

1.0 Introduction

As part of the Minerals Management Service Sediment Quality in Depositional Areas of Shelikof Strait and Outermost Cook Inlet, a two-year field program is being conducted. Samples for biological, chemical, and toxicological analyses will be collected from the study area. This document is intended to provide the basis for the specific sample collections to be carried out in 1997 and 1998.

This Field Logistics and Sampling Plan includes: detailed logistics and schedules; station locations; exact numbers, types, and locations of samples to be collected; sampling procedures; quality assurance and quality control guidelines; and a safety and health plan.

1.1 Objectives

The objectives of the program are to:

- Examine the sediments from depositional areas of the Shelikof Strait and Outermost Cook Inlet for oil industry contaminants (metals and organics)
- Determine whether the contaminant concentrations in these areas pose an environmental risk
- Determine whether contaminants in these areas have accumulated relative to pre-oil industry activities and whether any increases can be correlated to specific discharge events or activities

The objectives of the field survey are to:

- Occupy 14 fixed and 45 random stations in depositional areas of Shelikof Strait and Outermost Cook Inlet
- Collect surface sediment, sediment core, and fish samples from specified stations
- Deliver the field sample to analytical laboratories for appropriate analyses

2.0 Cruise Plan

2.1 Logistics

2.1.1 Research Vessel

The research vessel R/V *Alpha Helix* was contracted for the 1997 field survey. The *Alpha Helix* is a University National Oceanographic Laboratory System (UNOLS) vessel, owned by the National Science Foundation (NSF) and operated by the University of Alaska Fairbanks, Institute of Marine Science. The ship is based in Seward, which will serve as the base of operations for the field survey. The ship's operational center is:

Seward Marine Center
101 Railway Avenue
Seward, AK 99664

The *Alpha Helix* is an open-ocean vessel capable of 24-hour operation in offshore Alaskan waters, its sole charter is the support of scientific research. It is equipped with an A-frame and open stern, crane, electronic navigation systems (SATNAV/GPS and Loran C), wet and dry laboratory space, and can accommodate a 15 member field team.

The *Alpha Helix* is also equipped with modern communications, including Marine Operator VHF (coastal), High seas Operator (single side-ban), and INMARSAT (both voice and fax). Messages can be relayed to members of the scientific crew through the Seward Marine Center, they maintain daily communication with the vessel while under operation. The Marine Center telephone number is 907.224.5261, fax is 907.224.3392. The INMARSAT number is 011.872.150.6216. INMARSAT costs are approximately \$10 per minute, so use should be kept to a minimum. Scientific crew may use the INMARSAT to make outgoing calls and send faxes, a credit card is necessary to place the call.

The *Alpha Helix* comes equipped with sampling equipment that will be used in the field survey or will serve as back up equipment. Specific equipment that the *Alpha Helix* will supply:

- 1 MK III box core with 2 stainless steel boxes (primary)
- 1 Soutar box core (backup)
- 1 Benthos gravity core (backup)
- 2 seabird CTD (1 as backup)
- 2 Van-Veen grab samplers (backup for ADL Van-Veen grab)
- 1 Shipek grab sampler (Van-Veen backup)
- Long line gear (long lines [2], anchors [6], surface floats [6], float line, hooks and line)
- Acoustic doppler current profiler

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2.1.2 1997 MMS Field Team

The MMS 1997 field team consists of staff members from Arthur D. Little (ADL), Florida Institute of Technology (FIT), Applied Marine Sciences (AMS), EVS Environmental Consultants (EVS), and Minerals Management Service (MMS). The 1997 field team includes the following personnel:

John Brown - Chief Scientist (ADL)
George Naughton - Chemist/Shift Leader (ADL)
Ted Coogan - Chemist/CTD/GIS (ADL)
Cherie Howell - Chemist (ADL)
John Trefry - Chemistry Leader (FIT)
Simone Metz - Chemist (FIT)
Bob Trocine - Chemist (FIT)
Woo-Jun Kang - Chemist/CTD (FIT)
Jordan Gold - Biologist (AMS)
Tim Hammermeister - SPI Camera (EVS)
Dick Prentki - Oceanographer (MMS)
Peter Johnson - Geologist (MMS)

John Brown (ADL) is the chief scientist for the field survey; he will be responsible for coordinating all activities related to the conduct of the survey. George Naughton (ADL) will serve as a shift leader and chemist, overseeing sample collection at individual stations as a shift leader and otherwise assisting in collection of sediment samples for organics analyses. Ted Coogan (ADL) is a chemist, who will primarily collect conductivity, temperature, and depth (CTD) data and record data in a geographic information system (GIS) during the survey, but will also assist in sediment and fish sample collection. Cherie Howell (ADL) is a chemist who will collect sediment grab samples and core sections for organics analyses.

As the chemistry leader, John Trefry (FIT), will oversee chemistry sample collection and handling for all analyses. Simone Metz (FIT) is an inorganic chemist who will collect sediment grab samples for metals analyses and assist in geochronology sampling of sediment cores. Bob Trocine (FIT) is an inorganic chemist who will collect sediment samples for metals analyses and will prepare sediment samples for AVS/SEM analysis. Woo-Jun Kang is a chemist from FIT who will collect and record CTD data and assist in sediment sampling.

Jordan Gold is a biologist from AMS who will collect fish samples and conduct tissue dissection on-board for P-450, metals and organics analyses. Tim Hammermeister is a field technician from EVS who will deploy the sediment profile imaging (SPI) camera to collect images of the surface sediment cross-section at each station.

Dick Prentki, the project COTR, is an oceanographer from MMS who will accompany the survey to supervise and assist during station selection and sampling. Peter Johnson (MMS) is a geologist who will assist the field team in sediment sample collection.

2.0 Cruise Plan

2.1.3 Schedule

The 1997 cruise is scheduled for July 8-18, 1997, and coincides with the most favorable tidal and current conditions in the study area. The Field Team will arrive in Seward, Alaska on July 6. Mobilization of the field team and *Alpha Helix* takes place on July 7, and the *Alpha Helix* will depart Seward on July 8, 1997. Sediment and fish sampling is scheduled from July 9 through July 17, July 18 has been set aside as a weather contingency day. The *Alpha Helix* will return to Seward on July 19 for demobilization at the Seward Marine Center.

