

A Decade of Gas Hydrate Research in Taiwan: From Simulation to Observation of Methane Hydrate Emplacements

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Abstract

Methane hydrates are currently one of the most compelling topics in marine geophysics. Gas hydrates are ice-like crystalline solids composed of a hydrogen bonded water lattice entrapping low-molecular weighted gas molecules commonly of methane. Gas hydrate form under conditions of relative high pressure and low temperature, when the gas concentration exceeds those which can be held in solution, both in marine and on-land permafrost sediments. The quantities and distribution of hydrates are still poorly understood, offering excellent opportunities for contributions in areas of climate change, slope stability, and natural resources.

My research on gas hydrate began in 1999, as CDP-EDRI initiated a gas hydrate field investigation program. Then in early 2004, the Central Geological Survey of Taiwan took the helm of an even broader investigation project, that gathers today near 26 research teams, with the objectives to map the regional gas hydrate distribution offshore SW Taiwan and to understand the geological, geophysical and geochemical characteristics of hydrate-bearing strata. Geophysical investigations include multichannel seismic (MCS) reflection and OBS wide-angle surveys, geothermal gradient measurements, deep-toed marine chirp and magnetic as well as toe-cam surveys. Geological and geochemical analyses of bottom water and core sediments are also performed.

The integration of multi-disciplinary data analysis into a complete model for hydrate emplacements is a key issue in the hydrate investigation. Thus, computer simulation allows elegantly introducing and systematically examining the mechanisms leading to natural gas hydrate emplacement in geological environments. We are then able to better comprehend the results from geochemical analysis of bottom water and shallow sediments from core recovery, the rock modeling of seismic data in the hydrate stability zone and at its base (such as ocean bottom seismometer and multi-channel reflection surveys), and the role played by the geological structural setting in the migration of fluids and gases, the formation of BSR and the emplacement of gas hydrate.