Arctic and Marine Gas Hydrate Production Testing – Lessons Learned

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Abstract

It has been suggested that gas hydrates may represent an important future source of energy; however, much remains to be learned about their characteristics and occurrence in nature. This lecture reviews recent successes in exploration and production of natural gas from gas hydrate accumulations. Field studies have shown that gas hydrates in both Arctic permafrost regions and deep-marine settings can occur at high concentrations in conventional sand-dominated reservoirs. These settings have been the focus of recent gas hydrate exploration and production studies in northern Alaska and Canada, in the Gulf of Mexico, off the southeastern coast of Japan, in the Ulleung Basin off the east coast of the Korean Peninsula, and along the eastern margin of India. Gas hydrate in onshore Arctic environments is typically closely associated with permafrost. Two of the most studied permafrost-associated gas hydrate accumulations are those at the Mallik site in the Mackenzie River Delta of Canada and the Eileen gas hydrate accumulation on the North Slope of Alaska. The Mallik gas hydrate production research site has been the focus of three geologic and engineering field programs (1999/2002/2007-2008 Mallik Gas Hydrate Testing Projects) and yielded the first fully integrated production test of an onshore gas hydrate accumulation. The science program in support of the 2007 U.S. Department of Energy (DOE) and BP-sponsored Mount Elbert gas hydrate test well project in northern Alaska generated one of the most comprehensive data sets on an Arctic gas hydrate accumulation along with critical gas hydrate reservoir engineering data. In 2011/2012, DOE partnered with ConocoPhillips and the Japan Oil, Gas and Metals National Corporation to investigate a new production method during the Ignik Sikumi test in which carbon dioxide was injected into a gas hydrate-bearing rock unit to release methane while sequestering carbon dioxide in hydrate form. A major milestone in gas hydrate production technology evaluation was achieved in 2013 with the successful demonstration of gas production from deepwater gas hydrates in the Nankai Trough of Japan. Gas production was obtained readily upon depressurization using specially designed pumps that separated gas from water and flowed both to the surface through separate production strings.

The recent production tests in the Artic and offshore Japan have collectively shown that natural gas can be produced from gas hydrates with existing conventional oil and gas production technology. Additional gas hydrate production testing is underway in Japan and plans are being formulated for marine gas hydrate production testing in the offshore of India and China. There is also a proposal to establish a gas hydrate pilot test site in northern Alaska that will allow for extended gas hydrate production testing experiments.