# [GC]Seafloor Observatory Will Monitor Deepwater Gas Hydrate System

**By**
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## Background

A project to design, construct, and deploy a seafloor monitoring station across a deepwater hydrate mound in Mississippi Canyon Block 118 (MC 118) has been initiated by the Gulf of Mexico Hydrates Research Consortium, which is composed of 15 universities, five federal agencies, and several private corporations.

The consortium is managed by the Center for Marine Research and Environmental Technology at the University of Mississippi. The monitoring station project is funded by the Minerals Management Service of the Department of the Interior, the National Energy Technology Laboratory of the Department of Energy, and the National Undersea Research Program of the National Oceanographic and Atmospheric Administration of the Department of Commerce.

The monitoring station will have three types of seafloor observation systems:

- Geochemical
- Microbial
- Seismic

A representation of the station and its component systems is shown as Figure 1. The data recovery system ("Big M") shown in the background is an interim option for downloading data to a ship. Eventually, the station will be connected to shore by an optic-fiber cable.

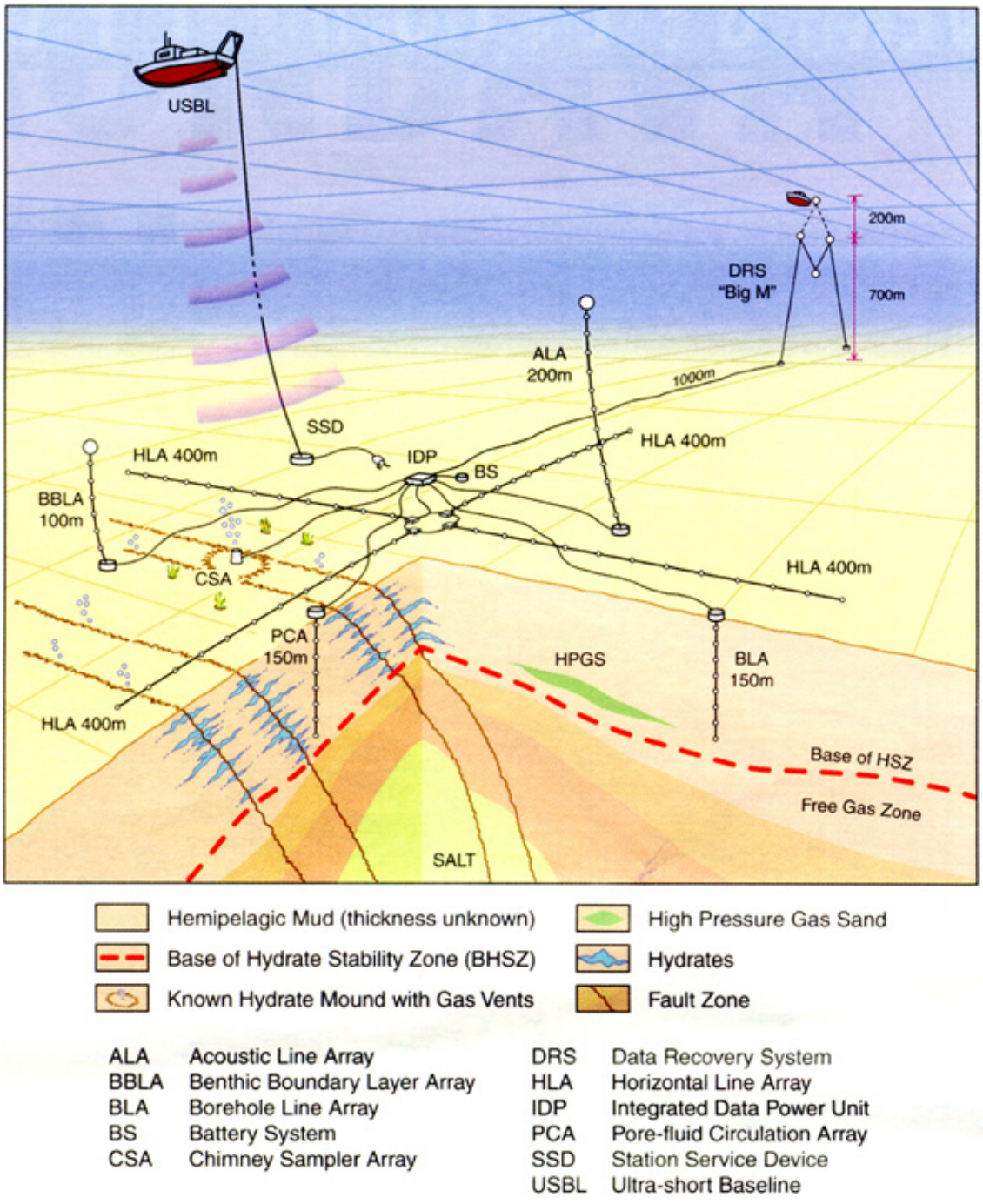


**Figure 1. Deepwater hydrate monitoring station and its component systems.**

## Geochemistry Data

Geochemical observations will be made within seafloor sediments, at the sea floor, and in the lower water column. Geochemical sensors include:

- Pore water samplers to measure salinity and concentrations of hydrocarbon gases at various depths below the seafloor.

- Chimney samplers to measure the composition and quantity of gas passing through the seafloor.
- Arrays to measure conductivity, temperature, density, and composition of dissolved gas at various levels in the lower water column.
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A mass spectrometer will perform chemical analyses on the seafloor.

## Microbiology Data

The microbial observatory will monitor various aspects of:

- Microbial activity including abundance, diversity, temporal variability, and dynamics of microbial communities.
