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USGS GAS HYDRATE RESEARCH PROGRAM

Summary/Goals

The program goals are to understand natural gas hydrates in relation to energy resources, seafloor stability/drilling safety, and global carbon budget/climate effects. We seek to identify gas hydrate by remote sensing and to understand the processes that control methane hydrate in the natural environment, such as concentration into possibly extractable accumulations, change in strength of sediments and generation of overpressures, processes of seafloor mobilization, and processes allowing transfer of methane to the atmosphere.

Program Strategy

We operate five cooperating groups having overlapping and mutually supporting interests.

1. Seismic reflection studies include collection and interpretation of field seismic data from our bases at Menlo Park and Woods Hole and specialized processing and advanced analysis and modeling at the Denver USGS seismic processing center. Multibeam sonar and acoustic backscatter are used to provide images of seafloor mass movement features.

2. Physical testing of gas hydrate-bearing sediments is done at our GHASTLI (Gas Hydrate And Sediment Testing Laboratory Instrument) facility at Woods Hole. The GHASTLI system provides the capability of either forming gas hydrate in sediments at simulated deep sea conditions or accepting gas hydrate-bearing cores drilled at sea or in the Arctic, and both of these approaches have been taken. Acoustic velocity measurements of gas hydrate-bearing sediments are critical to the interpretation of seismic data. Electrical resistivity measurements are used to image the gas hydrate in the test chamber and relate to well-logging. Other parameters tested are permeability and shear strength under varying conditions; these are significant to the problems of sea floor stability.

3. Petrophysics studies employ laboratory-formed gas hydrate using a method of placing ground ice in a methane environment, which produces a very concentrated (high methane content) artificial gas hydrate. This approach, used in Menlo Park, can allow the analysis of pure gas hydrate and the combination of the material with sediments for certain studies, such as for thermal characteristics, or analysis of the stability characteristics of gas hydrate outside its phase limits (important for sampling and transportation of natural hydrates). Synthesis and observation in optical cells is also planned. This work will aid in the prediction of the physical properties of gas hydrate/sediment columns.

4. Geochemical analysis to determine the gases present, quantities, sources, and migration is carried out in a specially developed laboratory in Menlo Park. Samples have been tested from a variety of sources, including Ocean Drilling Program drilling, oil company drilling in the Arctic, hydrates formed by remotely operated vehicles in the deep sea, from cores where hydrate exists near the sea floor, from the GHASTLI system, and other laboratory formed hydrate.

5. Well logging and Arctic geological studies to characterize and quantify gas hydrate in drillholes is carried out from Denver. Extensive work has been done in the Alaska/northern Canada area and the Blake Ridge. We anticipate further data-gathering in the Arctic in cooperation with oil company drilling , cooperative studies with offshore holes drilled by the Ocean Drilling Program, proposed industry consortia, and international collaboration (Japan/Canada). Joint studies between the well logging group and GHASTLI group to consider the effect of gas hydrate on electrical and acoustic characteristics of sediments are also planned.