PROGRAM facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Sequestration

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SEQUESTRATION OF CARBON DIOXIDE EMISSIONS IN THE OCEAN

Description

The world's oceans represent the largest potential sink for the carbon dioxide (CO_2) produced by human activities. Already oceans contain the equivalent of an estimated 140,000 gigatons of CO_2. The ocean's natural carbon transfer processes have spans of thousands of years and will eventually transfer 80-90 percent of today's man-made (anthropogenic) CO_2 emissions to the deep ocean. This natural CO_2 transfer may already be adversely affecting marine life near the ocean and could also be altering deep ocean circulation patterns.

The effectiveness of ocean storage techniques depends largely on how long the CO_2 would remain in the ocean. Most studies indicate that if CO_2 can be injected into deep oceanic water circulation, it will remain there for approximately 1000 years.

Direct injection of CO_2 into the ocean would reduce both atmospheric CO_2 concentrations and their sharp rate of increase. The purpose of this program is to investigate the technical, economic and environmental feasibility of CO_2 sequestration in the deep ocean, primarily by deep injection.

Projects

Feasibility of Large Scale Ocean Sequestration: Experiments on the Ocean Disposal of Fossil Fuel CO_2

Monterey Bay Aquarium Research Institute will use the Remotely Operated Vehicle (ROV) to carry out pilot experiments involving the deployment of small quantities of liquid CO_2 in the deep ocean for the purposes of investigating the fundamental science underlying concepts of ocean CO_2 sequestration. Below a depth of about 3000m the density of liquid CO_2 exceeds that of seawater, and the liquid CO_2 is quickly converted into a solid hydrate by reacting with the surrounding water.

Feasibility of Large Scale Ocean Sequestration: Optimized In Site Raman Spectroscopy on the Sea Floor and Effects of Clathrate Hydrates on Sediment

The research group at Washington University in St. Louis will work with MBARI to carry out the first direct in situ analysis on the seafloor of CO_2 clathrate hydrates, their entrained and surrounding fluids, along with sediments adjacent to the clathrate hydrates, using a Raman spectrometer. This information on the physical chemical of clathrate hydrates and clathrate sediment interaction is essential for the evaluation of CO_2 ocean sequestration.

SEQUESTRATION OF CARBON DIOXIDE EMISSIONS IN THE OCEAN

PROJECTS

Feasibility of Large-Scale Ocean CO_2 Sequestration: Experiments on the Ocean Disposal of Fossil Fuel CO_2
Principal Investigator:
Dr. Peter Brewer, 831-775-1706
Partner: Monterey Bay Aquarium Research Institute

Feasibility of Large-Scale Ocean CO_2 Sequestration: Optimized in Situ Raman Spectroscopy on the Seafloor and Effects of Clathrate Hydrate on Sediment
Principal Investigator:
Prof. Jill Pasteris,
316-935-5889
Partner: University of Washington at St. Louis

Accelerated Carbonate Dissolution as CO_2 Capture and Sequestration Strategies
Principal Investigator:
Terry Surles, 925-423-1615
Partners: Lawrence Livermore National Laboratory (LLNL), and U.S. Geological Survey (USGS)

Large Scale CO_2 Transportation and Deep Ocean Sequestration
Principal Investigator:
Hamid Sarv, 330-821-9110
Partners: McDermott Technology, Inc., and University of Hawaii

Ocean Carbon Sequestration
Principal Investigator:
Rick Coffin, 202-767-0065
Partner: Naval Research Laboratory

International Collaboration Project on CO_2 Sequestration
Principal Investigator:
Howard Herzog, 617-253-0688

Public Outreach and Permitting
Principal Investigator:
Gerard Nihous, 808-539-3874
Partner: Pacific International Center for High Technology Research (PICHTR)

Accelerated Carbonated Dissolution as CO_2 Capture and Sequestration Strategy

Lawrence Livermore National Laboratory and the U.S. Geological Survey will conduct a laboratory program to synthesize and study the physical properties of CO_2 hydrates, and will contrast these properties of methane hydrates. Gas-solid exchange experiments will methane hydrates to determine whether methane extraction from natural gas and CO_2 sequestration can be accomplished in a single step.

Large Scale CO_2 Transportation and Deep Ocean Sequestration

The objective of the project is to investigate the techno-economic viability of large-scale carbon dioxide transportation and deep ocean sequestration. Two cases are being investigated; one involving ocean tanker transport of liquid CO_2 to an offshore floating platform on a barge with vertical injection to the ocean floor and the other involving transporting liquid CO_2 through undersea pipelines to the bottom of the ocean.

Ocean Carbon Sequestration

The objective of this project is to provide logistical and technical support for the International Collaboration Project on CO_2 Ocean Sequestration. Such support includes providing a surface vessel for the project, biological experiments and a survey of potential test sites.

International collaboration Project on CO_2 Ocean Sequestration

The objective of this project is to develop instrumentation and potential experiments for the International Project on CO_2 Ocean Sequestration. This international effort involves four nations (United States, Japan, Norway, and Canada) and one private corporation, CABB of Switzerland. The field experiment is scheduled to take place in the summer of the year 2001, at Keahole Point on the Kana Coast off the big island of Hawaii.

Public Outreach and Permitting

The objective of this project is to conduct the public outreach and permitting activities associated with the International Project on CO_2 Ocean Sequestration. This effort although primarily conducted on the large island of Hawaii, is also being carried out within the state of Hawaii and on the continental United States.

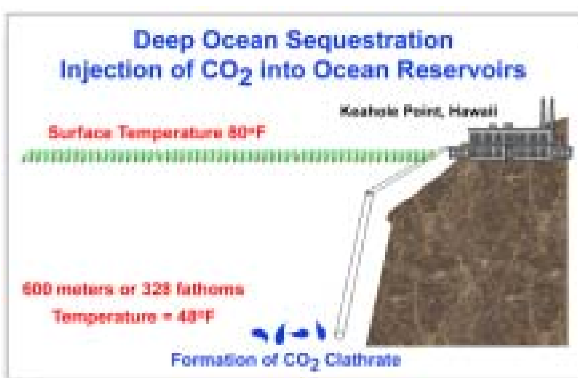

Figure 1 presents the basic idea of ocean based sequestration. While the surface of the ocean (near Hawaii) is at the perfect temperature of 80 degrees F for a vacation, the temperature at 600 meters is a cold 48 degrees Fahrenheit. Water pressure increases with depth and at 600 meter below the surface, the water pressure is sufficient to keep CO_2 in the liquid or solid state.