- Rates of methane oxidation and sulfate reduction.
- Relationships between microbial products and hydrate formation.
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Monitoring sensors will include retrievable, pressurized seafloor test cells and bioreactors, high-surface-area sampling plates of different materials, low-light digital cameras, and devices to retrieve samples under in-situ conditions.

Research goals include:

- Documenting the stability and persistence of gas hydrate outcrops.
- Determining whether methane oxidation and sulfate reduction occur within hydrates without dissociation.
- Characterizing the structure and functions of microbial communities.
- Identifying biochemical controls on, and ecological roles of, certain bacterial mats.

Fine-grained magnetic sulfides that originate with magnetotactic bacteria and then accumulate in gas hydrates will be monitored as possible locators of hydrate deposits.

## Seismic Data

Seismic data will be collected with six linear sensor arrays: two vertical and four horizontal. One vertical array of hydrophones, inclinometers and compasses will extend from the seafloor to a height of 200 meters into the water column. A second vertical array of hydrophones and 3-component (3-C) accelerometers will be in a borehole and extend 150 meters below the seafloor.

Each horizontal array of hydrophones and 3-C accelerometers will be 400 meters long. Four horizontal arrays will be deployed in an orthogonal cross to create arm lengths equal to water depth (~800 meters).

## Deployment

The monitoring station is being deployed near a hydrate mound in water more than 800 meters deep in Block MC 118 (Figure 2). The mound is located inside the distorted bathymetry contours in the lower part of Figure 2.

The Minerals Management Service has reserved a large portion of Block MC 118 (the area inside the "MMS Reserve Boundary" in Figure 2) for exclusive use of the monitoring station and associated research.

Pre-installation surveys began in January, 2005. The first observing systems, a pore-fluid sampler and an array of sub-bottom thermisters were installed in May, 2005. Installation is continuing in stages until the monitoring station is complete. Completion is expected in 2007.