2.2 Cruise Track

The cruise track will begin with a transit to the outermost sampling area, Zone 3 of the Shelikof Strait (see Figure 1 for a map of the study area). As work is completed the cruise will progress through Zones 2, 1 and 0 (Outer Cook Inlet). The backbone schedule in each Zone will be to sample the required fixed and random stations, in order of proximity, starting with the southern most stations first. Long line fish sampling will be performed concurrently with the sediment station sampling. Long line fishing will take place in areas where historical data indicate that target species may be collected within each zone, and may not necessarily be conducted at specified sediment stations. A complete list of the random and fixed sampling stations for all zones is included in Table 1 and is shown on Figure 2.

The sampling stations and cruise track have taken into consideration a 3 mile exclusion zone, which has been imposed around Sugarloaf Island in Barren Islands because of a sensitive Stellar sea lion haul out located there.

Several contingencies have been incorporated into this plan. They include backup equipment and parts, the scheduling of an extra day should weather prevent work, a scientific and ship crew capable of performing 24 hours a day, and the selection of alternate station locations in each Zone.

2.0 Cruise Plan

Figure 1

2.0 Cruise Plan

Table 1

2.0 Cruise Plan

Figure 2

3.0 Sampling Plan and Procedures

3.1 Station Selection

Stations for sediment sampling are composed of random and fixed stations. The positions of the random and fixed stations in each zone, as well as, alternate station positions are included in Table 1. In Zones 1, 2 and 3 (Shelikof Strait), fifteen random stations and two fixed stations were selected in each zone. In addition, ten alternate stations were identified. In Zone 0 (Outermost Cook Inlet), eight fixed stations and four alternate stations were selected. Only fixed stations were selected from outermost Cook Inlet due to the limited area where depositional environments could be identified (i.e. “mud” or silt/clay bottom).

Random stations were selected in Zones 1, 2 and 3 by establishing a 5 kilometer grid within the 50 fathom depth contour of each zone. This grid resulted in over 100 blocks fully contained in each zone. Each block within a zone was sequentially numbered. Random numbers were then generated to identify the random stations within each zone. The first fifteen stations randomly identified in each zone, which contained silt/clay sediment, based on historical data, were established as the primary random stations. The station location was positioned in the center of the random block selected. An additional ten random stations in each zone were selected in the same manner as alternate random stations. The alternate random stations will be selected if, based on field observations, one of the primary random stations does not contain silt/clay sediment. The two fixed stations in Zones 1, 2 and 3 were selected in deep “holes” likely to contain depositional sediment.

The eight fixed stations in Zone 0 were selected to obtain representative spatial coverage within the zone (i.e., Kechemak Bay, Kamishak Bay, Kennedy Entrance, etc.) The eight fixed stations were selected from areas where historical grain size data indicated depositional sediments occurred. In addition, four alternate fixed stations were identified in case depositional sediment could not be collected from one of the eight primary fixed stations.

3.2 Source Sample Selection

Source samples will be collected in order to compare concentrations and distributions of contaminants in the sediments to potential contaminant sources. Based on a review of the literature and historical data on the Outermost Cook Inlet and Shelikof Strait, a number of potential contamination sources for the depositional sediments were identified. These sources include oil and gas activities, oil seeps, municipal discharges, boat harbors, and riverine inputs. Samples representative of these sources will be collected as part of the overall study. The targeted source samples will include:

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- Cook Inlet Crude Oil (obtained through UNOCAL)
- Cook Inlet Produced Water (2 samples obtained through UNOCAL)
- Oil Creek sediment
- Susitna River mud
- Copper River mud
- Anchorage municipal wastewater discharge
- Homer boat harbor sediment

The Homer boat harbor sediment and the Oil Creek sediment source samples will be collected during the 1997 *Alpha Helix* cruise. Arrangements for the collection of the other source samples will be made after the cruise. The Homer boat harbor sediment will be collected just outside the entrance of the boat harbor to the west of the dredged channel in an area where sampling activities will not interfere with boat traffic in the harbor. The Oil Creek sediment will be collected by a shore party using the *Alpha Helix* skiff. The Oil Creek sediment or mud will be collected from the creek upstream of tidal influence and preferably in an area along where active sheens are visible. If no sheens are visible, mud from a “depositional” area of the creek will be selected.

3.3 Sample Identification Scheme

Each sediment or tissue sample collected will be assigned a unique sample tracking number. The sample identification will provide some basic information about the sample and allow the sample to be uniquely identified throughout the program.

The basic index for the sample identification is as follows: year-zone-station-replicate-depth interval -analysis-matrix, e.g., 97-1-01-01-HC-S. A description of the data fields in these numbers is provided below.

Field	Acceptable inputs
Year	97, 98
Zone	0, 1, 2, 3
Station	Random = 01-15 Fixed = F1-F8
Replicate	01-99
Depth Interval	01-99
Analysis	AVS (AVS/SEM), MET (metals), PHC (hydrocarbons), TOC (total organic carbon), GRS (grain size), RGS (reporter gene), TOX (sediment toxicity), 450(P450), GEO (geochronology, Cs ¹³⁷ and Pb ²¹⁰)
Matrix	S(sediment), T(tissue)

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Additional notes will be maintained by the field crew including station logs which will provide further details for each sample.

The basic goals of this survey are to collect samples of surface sediments, sediment cores and fish tissue and to provide sufficient sample for laboratory analysis. The analyses to be performed include:

- Hydrocarbons - PAH, Biomarkers, and SHC
- Metals - Trace and major elements
- AVS/SEM - Acid Volatile Sulfide/Simultaneous Extracted Metals
- Cytochrome P450 reporter gene
- Sediment Toxicology
- Geochronology - Cs¹³⁷ and Pb²¹⁰
- Total Organic Carbon
- Grain Size
- Sediment Profiling Camera Imagery

In addition, a Seabird CTD (conductivity, temperature, depth) profiler will be deployed at each sampling station.

