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April 4, 2002

Mr. Kurt Schnebele  
National Oceanographic Data Center  
NOAA/NESDIS E/OC  
SSMC3, Room 4820  
1315 East-West Highway  
Silver Spring, Maryland  
20910-3282

Re: Shelikof Strait Database and Report Submission  
Arthur D. Little Reference 32319

Dear Kurt:

As we discussed early this week, I am submitting to NODC the final database and report files for the Minerals Management Service (MMS) program "Sediment Quality in Depositional Areas of Shelikof Strait and Outermost Cook Inlet."

This program consisted of a two-year study to provide and update environmental information to support future MMS oil- and gas-leasing decisions in the outermost Cook Inlet/Shelikof Strait planning area. As part of this study, a scientific crew collected samples for biological, chemical, and toxicological analyses from the program study area during two sampling surveys. Potential uses of this information include environmental risk assessments, environmental impact statements, and other pre- and post-leasing decision documents. This study was initiated to establish baseline environmental conditions prior to any oil- and gas-leasing activities. The results of the entire two-year field survey are described in the report *Sediment Quality in Depositional Areas of Shelikof Strait and Outermost Cook Inlet* (OCS Study MMS 2000-024).

Enclosed is a compact disc containing the following files:

**MMS-Shelikof Strait-Sample Data Table.xls** – An Excel file containing the final analytical data associated with the MMS program "Sediment Quality in Depositional Areas of Shelikof Strait and Outermost Cook Inlet."

**MMS-Shelikof Strait-Sample Data Table Definitions.xls** – An Excel file containing descriptions of each Data Table field.

**Station Summary Table.wpd** – A Word Perfect table (Table 2-1 from the final report) that summarizes the field stations, station coordinates, and types of samples collected at

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each station. Most of this information is also included within the data table, but is provided again for convenience.

**Technical Summary.wpd** – A Word Perfect file containing a three-page summary of the report titled *Sediment Quality in Depositional Areas of Shelikof Strait and Outermost Cook Inlet*.

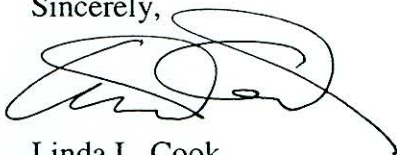
**Technical Summary Map.pdf** – A PDF file containing a general map of the Shelikof Strait region, with study zones and stations identified, meant to accompany the technical summary.

Also included on this compact disc is a directory named “Shelikof Strait Final Report Files.” The final report files are included in this directory and are presented in a variety of formats (e.g., Word Perfect, Excel, Adobe Acrobat, Word). Richard Prentki of MMS has already produced a PDF file of the entire report and a copy of this file will be submitted to save you the time of converting the original report files to PDF.

Please provide me with confirmation of receipt of this data submission.

Call me at 617-498-5374 (e-mail [cook.linda.l@adlittle.com](mailto:cook.linda.l@adlittle.com)) with any questions that you might have regarding this submission.

Sincerely,

A handwritten signature in black ink, appearing to read 'Linda L. Cook', with a long, sweeping horizontal line extending to the right.

Linda L. Cook  
Case Manager

Enclosure – CD

cc: Richard Prentki, MMS ~



**STUDY TITLE:** Sediment Quality in Depositional Areas of Shelikof Strait and Outermost Cook Inlet

**REPORT TITLE:** Sediment Quality in Depositional Areas of Shelikof Strait and Outermost Cook Inlet, Final Report. OCS Study MMS 2000-024

CONTRACT NUMBER): 1435-01-97-CT-30830

SPONSORING OCS REGION: MMS Alaska Outer Continental Shelf Region

APPLICABLE PLANNING AREA(S): Shelikof Strait and Lower Cook Inlet, Alaska

FISCAL YEAR(S) OF PROJECT FUNDING: 1997, 1998, 1999, 2000

COMPLETION DATE OF REPORT: May 2001

CUMULATIVE PROJECT COST: 1.426 Million

PROJECT MANAGER(S): Arthur D. Little, Inc

ADDRESS: Acorn Park Drive, Cambridge, MA 02140

PRINCIPAL INVESTIGATOR(S)\*: Dr. Paul D. Boehm, ADL; Dr. John Trefry, FIT; Dr. Robert Spies, AMS

