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BACKGROUND: Numerous descriptive studies of the continental shelf are available. In contrast, the topography, geology, geophysics, currents, chemistry, and biota of the continental slope are less well known. For the most part, deep-sea animals live under conditions of total darkness, low temperature, nearly featureless mud, and sparse food resources. They are generally small and fragile. But chemosynthetic animals are exceptions to the generality. The first chemosynthetic animals were discovered in the Pacific Ocean (Galapagos Rift, 1977). Living near hydrothermal vents in the spreading seafloor, these remarkable animals were shown subsequently to obtain their metabolic energy from dissolved hydrogen sulfide issuing from the vents. The high density and biomass of these very large forms were the exception which proved the rule that the main limiting factor to the deep-sea fauna is the availability of nutrients. The 1982 discovery of well-developed chemosynthetic communities near petroleum seeps in the

Gulf of Mexico led MMS to require that industry protect them from the physical effects of upper continental slope exploration and production. While some investigations have been conducted in recent years, there are still few data on the life history and ecological interactions within these communities. This study addresses both operational and biological questions, the answers to which are needed for effective description, detection, and protection of these communities.

OBJECTIVES: The objectives of this program are to:

1. Gather and synthesize all available information on Gulf of Mexico chemosynthetic communities and associated fauna.

2. Develop a conceptual model containing all biotic and abiotic features of chemosynthetic communities, which explains the observed patterns of distribution and abundance.

3. Appoint a Scientific Review Board for periodic reviews of the quality of data and reports and general oversight of the scientific program.

4. Determine quantitatively what animals compromise chemosynthetic communities, their spatial and temporal variability, and spatial relationships among animals.

5. Determine the physical-chemical factors (e.g. depth, temperature, water chemistry, sediment types, and dissolved gasses) which influence, limit, or control the distribution, abundance, and growth of chemosynthetic communities.

6. So far as possible with available information, determine the sources (e.g. deep vs. shallow or petrogenic vs. biogenic) of any necessary dissolved gasses and the likelihood that petroleum production may ultimately deprive the animals of an energy source.

7. Determine whether chemosynthetic communities are robust or fragile and whether they are essentially permanent or ephemeral. Characterize the age, growth rate, turnover rates, reproduction and recruitment, and patterns of senescence and death in the dominant chemosynthetic animals. Also estimate recovery rates of communities damaged by physical disturbance.

8. Determine the reliability of methods for detecting chemosynthetic communities using remote acoustic and/or geophysical devices, imaging instrumentation, hydrocarbon measurements, and/or other available technologies.

9. Recommend the content of future studies (three to ten years following the completion of this study) which will complement the data obtained and detect temporal changes.

DESCRIPTION: In general, this investigation employs remote sensing instrumentation (e.g. side-scan sonar and geophysical acoustic devices), bottom samplers (corers), and manned submersibles to collect very detailed and site-specific samples and data. The sample design allows the investigators to determine biogeochemical conditions and life requirements of chemosynthetic animals on a fine scale. In addition, various *in situ* experiments are designed to address several of the above objectives.

SIGNIFICANT CONCLUSIONS: The Chemosynthetic Ecosystems Study is a three-year program that has been undertaken to determine the geological, geochemical, physiological, and ecological factors that control the formation and persistence of chemosynthetic communities at hydrocarbon seeps. Dense aggregations of vestimentiferan tube worms, mytilid mussels, and vesicomyid clams are known to colonize natural hydrocarbon seeps in the norther Gulf of Mexico at wide-spread locations in water depths of 300 to 2200 m. These animals derive all of their food from chemoautotrophic bacterial symbionts, which in turn utilize sulfide and methane associated with the seeping hydrocarbons. The aggregations thus exploit a food supply entirely decoupled from sunlight and surface productivity. The aggregations generally support communities of heterotrophic animals such as fish or crustaceans, many of which are common elsewhere on the continental slope. Because the communities are comparatively lush, and because they occur in seafloor localities that are likely to be near to drilling or energy production activities, there is to be near to drilling or energy production activities, there is concern to protect them from possible harmful impact. The first annual report reviews literature pertinent to the study and synthesizes previously collected data.

STUDY PRODUCTS: U.S. Dept. of the Interior, Minerals Management Service. 1992. Chemosynthetic Ecosystem Study Literature Review and Data Synthesis, Volume I: Executive Summary. Prepared by Geochemical and Environmental Research Group. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Regional Office, New Orleans, LA 32 pp.

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