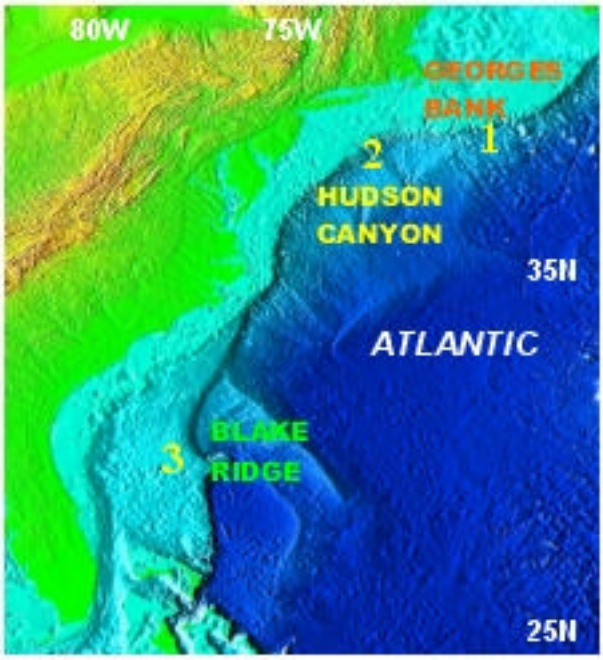
# DEEP EAST 2001: VOYAGE OF DISCOVERY TO DEEP SEA FRONTIERS OFF THE U.S. EAST COAST




**NOAA Inaugurates a New Era of Ocean Exploration**

On October 10, 2000, a panel of experts, commissioned by the President produced a report entitled ***Discovering the Earth's Final Frontier: A U.S. Strategy for Ocean Exploration***. Four significant challenges were highlighted as gaps in knowledge of the oceans including the need for: 1) mapping at new scales, 2) exploring ocean dynamics and interactions at new scales, 3) developing new technologies and 4) reaching out in new ways to stakeholders. A key objective to address these needs was support for new, exploratory "Voyages of Discovery."

Three regional centers in NOAA's National Undersea Research Program will partner in 2001 to coordinate *Deep East*, a Voyage of Discovery exploring new resources and ocean dynamics off the east coast of the U.S. Their inner space ship will be the deep submergence vehicle *Alvin*, America's only occupied submersible capable of diving below 2,000 meters. Teams of scientists and educators will embark upon three cruise legs in September, 2001.

**VOYAGE OF DISCOVERY- LEG ONE: Deep Sea Coral Communities in the Georges Bank Canyons**

Science Team: Les Watling, University of Maine; Kevin Eckelbarger, University of Maine; Peter Auster, University of Connecticut; Barbara Hecker, Hecker Associates

Until recent legislation banned trawling in deep coral beds off the coast of Norway, the existence of deep sea corals was known only to a handful of scientists and a large number of fishermen. Along the American east coast several deep-water corals, such as the octocoral *Primnoa resedaeformis* and gorgonian *Paragorgia arborea,* are common inhabitants of the upper and middle slope faunas in the canyons south of Georges Bank. Given that the existence of these remarkable species has been known for more than a century, it is striking that almost nothing is known about their biology, population status, the role they play in enhancing local species diversity, and their role as habitat for deep water fishes, including those recently targeted by fishermen. The rarity of encounters with octocorals during recent submersible dives across the shelf of the northeast U.S. suggests that the distribution of these species has significantly declined in the past three decades. These slow-growing species may live for centuries, yet be destroyed in seconds by human activities such as trawling and dredging. Trawling with roller gear has allowed even larger and heavier gear into their rugged canyon homes.

*Primnoa resedaeformis* (from http://www.kystnett.no/~emil/cnidaria/primnoa_resedaeformis.html)