**KEY WORDS:** acid volatile sulfide/simultaneously extracted metals (AVS/SEM), Alaska, alkylated PAHs, aluminum, amphipod, antimony, arsenic, barium, baseline environmental conditions, benthic environment, beryllium, biological analyses, biomarkers, biota, bottom-feeding fish, cadmium, calcium, cesium-137, chemical body burdens, chemical analyses, chromium, coal seams, Cook Inlet, copper, Cytochrome P450 (CYP1A) induction, deposition, environmental risk, fish tissue, Gulf of Alaska, inorganic, iron, Kenai Peninsula, lead, lead-210, magnesium, manganese, marine environment, mercury, metals, Minerals Management Service (MMS), nickel, offshore oil exploration and production, oil and gas transportation, oil seeps, oil and gas operational discharges, oil and gas production, oil industry contaminants, oil and gas exploration, Outer Continental Shelf (OCS) leases, P450, petroleum hydrocarbons (PHC), polynuclear aromatic hydrocarbons (PAHs), potassium, reporter gene system (RGS), river runoff, sediment core dating, sediment, sediment cores, sediment profile imagery (SPI), selenium, Shelikof Strait, silver, steranes/triterpanes (S/T), subtidal bottom sediment, surface sediment, thallium, tin, toxicity tests, toxicological analyses, vanadium, zinc

**BACKGROUND:** Oil and gas exploration, production, and transportation activities in Cook Inlet, Alaska have the potential for impacting marine resources. Though these operations are well-managed and are regulated so as to minimize the input of pollutants to the marine environment, the longer-term accumulation of pollutants in depositional areas on the sea floor is an area of concern when contemplating future Outer Continental Shelf (OCS) leases.

The Minerals Management Service (MMS) program "Sediment Quality in Depositional Areas of Shelikof Strait and Outermost Cook Inlet," consisted of a two-year study to provide and update environmental information to support future MMS oil- and gas-leasing decisions in the outermost Cook Inlet/Shelikof Strait planning area. As part of this study, a scientific crew on board the Research Vessel (R/V) *Alpha Helix*, collected samples for biological, chemical, and toxicological analyses from the program study area during two sampling surveys. The first survey was conducted from July 7 to July 17, 1997 and the second undertaken the following year, from June 27 to July 5, 1998. Such uses of this information include environmental risk assessments, environmental impact statements, and other pre- and post-leasing decision documents. This study was initiated to establish baseline environmental conditions prior to any oil- and gas-leasing activities. The results of the entire two-year field survey data are described in this report.



**OBJECTIVES:** Because of the need to definitively examine the distribution and environmental risk of anthropogenic chemicals (i.e., metals, petroleum hydrocarbons including polynuclear aromatic hydrocarbons [PAHs]) in advance of any future oil and gas E&P activities that could potentially affect the lower Cook Inlet and Shelikof Strait, MMS contracted with Arthur D. Little, Inc. (ADL) to undertake a two-year study in the region. The objectives of the study were to:

- Evaluate the Shelikof Strait and outermost Cook Inlet as potential depositional areas or "traps" for oil industry contaminants
- Determine whether contaminant concentrations in sediments of these areas pose an environmental risk
- Determine whether contaminants in these areas have accumulated relative to pre-industry concentrations
- Determine whether any increases can be correlated with specific discharge events or activities (e.g., the *Exxon Valdez* oil spill)
- Determine the importance of other hydrocarbon and metal sources to the sediments

**DESCRIPTION:** The design of the data acquisition/field program for the two-year study focused on two facets. The first was the deep subtidal bottom sediments of the region as the focal point of any long-range contaminant deposition. The design was intended to obtain both chemical (i.e., exposure) and biological (i.e., effects) data on surface sediments. It also was directed at looking at historical deposition in the study area through the use of dated sediment cores. The second facet addressed the status of chemical body burdens in bottom-feeding fish and indicators of sublethal effects. These "biomarker" measurements were made to address their exposure to contaminants.