3.4 Station Plan

This section describes the sequence of events at each sampling station and the goals of each task on station. Specific procedures are described in detail in a later section.

3.4.1 Identify Station

Stations positions (latitude and longitude) are provided in Table 1. A “station” is defined as a 0.2 nm radius around a nominal station position. The actual latitude and longitude of the station will be determined by the global positioning system (GPS) position when a station has been successfully sampled.

3.4.2 Navigate to Station Position

Once a station has been identified it will be necessary to select a location within the 0.2 nm radius which is likely to provide successful sampling results. Two key considerations will be the acoustic bottom profile, which can assist in the identification of unconsolidated muds, and the results of a doppler current profile. Strong bottom currents could prevent successful sampling.

3.4.3 Acoustic Bottom Profile

The *Alpha Helix* is equipped with an acoustic bottom profiler. The bottom profile will be “read” to determine the likelihood of the station having depositional sediments.

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3.4.4 Doppler Current Profile

The *Alpha Helix* is also equipped with a doppler current profiler. The doppler current profiler is capable of measuring ocean currents throughout the water column. The presence of strong bottom currents will be evaluated to determine if sampling gear can be successfully deployed.

3.4.5 Van-Veen Grab, Acceptable Sedimentology and Alternate Station Selection

A grab sample will be collected to determine if the station sediment is acceptable for sampling. A sediment sample will be considered acceptable if it contains greater than 50 percent silt/clay (i.e., “mud”). The percent silt/clay will be estimated by visual observation of the sediments. If the sediment sample is not acceptable, repeat grabs may be attempted at the station, but no more than three attempts are recommended. If after repeated grab attempts the station is deemed unacceptable, the next closest alternate station will be selected from the list in Table 1.

It is possible that locating stations with greater than 50 percent silt/clay may not be feasible in Zone 0 due to the dynamic sedimentological and oceanographic regime of this area (i.e., sand waves, cobble and rock bottom predominate in much of the area). Thus, it may be necessary to reduce the percent silt/clay criteria for acceptable depositional sediment in Zone 0. Any modifications to acceptable depositional sediment will be based on field observations during the cruise.

3.4.6 CTD

Conductivity, temperature, and depth measurements will be taken at each station using the seabird CTD. The CTD data will be recorded in hard copy and digital format.

3.4.7 Sediment Profile Imaging Camera

The Sediment Profile Imaging (SPI) Camera will be used to photograph the surface and subsurface layers of sediment on the ocean floor. These images can be used to describe benthic community and benthic structure, physical setting (e.g., grain size), biochemical parameters, and depth of the redox layer.

3.4.8 Repeat Grabs as Necessary/Move to Alternate Station if Necessary

At each station, it may be necessary to repeat grabs to collect a greater volume of sediments depending on the number of analyses to be conducted for that station. For example, when sediment toxicity samples are collected, up to 4 to 6 grabs may be needed to collect enough sediment for the 2 liter toxicity sample.

3.4.9 Box Core

Box cores will be taken at stations where it is necessary to obtain subsurface sediment core samples. Subsequent subcores will be taken within the box to a depth of 75 cm. These cores represent a picture of sediment accumulation over time. By sectioning the cores, discrete layers can be examined to determine the geochronology of the sediments

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and characterize any unusual sediment types. In addition, specific laboratory analyses will be conducted on sections of the cores that will be selected in the field.

3.5 Station Procedures

The purpose of this section is to describe in detail the procedures to be followed at each station. A summary of the type of samples to be collected at each station is provided in Table 2. A station log (attachment) will be completed for each station occupied. In addition, a Shift Report Form (attachment) will be completed daily by the field shift leader to summarize the sampling activities completed during each day/shift.

3.5.1 Navigation

The *Alpha Helix* will be navigated by the ships crew to each station. At each station, the support vessel will be positioned at the sampling location and held on station using bow thrusters. The station position is documented minimally by latitude and longitude recorded from satellite transmissions using a GPS.

3.5.2 CTD

At each station, the seabird CTD will be deployed to collect data on conductivity, temperature, and depth. This data will be downloaded by a data logger to a computer system where it will be analyzed, graphically displayed, and stored electronically.

3.5.3 Sediment Profile Imaging

The Sediment Profile Imaging (SPI) camera will be operated by a technician from EVS at each station. Images will be collected at all sediment sampling stations. Following collection of sediment samples by Van-Veen Grab, the SPI camera will be deployed to the ocean floor. Three images will be taken at each station. Each shot takes approximately 30 seconds.

The SPI camera system will be deployed and retrieved by the field technician while the vessel operator controls the hydrowire winch. The general procedure for SPI activities is as follows:

1. Load the camera with color slide film, 100 ISO, and check and secure the camera housing in the SPI camera frame
2. On deck take two photographs of the Kodak Grey Scale (Small) (Eastman Kodak, 1994)
3. Signal the winch operator to lift the camera system
4. Guide the camera system overboard until it is clear of the vessel
5. Lower the camera system through the water column to the bottom at approximately 0.3 m/s
6. Record the location on the DGPS when the camera system contacts the bottom
7. Trigger the camera system to take a photograph

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Table 2

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Table 2 cont'd

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8. Signal the winch operator to begin retrieving the camera system and raise approximately 2 m off the bottom
9. Lower camera for the next replicate image. Repeat these steps until 3 images are obtained at each station
10. Guide the camera system aboard the vessel and place it securely on the deck
11. Check the frame counter to make sure that 3 images were taken
12. Check the prism penetration depth indicator on the camera frame to see that the optical prism actually penetrated the bottom to a sufficient depth to acquire a profile image
13. If images have been missed or the penetration depth is insufficient, take additional replicates

SPI film processing will be conducted on board the ship using a JOBO film processing kit according to standard operating procedures.