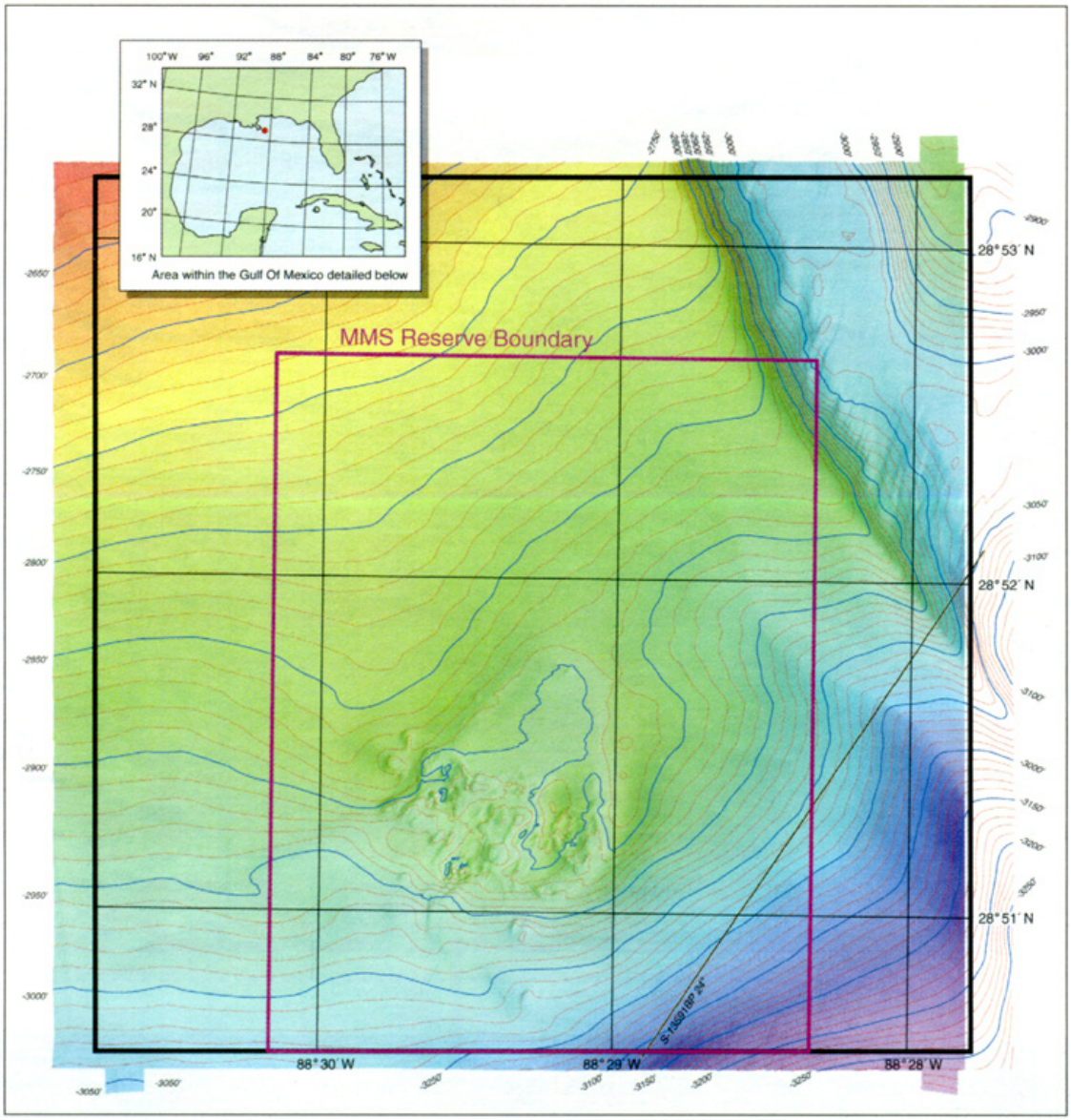


**Figure 2. Bathymetric image of Block MC 118. The MMS Reserve Boundary defines the area reserved by the Minerals Management Service for exclusive use of the seafloor monitoring station and its associated research program.**

## Seismic Monitoring

When fully operational, the observatory will generate about nine gigabytes of data per hour. Almost all of this data flow will come from seismic sensors operating in continuous acquisition mode.

A conventional image of the mound will be created by inverting data acquired using conventional seismic sources. Monitoring will consist of comparing this conventional image to subsequent images obtained using ambient noise as the energy source.

A procedure for imaging the mound using the noise of nearby ships is under development. This technique will utilize the station's hydrophone data and is based on an established technique known as Matched Field Inversion.

Attempts will be made to obtain images using other types of ambient noise, particularly the noise of wind-driven waves at the sea surface and the background noise of micro-seismic events. The mound will be re-imaged with conventional seismic sources from time to time.