The field sampling design included:

- Separation of the study area into four zones, each assumed to be relatively homogeneous
- The selection of a group of random sediment stations in each zone from a large number of candidate stations, each station representing a replicate of that zone
- The selection of fixed or biased stations at key locations from which we wanted to obtain data
- The selection of a limited number of stations from each zone (including the fixed stations) from which to take replicates to examine within-station variability
- The selection of additional sampling stations in the Gulf of Alaska off the Kenai Peninsula to represent "upstream" source material
- The selection of additional stations south of Shelikof Strait to examine longer-range transport
- The field-truthing of the suitability of each station prior to sampling
- The sampling of stations for surface sediments; selected locations for sediment coring; and selected locations for obtaining fish samples
- The selection and sampling of potential contaminant sources -- oil seeps; river runoff; coal seams; and oil and gas operational discharges

The analytical design centered on organic (i.e., petroleum-related) and metal parameters as measured in sediment, sediment core, fish tissue, and source samples. The design consisted of the following measurements:

- Petroleum hydrocarbons (PHC), including PAHs of petroleum and other origins, and steranes/triterpanes (S/T) in sediments and PAHs in fish tissue
- The use of detailed alkylated PAHs and S/T to elucidate source characteristics of source samples and source identification in the field samples
- Major and trace metals including silver, aluminum, arsenic, barium, beryllium, calcium, cadmium, chromium, copper, iron, mercury, potassium, manganese, magnesium, nickel, lead, antimony, selenium, tin, thallium, vanadium, and zinc in sediments
- Acid volatile sulfide/simultaneously extracted metals (AVS/SEM) in sediments (Year 1 only)
- All metals except calcium, potassium, magnesium, and nickel in fish tissues
- Amphipod toxicity tests in sediments
- Reporter gene system (RGS) P450 measurements for sediment and fish tissue extracts
- Cytochrome P450 (CYP1A) induction determinations on selected tissues
- Dating of sediment cores by <sup>210</sup>Pb and <sup>137</sup>Cs methods and analysis of core sections for



- hydrocarbons and metals as in the surface sediments
- Sediment profile imagery (SPI) of surface sediments (Year 1 only)

**SIGNIFICANT CONCLUSIONS:** The comprehensive findings of this two-year investigation indicate that the current concentrations of metals and PAHs in the Shelikof Strait and Outermost Cook Inlet are neither linked to oil and gas development in the upper Cook Inlet, nor to the *Exxon Valdez* oil spill. The residues that are present, from a combination of natural sources -- river inputs, oil seepages, etc. -- pose no significant risk to the biota and the benthic environment of outermost Cook Inlet and Shelikof Strait. The degree of current risk is indeed very low and is similar to non-impacted coastal regions in Alaska and elsewhere.

**STUDY RESULTS:** The surface sediments of outermost Cook Inlet and the Shelikof Strait are traps for fine-grained sediment and are potential traps for contaminants from oil and gas production activities in upper Cook Inlet. Nonetheless, based on evaluations of the organic and inorganic data, no contamination in the surface sediments from oil and gas production activities in upper Cook Inlet was identified.

The concentrations of metals and organics (i.e., PAHs) in sediments in outermost Cook Inlet and Shelikof Strait have not increased significantly since offshore oil exploration and production began in Cook Inlet (circa 1963).

The composition (source[s]) of metals in the sediments of outermost Cook Inlet and Shelikof Strait do not appear to have changed since offshore oil exploration and production began in Cook Inlet (circa 1963). The composition of hydrocarbons in sediment cores shows subtle changes in outermost Cook Inlet over the past 25 to 50 years, but these changes do not appear to be correlated with petroleum production activities or spills.

The concentrations of organics (i.e., PAHs) and metals do not appear to pose any immediate ecological risk to the marine environment in the study area.

**STUDY PRODUCT(S):** *Sediment Quality in Depositional Areas of the Shelikof Strait and Outermost Cook Inlet. Sediment Profile Imaging Report.* Prepared by EVS Environmental Consultants under contract to Arthur D. Little, Inc. for U.S. Department of the Interior, Minerals Management Service, Anchorage, Alaska. OCS Study MMS 99-0003. 40 pp.

*Sediment Quality in Depositional Areas of Shelikof Strait and Outermost Cook Inlet, Final Literature Synthesis.* Prepared by Arthur D. Little, Inc. for U.S. Department of the Interior, Minerals Management Service, Anchorage, Alaska. OCS Study MMS 97-0015. 69 pp.

\*Principal Investigators' affiliation may be different than that listed for Project Manager