3.5.4 Van-Veen Grab

The modified Van-Veen grab sample will be the primary equipment for surface sediment sampling. Sediment samples will be collected using the modified Van-Veen grab sampler at all stations except where sediment cores are collected in which case a box core will be used. The modified Van-Veen grab sampler is constructed of stainless steel and Kynar coated. The grab is designed to be deployed from a vessel equipped with a power winch and A-frame or boom system and to collect undisturbed “surface” sediment samples to a maximum depth of approximately 15 cm. Operation of the grab sampler for collection of a “bulk” sediment sample is discussed in SOP ADL-1018. The collection and handling of subtidal sediment chemistry samples from the Van-Veen grab sampler is discussed in SOP ADL-1019. The operation of the grab sampler is summarized below.

In preparing the grab sampler for deployment, the bucket is cocked open by collapsing down the scissors and hooking the cocking arms in place. In order to remain cocked, light tension is maintained on the lifting wire, which is secured to the top of the scissors mechanism. The grab is enclosed in a frame that provides stability and durability and makes it easier to handle while deploying and retrieving. It is important to maintain light tension on the lifting wire while maneuvering the grab aboard the support vessel, with or without a sample in it, as the tension keeps the grab jaws open when cocked or closed when not cocked (e.g., with a sample in it).

Weights are added to the frame to ensure vertical deployment in deep water or in conditions with strong currents. Vertical deployment is particularly important in ensuring collection of an undisturbed sample. The grab has a stand to support it up off the deck and facilitate subsampling of the sediment and cleaning of the grab.

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Sediments can be removed from the grab by loosening the cams or wing nuts which secure the hinged door. When the doors are opened carefully, the undisturbed sediments are readily accessible.

3.5.5 Box Cores

An MK III boxcore will be used to collect sediment cores at stations where geochronology cores are to be collected. After a Van-Veen grab sample has been collected to determine if sediment type is appropriate for collection of sediment cores, the box core will be deployed for sediment core collection. Sediment cores for geochronology and chemical analysis will be collected from 9 stations. However, additional cores may be collected and archived from some stations if sediment type is favorable.

The box coring device will be deployed by a remotely operated winch system to the ocean floor. Prior to deployment, the box coring device will be decontaminated according to procedures described in section 3.5.6. Once the box core sediment is collected, the following steps will be taken:

1. During the operations to secure the winch system and return the box core, operations will be designed to minimize the mixing of water and sediment within the box core. Various methods to minimize sediment disturbance will be utilized, such as dampening the movement of the box core by keeping it submerged during operations to secure the winch system. Personal safety and sea conditions will also dictate operational procedures.
2. After retrieval, the overlying water will be siphoned off as quickly as possible without disturbing the surface sediment layer. The inner “box” containing the sediment will be moved into a covered deck area to further reduce contamination. The outer box can then be cleaned in preparation for the next deployment.
3. Sediments for chemical analysis will be subsampled using a 10.3 cm (4 in.) diameter cellulose-acetate-butyrate (CAB) precleaned core liner. Duplicate subcores will be taken in order to have sufficient sediment for both geochronology and chemical analysis. The duplicate subcores will be collected as close together as possible to ensure consistency between the two cores.
4. The inner box will be decontaminated by the following the procedures in section 3.5.6. The clean inner box will be kept covered in a polyethylene bag prior to redeployment.

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3.5.6 Equipment Decontamination

All sampling equipment must be decontaminated prior to use at each sampling station following the procedure outlined below.

1. Physically scrub equipment with brushes and liquid soap and water mixture to removed any accumulated sediment, if necessary. Wipe clean with a sorbent pad, paper towel or rag, if necessary.
2. Rinse with seawater (from hose or buckets, as appropriate)
3. Rinse with distilled water.
4. Rinse with isopropanol solvent.
5. Optional rinse with deionized water.

Decontaminated sampling equipment must never be allowed to become recontaminated prior to sampling. To avoid this, either decontaminate equipment immediately prior to use or protected decontaminated equipment by wrapping securely in aluminum foil which has been decontaminated by the above procedure. Never allow “clean” equipment to come in contact with anything other than the sample, air, or other “cleaned” equipment. This precludes contact with the ground (except for the actual sampling area), hands, clothing, or plastic bags, bucket or trays, etc.

Note: When aluminum foil is used, the “shiny” side is machined and is thus subject to machine oil contamination which this procedure may not remove. Only the “dull” side of aluminum foil should be placed facing sampling equipment.

Specific requirements for each type of equipment are described below.

3.5.6.1 Van-Veen Grab. Following the collection of sediment chemistry samples, the grab will be emptied into a basin as discussed above and then rinsed in seawater prior to the next deployment at a station. The grab must be decontaminated prior to sampling at each discrete station. The grab must be cleaned inside and out as described above. Scrub brushes must be used that can fit inside the buckets of the grab.

3.5.6.2 Siphoning Tube. If a siphon tube is used, it will be decontaminated with detergent and water and then deionized water. No solvent will be used on the siphoning tube.

3.5.6.3 Spoons, Scoops, Bowls. The scoops, bowls, and spoons used to subsample the sediment sample will be physically scrubbed with soap and water mixture then rinsed by solvents, according to the above procedure. Equipment that remains on shipboard If necessary, the scoops and bowls will be wrapped in solvent-cleaned aluminum foil.

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3.5.6.4 Box Core. The box core will be rinsed in seawater following each use at a station. Prior to use at the next station, the box core will be rinsed with distilled water and decontaminated further if necessary.

3.5.6.5 Fish Dissection Equipment. Dissection tools, such as stainless steel scalpels, tweezers, thongs, and a nylon cutting board will be decontaminated prior to use at each sampling station and between dissection of each fish. Decontamination procedures will include washing with soap and water followed by rinsing with distilled water and isopropanol.

3.6 On-Board Processing of Samples

3.6.1 Collection and Handling of Sediment Samples

During the collection and handling of sediment samples from the grab sampler and box core extreme care should be taken throughout the subsampling process to avoid contact with metals and hydrocarbon sources. Samples should be taken away from the metal sides of the box core and no metal spatulas should be used for the trace metal samples. The grab sampler and box core also should be protected from stack smoke, grease drips from winches and wire and other potential airborne contamination during the sampling process.