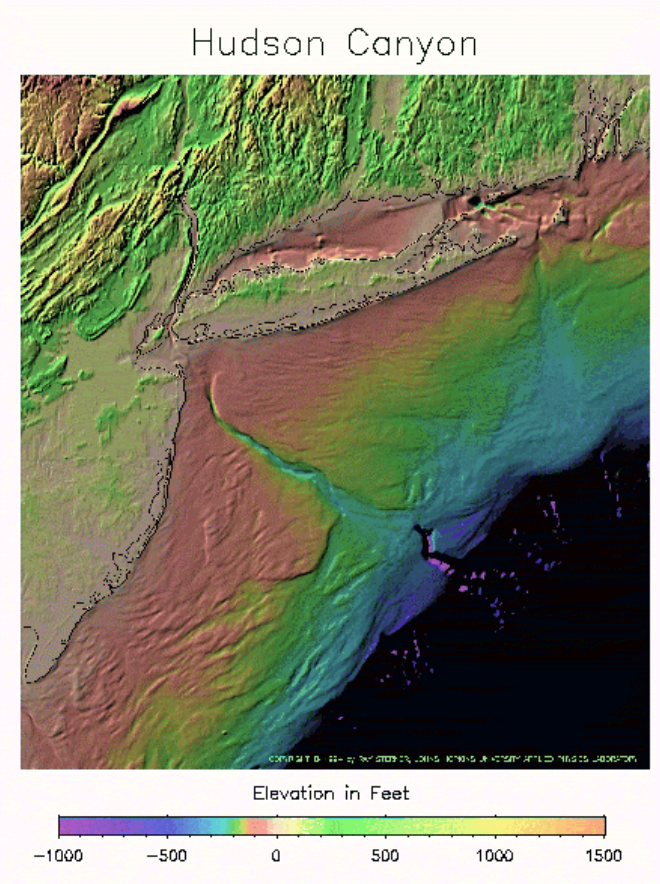
The overall goal of leg 1 is the characterization of deep-water octocoral communities of the Georges Bank Canyons and on Bear Seamount. Specific objectives include:

- To assess the diversity of coral communities in different canyon habitats, on Bear Seamount, and in the Gulf of Maine
- To determine whether coral populations are capable of reproduction through analysis of individual coral polyps
- To determine the size class distribution of octocoral populations
- To describe patterns of coral habitat use by associated fauna.
- To verify the taxonomy and genetic similarity of coral species from the continental slope off Georges Bank and on Bear Seamount.

**VOYAGE OF DISCOVERY- LEG TWO: Exploring Deep Sea Processes and Resources in Hudson Submarine Canyon**

Science Team: Fred Grassle, Rutgers University; Peter Rona, Rutgers University; Mike Bothner, U.S. Geological Survey; Mary Scranton, SUNY/Stony Brook

Hudson Submarine Canyon, an ancient extension of the Hudson River Valley, extends over 400 nautical miles seaward from the New York-New Jersey Harbor, across the continental margin to the deep ocean basin. Past undersea investigations show the canyon has great potential for discovery of unusual deep sea creatures and providing understanding as to how a major urban area connects with and impacts the deep ocean.




Submarine canyons are conduits for the transport of sediments including pollutants between land and sea. Hudson Canyon is particularly susceptible to movement of materials down-canyon and may concentrate pollutants and other materials in the canyon. Minerals Management Service (MMS) surveys in the canyon also revealed a remarkable diversity of deep sea life. The DWD-106 mile dumpsite on the continental rise east of New Jersey received the world's largest discharge of municipal sewage sludge to the deep sea. In 1989, NOAA, the university community, and private research institutions used research submersible *Alvin* to investigate the dump site. They found chemical increases and biological changes in the seafloor environment that had not been expected by regulatory agencies at the time the dumpsite was authorized. Dumping ceased in 1992, thus providing a unique opportunity to document the canyon's chemical and biological recovery.

Leg 2 will also investigate gas hydrates, an ice-like substance that forms under pressure when natural gas molecules, primarily methane, are trapped in a cage of water molecules. Gas hydrate reserves found along ocean margins greatly exceed present known petroleum reserves. Japan, Korea, Norway, India and Canada are now developing the technologies to extract methane from gas hydrates. Equally important, gas hydrates

influence ocean carbon cycling, global warming, and coastal sediment stability. Localized meltdowns may cause major undersea landslides and are considered a hazard by oil and gas production companies. Massive gas hydrate meltdowns have been implicated as the cause of past greenhouse gas emissions that resulted in major climate swings evident in the geologic record. Vast hydrate deposits exist below 1000 meters of water all along the U.S. east coast, including the flanks of Hudson Canyon.

