sh-L-Sh
Passive Acoustics
AURAL S/N: 297
Temperature
1.8 m
Sh-L-Sh
Solo T sn 246
(Below Aural)
59 m Spectra
SBE37 sn 3389
(above release)
PORT S/N: 36430
Enable: 414306
Disable: 414325
Release: 431731
PORT S/N: 36429
Enable: 414254
Disable: 414277
Release: 431712
.9 m
Acoustic Release
2 m Anchor Chain
Seafloor Anchor
2x Railroad wheel
at depth of 230 m, 1400 lbs

ORE-Offshore LFPort Serial #36430
Release code: 431731
Enable A: 414306
Disable A+B: 414325

ORE-Offshore LFPort Serial #36429
Release code: 431712
Enable A: 414254
Disable A+B: 414277

PORT LF Manual SECTION 3: INSTALLATION 3-2

3.3 Status Reply

The PORT-LF is equipped with sensors that monitor the tilted or not tilted orientation of the system and release shaft rotation. This information allows the Unit to send a coded status reply, based on the instruments orientation and to emit one ping each time the release shaft completes a rotation. The tilt status is useful for ascertaining whether the mooring or platform that has been deployed and/or has
landed as planned. At the end of a deployment, this information is useful in determining whether forces such as strong currents or trawl activity have affected the mooring or platform. The status reply indicates one of two states:

- "upright (within 45' of upright)"
- "tilted (more than 45' from upright)"

After a(n) DISABLE or ENABLE command has been received, the Unit transmits a series of pings encoded as follows:

PATTERN STATUS

15 pings at 2 second intervals: “upright
7 pings at 2 second Intervals: ”tilted”

The tilt sensor is a 45' mechanical switch that is mounted on the Release Circuit Board Assembly In the standard instrument configuration, with the release mechanism down, the Unit is defined as “not tilted". For applications requiring a narrower maximum allowable angle of tilt optional tilt switches are available. The switch can also be installed at different angles to change the standard orientation.

PORT LF 000859S_REV_E

GEO2 location (begin search here): -148.69340, 59.015283

Other search grid coordinates:

-148.65840, 59.033283	-148.65840, 58.943283	-148.67590, 58.970283
-148.65840, 59.024283	-148.65840, 58.934283	-148.67590, 58.961283
-148.65840, 59.015283	-148.65840, 58.925283	-148.67590, 58.952283
-148.65840, 59.006283	-148.67590, 59.033283	-148.67590, 58.943283
-148.65840, 58.997283	-148.67590, 59.024283	-148.67590, 58.934283
-148.65840, 58.988283	-148.67590, 59.015283	-148.67590, 58.925283
-148.65840, 58.979283	-148.67590, 59.006283	-148.69340, 59.033283
-148.65840, 58.970283	-148.67590, 58.997283	-148.69340, 59.024283
-148.65840, 58.961283	-148.67590, 58.988283	-148.69340, 59.006283
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Table 1. **STANDARD STATIONS** (intensive stations highlighted)

Latitude N (degrees, minutes)		Longitude W (degrees, minutes)		Station Name
Resurrection Bay Station				
60	1.5	149	21.5	RES2.5
Seward Line				
59	50.7	149	28	GAK1
59	46	149	23.8	GAK1I
59	41.5	149	19.6	GAK2
59	37.6	149	15.5	GAK2I
59	33.2	149	11.3	GAK3
59	28.9	149	7.1	GAK3I
59	24.5	149	2.9	GAK4
59	20.1	148	58.7	GAK4I
59	15.7	148	54.5	GAK5
59	11.4	148	50.3	GAK5I
59	7	148	46.2	GAK6
59	2.7	148	42	GAK6I
58	58.3	148	37.8	GAK7
58	52.9	148	33.6	GAK7I
58	48.5	148	29.4	GAK8
58	44.6	148	25.2	GAK8I
58	40.8	148	21	GAK9
58	36.7	148	16.7	GAK9I
58	32.5	148	12.7	GAK10
58	23.3	148	4.3	GAK11
58	14.6	147	56	GAK12
58	5.9	147	47.6	GAK13
57	***56.6***	***147***	***39***	***GAK14***
57	***47.5***	***147***	***30***	***GAK15***
Prince William Sound Stations				
60	7.5	147	50	KIP0
60	16.7	147	59.2	KIP2
60	22.78	147	56.17	PWS1
60	32.1	147	48.2	PWS2
Icy Bay				
60	16.3	148	21.7	IB0
60	15.5	148	20.1	IB1
60	16.3	148	14	IB2
Montague Strait Line				
59	57.257	147	55.602	MS1
59	56.6	147	53.7	MS2
59	55.9	147	51.4	MS3
59	55.2	147	49.7	MS4

Table 2. Additional LTER Stations (intensive stations highlighted)

Latitude N (degrees, minutes)		Longitude W (degrees, minutes)		Station Name
Kodiak Line				
58	14.7	151	35.4	KOD1
58	7.8	151	23.07	KOD2
58	0.9	151	10.74	KOD3
57	54	150	58.17	KOD4
57	47.1	150	45.6	KOD5
57	40.26	150	32.97	KOD6
57	33.42	150	20.34	KOD7
57	26.37	150	7.95	KOD8
57	19.32	149	55.56	KOD9
57	12.27	149	43.17	KOD10
Middleton Island Line				
60	15	145	30	MID1
60	10.5	145	34.5	MID1i
60	6	145	39	MID2
60	1.5	145	43.5	MID2i
59	57	145	48	MID3
59	52.5	145	52.5	MID3i
59	48	145	57	MID4
59	43.5	146	1.5	MID4i
59	39	146	6	MID5
59	34.5	146	10.5	MID5i
59	30	146	15	MID6
59	25.7	146	10	MID6i
59	22.5	146	17.8	MID7
59	18.267	146	15	MID7i
59	13.534	146	12	MID8
59	4.067	146	6	MID9
58	54.6	146	0	MID10