Grab Samples. When the grab is returned to the deck of the vessel, the sample is visually inspected; the bucket should be closed and the scissors extended upright. The doors are opened and the sample is visually inspected: there should be sediment and overlying water in the bucket. If the grab has been successful, proceed with sample collection; if not, discard the grab contents and re-deploy the grab. Overlying water indicates that the sediment sample is undisturbed and that surface sediments remain intact (e.g., there has been no leakage of water and hence fine sediment from the grab). If there is overlying water and the sediments are undisturbed proceed with sample collection.

Subsamples are removed from the grab sampler through the hinged doors on the top of the bucket. Overlying water is removed from the grab by siphoning through a precleaned teflon tube using a siphon bulb. The teflon tube should be decontaminated prior to use. It is important that the siphon tube be cleaned following each use and stored in solvent-cleaned aluminum foil or other decontaminated storage container.

Sediment samples are collected from the top 2 cm of the grab to represent recent accumulation. Unconsolidated sediment 2 cm deep is removed from the grab with a stainless steel scoop coated with Kynar. The scoop is 2 cm in depth to facilitate accurate depth collection of the sediment. The top 2 cm will be collected by several scoops up to the volume needed for subsamples and placed directly in appropriate sample containers (Table 3). At stations where toxicity samples are needed, four to six grabs may be necessary to obtain enough sediment volume for toxicity subsamples. Toxicity sediments

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from multiple grabs will be composited in a Kynar coated bowl. When the appropriate volume is reached, the sample is homogenized in the bowl and then transferred into appropriate precleaned containers. All sampling equipment is decontaminated before use as outlined section 3.5.6. Specific subsamples are collected from each grab into their individual container and stored as indicated in Table 3.

After the desired subsamples have been removed, an open basin is placed beneath the grab on the grab stand. The grab jaws are then opened by releasing tension on the lifting wire and collapsing the scissor mechanism. Any remaining sediment will fall into the basin and can be discarded if desired. The grab should be rinsed with clean seawater prior to redeployment at a station. The grab should be decontaminated prior to deployment at a new station.

Box Core Samples. After retrieval of the box core, the overlying water will be siphoned off as quickly as possible without disturbing the surface sediment layer. The inner “box” containing the sediment will be moved into a covered deck area to further reduce contamination. Sediments for chemical analysis will be subsampled using a 10.3 cm (4 in.) diameter cellulose-acetate-butyrate (CAB) precleaned core liner. Duplicate subcores will be taken in order to have sufficient sediment for both geochronology and chemical analysis. The duplicate subcores will be collected as close together as possible to ensure consistency between the two cores.

The precleaned core liner will be slowly inserted vertically into the sediments. The length of the core liner used will be longer than the deepest depth of the box core (the dimensions of which are approximately 50 cm deep x 50 cm wide x 80 cm tall), to be able to completely penetrate the box core. The air space left at the top of the subcore will allow for expansion during freezing. The liner will be inserted slowly with a continuous oscillating motion to minimize disturbance and maximize the depth of penetration. Once the liner is in place, the top will be capped immediately to minimize potential contamination by stack gases from the survey vessel. One hand will slide down along the side of the liner to the base of the core and firmly placed on the bottom of the core. The core liner will be lifted from the sediment until the bottom can be capped. The outside of the core liner will then be rinsed with seawater, the caps will be secured first with Teflon tape then with electrical tape, and the core labeled with identifying numbers, measured. The top of the core will be marked, then stored refrigerated in the vertical position until subsampled on the ship. If subsampling on the ship is not possible due to adverse weather conditions, the cores will be frozen and subsampled at the FIT laboratory. Any sediment cores for archival be frozen in the field and shipped to Arthur D. Little, Inc.

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Table 3

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3.6.1.1 Protocol for Sediment Sampling and Handling for Toxicity Analysis

1. Sediment toxicity analysis will be conducted by Pacific Eco-Risk Laboratory following EPA guidelines utilizing the amphipod *Eohaustorius estuarius* obtained from a commercial supplier. A total of 20 samples will be collected in 1997.
2. Two liters of surficial (top two cm.) sediments from each toxicity testing site will be placed in clean plastic containers and stored in coolers filled with wet ice.
3. Each sample will be documented (see Sediment Toxicity Collection Data Sheet) with all important ancillary data.
4. Samples will be stored on wet ice onboard ship, and will be shipped with blue ice within ten days of the sampling.
5. Chain of custody forms will be completed for all samples and will accompany the samples when shipped to Pacific Eco-Risk Laboratory.
6. A sample blank will be created by opening a sample container for the period of one sediment sampling event, sealing it, and shipping it along with the sediment samples for analysis.

3.6.2 Subsampling Core Samples

Sediment cores will be subsampled by extruding aboard ship. Subsamples will be taken using a Teflon spatula. Assuming sediment accumulation rates of as low as 0.1 cm/y, sample sections of about 0.5 cm thick (or less) will need to be sampled and analyzed. This is because the recent record of potential sediment contaminants and recent geochronometers will be restricted to the topmost layers. For example, the ^{137}Cs signal is visible back in time to about 1950 and this 45 years of deposition will occur (without mixing) over only 4.5 cm of sediment. Such careful subsampling will be achieved by placing plastic disks into the sediment at 0.5-cm intervals and removing the intervening sediment. A special rack with meter sticks on each side of the open core barrel help to facilitate this delicate processing. All processing will be carried out in a clean area of the laboratory to avoid introduction of metal contaminants. Sediment from each layer will be placed in wide-mouth polyethylene bottles (pre-cleaned/acid washed) for geochronology, metals, grain size and TOC. Samples for organics analyses will be placed in wide-mouth glass jars.