In 2001, the Hudson Canyon leg of the Deep East expedition will focus on four primary exploration objectives:

- Explore deep sea diversity in the Hudson Submarine Canyon
- Determine the fate and effects of past dumping activities at the DWD-106 mile site
- Explore the processes governing distribution and stability of gas hydrate deposits, and
- Explore the potential occurrence of exotic communities associated with active methane venting from hydrate beds

**VOYAGE OF DISCOVERY- LEG 3: Gas Hydrates on the Blake Ridge**

Science Team: Cindy Van Dover, College of William and Mary; Carolyn Ruppel, Georgia Tech University; Barun Sen Gupta, Louisiana State University; Joan Bernhard, University of South Carolina

Iceworm, *Hesiocaeca methanicola*, discovered in hydrate bed during JSL submersible studies in 1997 (photo from C. Fisher)

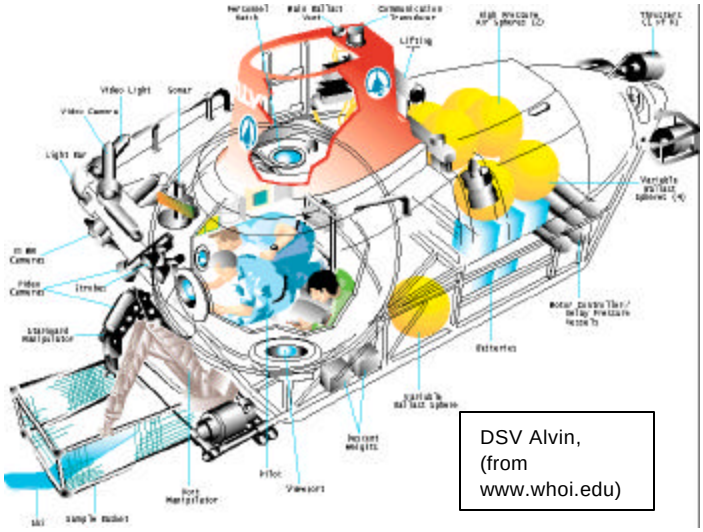
Cold oil and gas seeps are common under the sea—methane leaking from a gas hydrate bed is an example of a cold seep. Chemosynthetic communities similar to those found at hydrothermal vents inhabit these cold seeps and use hydrocarbons or hydrogen sulfide for carbon and energy. Tubeworms, mussels and clams form 2-meter high bushes and kilometer-sized beds. Most cold seeps are also characterized by high microbial productivity—as high as most tidal marshes. Cold seep communities may vary in species composition and abundance depending on the type and amount of seepage. Some species live exclusively with a particular type of seep, such as hydrate iceworms (see figure). Others are common to a range of seepage, for example, *Beggiatoa* bacteria. Seep communities are ecologically important as sources of food and refuge for vast array of background slope species, and economically important as they mark underlying oil and gas resources. At a time when energy is limited and more expensive, oil companies are pushing deeper in search of new resources. Understanding the dynamics and ecology of seep communities assists NOAA in its role as steward of ocean environments. To date, the only U.S. cold seep communities to be explored and studied have been in the Pacific and Gulf of Mexico, although extensive hydrate beds and associated cold seeps exist off the U.S. east coast.

Off the southeastern United States, a small area (only 3,000 square kilometers) beneath the Blake Ridge, formed by rapidly-deposited sediments, appears to contain a volume of methane in hydrate that is equivalent to approximately 30 times the U.S. annual consumption of gas. The bed was drilled during

Ocean Drilling Program leg 164 in 1992. During site surveys with a photo sled, chemosynthetic mussel beds were discovered, the first cold seep community found along the U.S. east coast outside the Gulf of Mexico. This Voyage of Discovery will be the first-ever submersible exploration of a cold seep chemosynthetic community off the U.S. east coast, on the Blake Ridge off northern Florida, Georgia and the Carolinas. Specific objectives include:

- To describe the community associated with mussel beds at the Blake Ridge gas-hydrate seep site and map the diversity and extent of communities within this biologically unexplored hydrate field.
- To describe geochemical conditions in and adjacent to the seep community.
- To correlate seep types and geochemical conditions to microbial assemblages

**Outreach and Education Opportunities**



DSV Alvin, (from www.whoi.edu)

NOAA's Ocean Exploration initiative is dedicated to supporting outreach and education. Related activities during Deep East include:

- Web site production at www.oceanexplorer.noaa.gov, will include a daily log written by an education specialist, with images and video clips, downloaded to the site from sea
- TV production—Ecology Communications will fund and produce an hour-long documentary to be aired nationally on PBS and cable
- Press kits—background (B-roll) video footage, description of the undersea technologies, R/V *Atlantis* and *Alvin*, description of the partners, and summaries of the research projects written for public and including images of the scientists and their work
- Lesson plans developed for grades 5-12 developed by teachers before the expedition
- Professional development workshops for teachers during expedition port stops
- Classroom at sea interactive activities (internet chat sessions and satellite phone)

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