

STUDY TITLE: Southern California Bight Intertidal Baseline Survey, Year II.

REPORT TITLE: Intertidal Study of the Southern California Bight, 1976/1977 (Second Year), Vol. III, Report 3.1 - Trace Metals in Sediments; Report 3.2 - The Concentration and Variability of Cd, Cr, Cu, Ni, Pb, and Zn in Intertidal/Subtidal Marine Organisms prior to Offshore Drilling in Southern California; Report 3.3.1 - Barium and Vanadium in Southern California Sediments Determined by Neutron Activation Analysis; Report 3.3.2 - Barium and Vanadium in Southern California Sediments Intertidal/Subtidal Fauna and Flora Determined by Neutron Activation Analysis; Report 4.1 - Sediment Texture and Organic Carbon Characterization; Report 4.2 - Determination of Microbial Biomass in Intertidal Sediments; Master Bibliography.

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SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

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KEY WORDS: Southern California; Southern California Bight; baseline; biology; intertidal; trace metals; sediment; microbiology; spectroscopy; mussel; Mytilus; sand crab; Emerita; kelp; Macrocystis; seasonality; grain size.

BACKGROUND: A comprehensive marine environmental survey of the Southern California coastal region was supported by the U.S. Department of the Interior from 1975 through 1977. A portion of this survey was devoted to trace metal studies of intertidal sediments and biota. Baseline information was gathered during 1975-1976 which allowed for sampling and analytical refinements during second year (1976 to 1977) studies.

OBJECTIVES: (1) To provide statistically valid baseline data on spatial and temporal variability in trace metal levels in intertidal sediments and biota; (2) To determine textural, carbonate, organic carbon, and microbial characteristics of intertidal sediments; and (3) To determine how and where petroleum development may affect the intertidal area.

DESCRIPTION: Intertidal sediments and biota from the Southern California mainland and island sites were analyzed for trace metals related to oil and gas activities. In 1975, Corona Del Mar, Coal Oil Point, Government Point, and San Nicolas Island were sampled seasonally. Sites added during winter (1976-1977) were Point Loma, San Clemente Island, San Miguel Island, Santa Cruz Island, and Santa Catalina Island.

Four replicate samples were taken at each location (after removing the upper 5 cm of sediment) using a 2.5-cm diameter acrylic tube. Samples were taken at lower, middle, and upper tide heights. Trace metals (cadmium, copper, lead, and nickel) were analyzed by flameless (graphite furnace) atomic absorption spectroscopy (AAS) after acid leaching (5N nitric acid). Chromium, iron, and zinc were determined by flame AAS. In conjunction with sediment trace metal studies, selected

rocky and sandy intertidal and subtidal biota were analyzed for trace metal concentrations (cadmium, chromium, copper, lead, nickel, and zinc). Nine intertidal sites were sampled for California mussel Mytilus californianus, giant kelp, Macrocystis pyrifera, and black abalone Haliotis cracherodii. At sandy beaches, the sand crab Emerita analoga was collected. At four subtidal sites, two on Cortes Bank and two on Tanner Bank, the echinoderms Patiria miniata and Pisaster giganteus were collected for trace metal analysis. Specific organs or tissues were digested and then analyzed using either flame or flameless (graphite furnace) AAS depending on the metal. Aluminum, barium, and vanadium in sediments and biota were analyzed using more sensitive instrumental neutron activation analysis (INAA). Quality control measures were implemented on all instrumentation and laboratory procedures prior to actual data analyses.

During 1976-1977, 524 sediment samples were taken from 17 mainland and island sites and analyzed for their grain size, moisture content, and carbonate and organic carbon characteristics. Samples were frozen until analyses could be performed. Grain size was determined using settling tube, pipette, and particle analyzer. Total organic carbon was estimated using combustion techniques. Grain size frequency was divided into 1/4 phi intervals for computation of mean, sorting, skewness, and kurtosis. Preliminary tests of normality were performed prior to all statistical analyses (e.g., t-tests and regression). Sedimentary microfloral biomass was estimated from total sediment adenosine triphosphate (ATP) content.

SIGNIFICANT CONCLUSIONS: Analytical sensitivity necessary to discern small changes in leachable metals appears to be available. Variability in sediment metal concentrations were due to local mineralogy, pollution, and hydrodynamics at most intertidal sites. The variability in sediment metal concentrations increased with increasing sampling grid size. A sample of 20 to 30 individuals of Mytilus, Macrocystis, or Haliotis provided sufficient samples to detect acceptable mean differences in metal concentrations. Further collections of Emerita, Haliotis, and subtidal species should be discontinued due to their inavailability at most sites. Geographical, seasonal, or within-site studies should sample organisms from equal size classes to control metal size variations. Barium and aluminum exhibited low leachable fractions relative to iron and vanadium. There was good general agreement between intertidal trace metal levels reported for both study years. Sediment grain size and beach profile measurements are cost-effective environmental variables that may be used as control parameters during monitoring programs.

STUDY RESULTS: Each site exhibited a unique leachable trace metal distribution pattern; within site variations among locations were greater than between-site variations. Offshore islands were grouped into categories based on total and leachable metal concentrations. Varying concentrations on the islands are due to a number of causes, including mineralogy and pollution. Biotal samples were collected during 1975-1976 without replication, while in 1976-1977, fewer taxa with increased replication were sampled allowing spatial and temporal statistical comparisons. Biota from Corona Del Mar generally showed the highest trace metal concentrations. Copper values in Mytilus and Macrocystis were significantly lower in island samples than coastal samples. Significant seasonal differences were found for Mytilus while no seasonal differences were observed for Macrocystis. It was determined that for Mytilus, Macrocystis, and Haliotis that 20 to 30 samples are required for acceptable statistical resolution. The study indicated that the observed variations in aluminum, barium, and vanadium were due to sediment source and wave energy. All beaches had low leachable fractions of barium, aluminum, and vanadium. Barium and vanadium levels in macrobiota from benthic and intertidal areas were generally low. Total carbonate was generally higher at offshore sites.

Grain size parameters (mean, skewness, sorting, kurtosis) varied with intertidal position and core depth. At 5 to 20 cm depth, mean grain size was lowest, sorting was highest, skewness was most negative, and kurtosis was most positive. There was a relationship between grain size and beach profile slope. Coal Oil Point and Government Point were similar to each other in grain size and carbonate content, but distinct from other mainland beaches. Island beaches were not uniform in grain size characteristics but were unique in their high carbonate levels. Total organic carbon values could not be accurately

associated with sediment carbonate or concentrations of organic matter. Total organic carbon was related to position in the intertidal zone, but not necessarily to grain size, with concentrations increasing from upper to lower tidal position. Seasonal variation in total organic carbon were indicated by statistically significant differences between winter and summer samples. Intertidal position, microepiflora, carbonate content, and presence of marine mammals all contributed to variations in total organic carbon. Intertidal ATP concentrations from four sandy beaches were lowest in high-tide samples with no apparent trend in lower and middle tidal samples.

STUDY PRODUCT(S): Science Applications, Inc. 1978. Intertidal Study of the California Bight--1976/1977. Vol. III, Principal Investigators' Reports, Sections 3.1, 3.2, 3.3, 4.1, 4.2, and Master Bibliography. A final report for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB300352/AS. Contract No. AA550-CT6-40. 220 pp. + app.

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