3.6.3 Acid Volatile Sulfide and Simultaneously Extracted Metals (AVS/SEM)

Sediment samples will be treated separately to determine the concentrations of acid volatile sulfide (AVS) and simultaneously extracted metals (SEM) using standard EPA methodology. Although this process may be conducted at Florida Institute of Technology following the cruise, the procedure for AVS/SEM may be done on board and is presented here. Results from the AVS and SEM measurements have been used to help predict the potential bioavailability of sediment metals. If the molar content of SEM for

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the sum of [Cd+Cu+Pb+Hg+Ni+Zn] exceeds the molar content of AVS, then the metals in that sediment sample are potentially bioavailable.

The AVS content of the sediment will be determined in at sea (or on frozen samples that are shipped to the laboratory and analyzed within 3 weeks). The analysis is performed by adding HCl to 10 g of wet sediment in a closed system consisting of gas washing bottles, oxygen trap, flow controllers, reaction flask and assorted fittings. The AVS is purged from the sample over a 1 hour period and trapped in aqueous solution for analysis by ion specific electrode. Concentrations of the SEM will be determined by filtering the sediment-HCl slurry through a membrane filter and analyzing the solution for Cd, Cu, Pb, Hg, Ni and Zn by atomic absorption spectrometry or inductively coupled plasma-mass spectrometry using methods outlined for analysis of these metals in solutions of digested sediment.

3.6.5 Procedures for Fish Capture, Dissection, and Sample Handling

This section presents the protocols for fish capture, dissection, and sample handling aboard the R/V *Alpha Helix*.

A minimum of 15 fish will be collected to represent a station sample. A total of 60 fish will be collected over the course of the survey. In each of Zones 0, 1, 2, and 3, 15 fish will be collected at one selected station.

Prior to the field event, permits were filed with the Alaska Department of Fish and Game (ADF&G) and the Pacific Halibut Commission (PHC). A copy of these permits are attached. When fish samples are shipped, a copy of the ADF&G must accompany the samples in the cooler. If the fish samples are halibut, then the PHC permit must accompany the shipment as well.

The target species for this study is Arrowtooth flounder, and alternate species include: Yellowfin sole, Flathead sole, Butter sole, Rock sole, Sablefish, Greenland turbot, and Pacific halibut. Though multiple species will likely be captured, attempts will be made to sample the same species at all four fish capture locations.

Each participating group will provide protocols for the processing of the samples which they will analyze.

Fish capture will be undertaken through the use of long lines. Sets will be of short duration (~6 hours) to insure that the fish will be brought aboard ship alive. Fish will be removed from the hooks rapidly and in a manner which avoids contact with potentially contaminating surfaces (e.g. the ship deck). Attempts will be made to keep the fish alive until shortly before dissection by placing them in a tank filled with running seawater. Dissections will begin as soon as possible following the collections.

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3.6.5.1 Procedures for Fish Dissection. A collection/dissection data sheet will be started for each fish to potentially be dissected (capture of non-target species will be documented separately).

Approximately 1/2 hour prior to dissection, one fish at a time will be removed from the live tank, sacrificed with a blow to the head, enclosed in a numbered plastic bag, and placed in the walk-in freezer. The fish will be removed before becoming frozen, but will be chilled enough to diminish muscular activity to a point where they can be safely dissected.

Prior to initiating each dissection, the dissection surface, dissecting tools, and any other surface which the sampled tissues will contact will be thoroughly cleaned with Liquid detergent, followed by 1% HCl, followed by Optima grade isopropanol. The isopropanol will be allowed to evaporate, as it may interfere with the P-450 analyses.

One fish at a time will be removed from the freezer, and several ancillary measurements (see fish collection/dissection sheet) will be taken prior to starting the dissection. If available, two researchers will conduct the dissection. One individual to dissect and one to document the information, label sample containers, weigh the samples and aid the dissector. The dissections can be accomplished by a single researcher if necessary though they will be far more efficiently conducted utilizing two (or more) individuals.

Fish will be dissected using stainless steel filleting knives to open the peritoneal cavity thus exposing the liver. Liver samples will be removed for RGS, metals, organics, and P-450 analyses, by slicing off sections with a stainless steel scalpel blade (pre-cleaned with methanol). The samples will be placed in clean, pre-weighed, and labeled containers appropriate for the analyses to be conducted, and then weighed. The remaining liver will then be removed from the fish and weighed, thus allowing the total weight of the liver to be calculated. Samples for RGS, metals, and organics, will be frozen. The kidney sample for P-450 analysis will be removed from the (now exposed) kidney, weighed, and placed with the liver sample, and then a section of gill arch will be cut out with stainless steel scissors, weighed, and placed with the liver and kidney samples. A portion of the filleted musculature will be removed for metals (Hg) analysis placed in an appropriate labeled container and frozen. the P-450 samples will be fixed in 10% formalin buffered with seawater. The data sheet will be checked for completeness, and the dissection equipment will be cleaned and readied for the next fish.

Pacific halibut can be over 2 meters in length and 200 plus kilos in weight, and will therefore require significant changes to the protocols to be used as study animals. If they are used in this study, dissections will most likely need to be conducted (at least partially) on deck. In this eventuality, the dissections will be done in the fish, by cutting away the ventral (blind side) musculature to expose the peritoneal cavity. This will be accomplished in a manner which avoids trace metal/organics contamination by avoiding contact with contamination surfaces, and fallout from the ship's exhaust.

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Chain of custody forms will be filled out onboard ship, and will accompany the samples to the analytical labs. Tissue sample blanks will be created and analyzed for metals and organics.

3.6.6 Photodocumentation

Photodocumentation will be conducted during the survey using a 35 mm camera and a video camera. Activities such as sampling procedures will be videotaped, and photographs will be taken to record specific samples, sampling procedures, and unusual sediment types.

