

Methane Hydrates

Methane Hydrates: A Primer

Methane hydrates represent an enormous untapped energy resource. Estimates of the total volume of methane gas locked in hydrate deposits worldwide range widely from about 105 trillion standard cubic feet (TCF) to 2.7×10^8 TCF (i.e., 2.8×10^{15} to 7.6×10^{18} cubic meters). Even at the lower end of this range, the energy contained in the methane hydrate resource exceeds that of all known coal, oil, and natural gas reserves. If practicable recovery techniques can be developed, then methane hydrates may play a major role in meeting the world's future energy needs.

Hydrates are crystalline solids comprising water molecules linked by hydrogen bonds in a tight polyhedral cage structure. Guest molecules, which can include various hydrocarbons found in natural gas mixtures, reside in the interstices of this lattice. Methane (or other hydrocarbon) molecules are packed closely together in the hydrate lattice. A cubic meter of hydrate yields about 160 cubic meters of methane at standard temperature and pressure and about 0.87 cubic meter of water. This relatively high energy density has prompted studies to investigate hydrates as an alternative means to transport and to store natural gas.

Methane hydrates are found in high-pressure, moderate-temperature regimes in ocean sediments and low-temperature Arctic permafrost zones. Methane hydrate is stable in seafloors below about the 450-meter depth in open oceans with an average temperate hydrothermal profile. Significant marine hydrate deposits have been identified worldwide in continental margins. Sediment layers in deep ocean basins also may contain large deposits of methane hydrates, but these areas have not yet been thoroughly explored. The photo shows a surface outcropping of methane hydrates encountered in the Gulf of Mexico.



Methane hydrates (yellow color) on the sea floor in the Gulf of Mexico.

During the first half of the 20th century, blockage of natural gas pipelines by methane hydrates posed a serious problem for the gas industry. Research was initiated to study hydrate properties and formation and dissociation phenomena, and to develop means to inhibit and remediate hydrate formation in pipelines. After solutions to the pipeline blockage problem had been identified and implemented, interest in methane hydrates waned. Naturally occurring methane hydrates remained largely a curiosity for many decades, with limited practical use.

Beginning in the early 1990s, interest in methane hydrates began to revive. While offering tremendous opportunities as a future energy resource, sedimental marine hydrate deposits also emerged as an immediate and formidable nuisance to offshore oil and gas operations, compromising sea floor stability and imperiling drilling activities. The hydrate problem has become more critical as oil and gas exploration and recovery move into increasingly deeper waters where hydrates abound. From a military perspective, it was recognized that characterizing the geo-acoustic properties of hydrate sediments was important to a number of naval operations, such as surveillance and mine detection. Finally, methane hydrates may exercise a profound effect on the global climate if the carbon sequestered in these solids is released into the environment by commercial exploitation of the fuel or through destabilization and outgassing induced by ocean warming.

Methane Hydrates: Research at the Hawaii Natural Energy Institute (HNEI)

HNEI has been active in research activities involved with methane hydrates for many years. For details concerning such research, see the [Hydrate Research](#) ^[1] section of our website.

Contact: [Stephen M. Masutani](#) ^[2]

Last Updated: Tuesday, March 12, 2013

[Hawaii Natural Energy Institute](#) ? 1680 East West Road, POST 109 ? Honolulu, HI 96822 ? Ph: (808) 956-8890 ? Fax: (808) 956-2336 ? Email:[Contact](#) ?

Source URL: <http://www.hnei.hawaii.edu/research/ocean-researches/methane-hydrates>

Links:

[1] <http://www.hnei.hawaii.edu/research/ocean-researches/hydrate-research>

[2] <http://www.hnei.hawaii.edu/staff/stephen-m-masutani>