

STUDY TITLE: Northern Gulf of Mexico Continental Slope Study

REPORT TITLE: Gulf of Mexico Continental Slope Study Annual Report, Year 2.
Volume I: Executive Summary; Volume II: Primary Volume, and Volume III:
Appendices

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APPLICABLE PLANNING AREA: Gulfwide

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\$2,224,893

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BACKGROUND: In 1983 (Year I), the U.S. Department of the Interior initiated a four-year study program to investigate the chemical, physical, and biological aspects of the continental slope of the northern Gulf of Mexico. This report details the findings of the second study year, an extension of the Year I effort.

OBJECTIVES: (1) To determine the abundance, structure, and distribution of animal communities in the deep sea in the Gulf of Mexico; (2) To determine the hydrographic structure of the water column and bottom conditions at selected sites within the study area; (3) To determine and compare sedimentary characteristics at selected sites within the study area; (4) To relate differences in biological communities to hydrographic, sedimentary, and geographic variables; (5) To assess seasonal changes in deep-sea biological communities in terms of abundance, structure, animal size, and reproductive state; and (6) To measure present levels of hydrocarbon contamination in deep-sea sediments and selected animals prior to, and in anticipation of, petroleum resource development beyond the shelf-slope break.

DESCRIPTION: All sampling efforts were confined to the northern Gulf of Mexico, north of 27°N Lat, where physical, chemical, and biological characteristics of the water column and seafloor were obtained. One transect, perpendicular to the slope and comprised of five stations, was located in each of the three Gulf of Mexico Planning Areas (Eastern, Central, and Western). Cruises were conducted to examine possible effects of seasonal changes, and stations were located on transects in a sequence of increasing depth. During Cruise I (November 1983), only the Central Transect was sampled at five stations (water depths of 329, 786, 850, 1,440, and 2,450 m). During Cruise II (April 1984), these Central stations were sampled, and five stations on the Western Transect at 342, 653, 828, 1,413, and 2,314 m water depths, and five stations in the Eastern Transect at water depths of 367, 622, 828, 1,172, and 2,857 m were sampled. During Cruise III (November 1984), 12 stations were sampled, all on the Central Transect, at seven intervening depths as well as the original five. Field sampling consisted of taking water column measurements and sampling bottom sediments for physical/chemical characteristics, meiofauna, macroinfauna, and collecting and photographing demersal fishes, epifauna, and macroinvertebrates and their habitat. Hydrographic measurements included continuous and discrete samples. Discrete sampling employed a 12-bottle rosette sampler, which provided water samples for temperature, salinity, dissolved oxygen, and particulate organic carbon (POC). Transmissometry profiles were taken during each cruise. For sediment sampling, six replicate box cores (24.5 x 24.5 x 44 cm) were taken at each of the Central Transect stations during both cruises; three replicates were taken at each of the Eastern and Western sampling stations. Undisturbed and uncontaminated sediment samples for analysis of hydrocarbons, grain size, carbonate, and total organic carbon, meiofauna, and infauna were subsampled from each box core. Meiofauna were defined as those infaunal organisms passing through a 0.3 mm sieve but retained on a 0.63 mm sieve. Epifauna, macroinvertebrates, and demersal fishes were collected using a 9-m, semi-balloon trawl with 3.8 cm stretch mesh and 1.3 cm cod end mesh. A single haul was taken at each station. Benthic photography was achieved using a Benthic Underwater Camera System (a Benthos 35-mm camera mounted on a sled equipped with a pinger operated altimeter). In the laboratory, sediments were analyzed for grain size, organic carbon, and carbonate carbon content. Carbon isotopic analyses were performed on sediments and selected organisms to determine carbon source. High molecular weight hydrocarbons in macroepifauna, infauna, fishes, and sediments were determined using total scanning fluorescence followed by gas chromatography/mass spectroscopy. Benthic photographs were processed using a microcomputer driven digitizer.

SIGNIFICANT CONCLUSIONS: Petroleum input was greatest on the Central Transect, but all values on all transects were low. Natural hydrocarbon seepage was considered the major source of petroleum hydrocarbons in sediments of the central and western Gulf of Mexico. Faunal zonation patterns inferred during this study generally agreed with existing schemes.