3.6.7 Handling of Samples

All sediment samples and quality control samples for chemical analysis are inventoried and stored in a secure area immediately after collection. Inventory includes counting all the samples to insure that all samples were collected and safely returned to the custody area on board, documenting all samples, and preparing a Chain-of-Custody form (COC) (Attachment) for all samples. Sediment samples and sediment cores will be secured and frozen in an upright position on the ship to ensure their vertical integrity. The sediment samples will remain frozen prior to transportation and shipped with dry-ice via overnight service. Refer to SOP ADL-1017 for documentation and chain-of-custody procedures and requirements. At all times after collection, sample integrity and custody must be maintained. Custody seals are used on all shipping containers (i.e., coolers) to maintain custodial security while the samples are in the possession of a third party (e.g., air freight courier).

Consult Table 3 for analytical sample types and their storage requirements. Sediment samples for chemical analysis have a limited holding time. Every effort is made to deliver samples to the analytical laboratory in a timely manner. The Chief Scientist, his designee, and subcontractors are responsible for arranging sample pickup.

3.6.8 Shipping of Hazardous Materials

When shipping containers of a hazardous material, check to see that packaging and labels comply with all applicable federal, state, and local regulations concerning the shipment of that material. Air freight courier personnel can assist in determining relevant regulations and compliance means. When shipping frozen chemistry samples packed in dry ice, the container must be vented (coolers should have a vent at the bottom on one end) and must bear a label which clearly states that the cooler contains dry ice and how many pounds, must bear the United Nations identification number (UN 1845) and the hazard classification (ORM-A).

Following completion of the cruise, samples will be shipped from the Seward Marine Center overnight delivery using Federal Express air freight courier. For pick up in Seward (Zip Code: 99664), the Federal Express dispatch office may be contacted at (800) 238-5355. For same day pick up and shipment, the pick up call must be made prior to

3.0 Sampling Plan and Procedures

8:30 am. For same day pick up, but next day shipment (i.e., two day delivery) the pick up call must be made by 1:30 PM. If necessary, the shipment may be dropped off at the closest office in Kenai, at 427 Willow Ave near the Kenai airport. From Kenai, for same day shipment the samples must be dropped off by 12 noon.

No Saturday pickup or shipment by Federal Express is available from Seward or Kenai, Alaska. Therefore, as a backup plan, the samples may be packed in coolers and held in the SMC walk-in refrigerator to be picked up for overnight shipment on Monday, July 21, 1997.

Depending on the chemical analysis, samples may be shipped to different laboratories. Table 3 indicates where specific samples will be transported to for chemical analysis. Each team of field personnel are responsible for shipping their respective samples to the arranged laboratories for analysis.

4.0 Field Quality Assurance/Quality Control

Quality Assurance/Quality Control (QA/QC) samples will be collected in the sampling program to assess data quality. Each survey team will be briefed by the Chief Scientist prior to the conduct of the first sampling on quality assurance measures of the sampling activities. All field personnel will be briefed on the potential for contamination and cross-contamination of samples and will be given guidance on techniques to avoid such problems. This includes the use of pre-cleaned samples containers; use of clean sampling equipment; use of the decontamination protocol described above; and good laboratory practices in general. It also includes following specified sampling procedures and protocols in accordance to SOPs as referenced above.

Several types of field quality control samples will be collected during the survey, including equipment blanks, field blanks, and replicate samples. For both equipment blank and field blank samples, two jars will be used to be analyzed for metals and organics respectively. Field quality control procedures should include the collection of equipment blanks. The project-specific requirements are detailed in Table 4 and described as follows. Equipment blanks are collected when sampling involves use of collection equipment which comes into direct contact with the sample (i.e., the modified Van-Veen grab) during or following the collection of sediment chemistry samples. The equipment blank is representative of potential contamination associated with the equipment. To collect the equipment blanks, the grab is first decontaminated according to the procedure outlined above. Then the inside of the bucket is rinsed with high-purity, deionized water and the rinsate is collected directly into a clean, pre-labeled water sample container. A stainless-steel funnel can be used to assist in the collection; the funnel must be decontaminated prior to use by the same procedure used for the grab sampler. The rinsate is the equipment blank and is refrigerated at 4 degrees C. For each equipment blank sample, two jars will be collected, one for metals analysis and one for organics analysis.

4.1 Field Blanks

Field blanks are also collected, which are representative of any atmospheric or other contamination that the field samples may be subject to and also of any potential contamination associated with the glassware. A clean, pre-labeled sample jar of the same batch used for sample collection is carried into the field, opened during the collection of one sample, and returned to the laboratory with the field samples. For each field blank, two sample containers will be used to be analyzed for metals and organics, respectively. This blank will be stored under the same conditions as the field samples it is representative of. Field blank samples will be taken during the collection of sediment samples as well as the onboard laboratory during the dissection of fish.

4.0 Field Quality Assurance/Quality Control

Table 4

4.0 Field Quality Assurance/Quality Control

4.2 Field Source Sample

An additional source sample will be taken in the field of the *Alpha Helix* diesel fuel. This sample will characterize any contamination believed to originate from the shipboard fuel.

5.0 Safety Considerations

It is recommended, but not required, that all field personnel have safety training which conforms to Federal (OSHA) regulations for working at hazardous sites.

All personnel will adhere to health and safety precautions as described in the R/V Alpha Helix Users' Manual. Specific safety requirements include the following:

- Learn the location of all fire equipment, life rings, life preservers, survival suits; and know their proper use.
- In the event of an emergency, know where to go and what your duties are. Emergency drills are held once a week
- Smoking in bunks is strictly prohibited
- No open-toed shoes or sandals will be worn when working on the deck
- No equipment will be deployed over the side without permission from the deck watch officer. All gear must be aboard and secured before moving between stations
- When working on deck at night use the buddy system. During rough weather do not go out unless necessary, and always tell someone if you must go out.

Field procedures require the use of several hazardous chemicals. These include isopropanol, hydrochloric acid, and dry ice. All field personnel will be briefed by the Chief Scientist before the conduct of the first sampling on the hazards and safe handling of these and any other chemicals on board.

