Chemosynthetic Communities

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The mission of the National Oceanic and Atmospheric Administration (NOAA) is twofold – describe and predict changes in the Earth's environment, and steward the nation's coastal and marine resources to enable sustainable economic opportunities. NOAA conducts research to develop new technologies, improve operations, and supply the scientific basis for managing natural resources and solving environmental problems. This mission leads to an interest in understanding the living and non-living resources of the oceans.

A principal contributor to methane hydrate research has been the National Undersea Research Program (NURP) – a program that specializes in getting scientists underwater,

- directly through the use of submersibles, underwater laboratories, and advanced wet diving techniques, or
- indirectly by using remotely operated vehicles, autonomous underwater vehicles and observatories.

This in-situ approach allows acquisition of otherwise unobtainable observations, samples and experimentation in support of NOAA and national priorities.

Substantial amounts of methane hydrate occur in the oceans at depths not readily visible or accessible. Studying these deposits requires the use of specialized tools and expertise available in NURP, primarily through the network of regional centers that form the core of the program. For a number of years, research on methane hydrates has been included in the suite of topics funded in this competitive, peer reviewed program. In recent years, NOAA has organized research expeditions to areas where methane hydrates are known to be present. While research teams are interdisciplinary and cover geological and chemical aspects, a principal focus has been the biological communities found in connection with hydrate deposits. These highly diverse communities have only recently been discovered and have yet to be fully characterized. Evidence suggests that some members of the biological communities associated with continental margin cold seeps may be similar to members of communities occurring near hydrothermal vents. Chemosynthetic communities associated with vents are fed by bacteria deriving energy from sulfide, whereas in seep habitats, sulfide is derived from microbial sulfate reduction. Organisms in hydrocarbon seep habitats rely on reduced carbon in the form of methane gas and crude oil present in migrating seep fluids.

The Gulf of Mexico hydrocarbon seep and methane hydrate habitats studied to date are colonized by dense mats of bacteria, vestimentiferan tubeworms, methanotrophic mussels, bivalves and methane-hydrate-dwelling worms. These communities made up of macro- and microorganisms thrive in environments that would be highly toxic to most known organisms and function through chemosynthetic processes and interactions that we are only beginning to identify and understand. Many questions arise: What is the significance of these communities with respect to hydrates? How widespread are these communities? What types of associations and linkages between animal and microbe exist? Do these interactions control the cycling of nutrients in these systems? Do they occur at all hydrate sites? How are they related to other deep sea communities like those found at seeps and vents? What is their role in fixing or dissolving effluents and gases? Long term and interdisciplinary research efforts will be required. Without doubt, new biological processes, interactions and organisms await discovery in these unique environments.