STUDY RESULTS: Hydrographic measurements at all stations revealed the expected layering of water masses based on previous studies: Tropical Atlantic Central Water

(oxygen minimum); Antarctic Intermediate Water (nitrate maximum, phosphate maximum, and salinity minimum); Caribbean Water (silicate maximum); and Gulf Deep Waters. Sediments along all three transects contained a mixture of petrogenic, terrigenous, and planktonic hydrocarbons. In general, sediment hydrocarbons were only present in low concentrations, especially at the Eastern Transect. The dominant normal alkane between n-C₁₅ and n-C₂₂ was variable; the dominant between n-C₂₃ and n-C₃₂ was consistently either n-C₂₉ or n-C₃₂. Qualitatively, alkane distribution was similar at all sites sampled. Hydrocarbon concentrations in macroinvertebrates and demersal fishes of the slope exhibited considerable variability. Shrimps and crabs had the lowest occurrence of hydrocarbons in muscle while fish had the highest. Tissue hydrocarbons were predominated by pristine (n-C₁₇, n-C₁₅, and n-C₁₉) which are primarily planktonic in origin. Sources of these hydrocarbons include plankton input, terrestrial input of straight-chain biowaxes, and petroleum input. Extractable organic matter, a composite material derived from both biogenic and petroleum sources, was found in low concentrations on all transects except Western Transect Station 1. Carbon isotope measurements made on vent-type organisms (bivalves, tubeworms, and gastropods) were lighter (-27 to -37%) than other benthic slope organisms (crabs, shrimps). These differences were attributed to the chemoautotrophic synthesis occurring symbiotically in the vent animals.

Meiofaunal densities decreased with increasing water depth. Collections were numerically dominated by nematodes followed by harpacticoid copepods, polychaetes, ostracods, and kinorhynchans. Macrofaunal densities were maximum in the Archibenthal and Upper Abyssal Zones. An average of 65% of the species is confined to the Upper Abyssal Zone. Polychaetes were the most speciose group followed by the Tanaidacea and Isopoda. One hundred and four crustacean species were collected along all three transects. An average of 70% of the crustacean species occurred at depths in excess of 1,000 m. Of the echinoderms collected in the trawl, asterioids and ophiuroids accounted for about 70% of the total. Only 60% were collected below 1,000 m water depths. About 94% of the holothurians collected occur below 1,000 m water depths. A total of 112 species of demersal or benthopelagic fish in 42 families was collected on the three transects. Thirty-two of these species were represented by the collection of a single specimen. A preliminary faunal zonation scheme based on cluster analysis of megafaunal collections was proposed. Prominent vent and seep megafauna observed in benthic photographs included vestimentiferan tube worms Riftia, Escarpia, and Lamellibrachia and vesicomid clams of the genera Calyptogena and Vesicomya.

STUDY PRODUCTS: LGL Ecological Research Associates, Inc. and Texas A&M University. 1986. Gulf of Mexico Continental Slope Study Annual Report, Year 2. Vol. I, Executive Summary. A final report for the U.S. Department of the Interior, Minerals Management Service Gulf of Mexico OCS Office, Metairie, LA. MMS Report 86-0089. Contract No. 14-12-0001-30212. 29 pp.

LGL Ecological Research Associates, Inc. and Texas A&M University. 1986. Gulf of Mexico Continental Slope Study Annual Report, Year 2. Vol. II, Primary Volume. A final report for the U.S. Department of the Interior, Minerals Management Service Gulf

of Mexico OCS Office, Metairie, LA. MMS Report 86-0090. Contract No. 14-12-0001-30212. 241 pp.

LGL Ecological Research Associates, Inc. and Texas A&M University. 1986. Gulf of Mexico Continental Slope Study Annual Report. Year 2. Vol. III, Appendices. A final report for the U.S. Department of the Interior, Minerals Management Service Gulf of Mexico OCS Office, Metairie, LA. MMS Report 86-0091. Contract No. 14-12-0001-30212. 331 pp.