Personnel should avoid direct contact with all chemicals and avoid breathing fumes. Contact with solvents will cause irritation of eyes, nose, throat, and skin. Isopropanol is an extremely flammable organic solvent that will be used for equipment decontamination. Hydrochloric acid is a strong acid that can burn the skin if contacted. Special care should be taken and nitrile gloves should be worn when handling hydrochloric acid. Dry ice is extremely cold, handling it can cause severe burns within seconds. Material Safety Data Sheets (MSDS) will be available on the vessel for each hazardous material on board. MSDS describe chemical properties, health hazards, and protection and safety measures. Refer to MSDS if unsure of the characteristics of a chemical. Follow these general guidelines when handling chemicals:

1. Wear rubber gloves (household or laboratory latex if possible).
2. Wear safety glasses (most sun glasses and corrective glasses are not safety glasses).
3. Work in a well ventilated area (on the open deck of ships, if possible).
4. Store chemicals secure and well padded.
5. Store chemicals away from living quarters and away from heat and ignition sources.

Waste solvents must be collected and disposed of separately from other waste streams. Waste streams may be generated in decontamination procedures and in the AVS/SEM extraction procedures. All waste solvents will be collected in a compatible container which is clearly labeled as waste solvents. Hazardous waste should be stored safely on

5.0 Safety Considerations

board, just as the other chemicals are and can be off loaded and disposed of on shore. The decontamination solvent isopropanol may be disposed of at sea.

5.1 Personal Protection

Personal protection equipment will be used by all personnel during the survey. Personal protection equipment such as hard hats and work (floatation) vests will be provided by the ship. Work vests must be worn at all times while working on the deck of the ship and on small boats. Hard hats must be worn at all times on the deck of the ship whenever weights are suspended and moved by cranes or booms.

Safety glasses are to be worn during sampling activities, when launching or retrieving any equipment that contains hazardous materials, when decontaminating equipment, working in an on-board laboratory, or when using any chemicals. Nitrile gloves will be worn during sampling activities or when handling any samples. Nitrile gloves are brought with ADL equipment. Individuals may bring their own safety with them or use the safety glasses brought with ADL equipment.

Individuals are responsible for arranging for or bring along their own rain gear and rubber boots. These items will be needed in case of foul weather or wet conditions.

Mustang (survival) suits are full-body floatation suits to be used in emergency situations. Survival suits are available on the ship for all personnel; five additional mustang suits will be brought with ADL equipment.

5.2 Shipboard Rules of Behavior

For general shipboard policies for conduct, refer to the R/V *Alpha Helix* Users' Manual. Several policies are summarized in this section.

Prior to sailing, the ship's master will call a general meeting of all scientific personnel and ship's crew to discuss safety procedures and the scientific work to be performed. At this time, the chief scientist and chemistry leader will present an outline of the purpose of the work and problems that may be encountered. The chief scientist will discuss the chemicals to be used during the cruise, their inherent danger and safety precautions.

Some guidelines are as follows:

- Water is limited and must be reasonably conserved
- The use of any non-prescribed drugs or alcohol on-board is strictly prohibited
- Boots and raingear are not to be worn inside the vessel except in the wet and dry labs

5.0 Safety Considerations

- The ship's radios may not be used without the permission of the master or the chief mate
- The washing machine may only be used at sea when permission is posted in the mess room
- Scientific personnel may visit the bridge only after asking permission of the crew on duty
- Scientific personnel are responsible for the cleanliness of their lab areas
- The engine room is off-limits to non-crew members, unless on a pre-arranged tour
- Deck hatches and portholes are not to be left open without obtaining permission from the deck watch officer. Watertight doors are marked and must be dogged *completely* at all times
- Marine toilets (heads) are *only* for human waste and toilet paper

Social conditions at sea are very different from those on land. Privacy is greatly reduced and constant interaction with others can be more intense. Everyone should be sensitive to the altered social conditions and atmosphere that is where they will work and live.

Quarters. The chief scientist will assign staterooms to the scientific party. Personnel are responsible for maintaining the cleanliness of their individual staterooms. Bed linen, soap, and towels are provided by the ship. Linen will be changed weekly. At the end of the cruise, individuals should strip their bunks and deposit soiled linen in hampers in the restrooms.

In the berthing areas, personnel should be quiet and considerate of their shipmates who may be sleeping. Socializing should be kept to the library and mess room.

Mess Deck/Galley. At sea, meal hours are normally as follows:

- Breakfast - 0520-0620
- Lunch - 1120-1220
- Dinner - 1720-1820

Instructions for meals are as follows:

- Clean up all dirty dishes and messes
- If scientific work requires a change in meal hours or the number of people eating, the cook should be notified in advance
- When not being used for meals, the mess deck may be used for lounge and recreational area. The galley must be vacated 20 minutes prior to meal hours for setup time

5.3 Incident Command

5.0 Safety Considerations

If there is an emergency, the ship's emergency procedures are to be followed. UNOLS who operates the R/V *Alpha Helix* has a contract with Maritime Health Services (MHS). All of the ship's crew are first aid trained. In addition, several of ADL scientific staff are first aid and CPR trained. The ship has an infirmary with some medical supplies, and ADL equipment has a first aid kit that is available to all scientific personnel.

In the event of serious personal injury, follow these general emergency procedures:

- 1) Stabilize the patient
- 2) Contact MHS
- 3) Evacuation based on MHS recommendation
- 4) Possible destinations would include Anchorage, Kenai, or Kodiak Hospitals

6.0 References

Arthur D. Little, Inc. Standard Operating Procedures:

- ADL 1016 - Documentation and Field Reporting Requirements for Marine Sampling
- ADL 1017 - Sample Labeling and Chain of Custody Requirements
- ADL 1018 - Operation of the Modified Van-Veen Grab Sampler
- ADL 1019 - Collection and Handling of Subtidal Sediment Chemistry Samples from the Modified Van-Veen Grab Sampler
- ADL 1021 - Collection and Handling of Chemistry Quality Control Samples

Eastman Kodak, 1994, Kodak Color Separation camera system Guide and Grey Scale (Small), Publication No. Q-13, catalog No. 152 7654, Rochester, NY

R/V *Alpha Helix* Users' Manual. Seward Marine Center, Institute of Marine Science University of Alaska, Seward, AK