News and Highlights

China Has Successfully Conducted its First Pilot Production of Natural Gas Hydrates

HAO Ziguo[1, 2, *], FEI Hongcai[1, 2], HAO Qingqing[3] and LIU Lian[1, 2]

1 *Chinese Academy of Geological Sciences, Beijing 100037, China*
2 *Editorial Office of Acta Geologica Sinica (English Edition), Geological Society of China, Beijing 100037, China*
3 *Editorial Office of Geology and Exploration, Institute of Mineral Resources Research, China Metallurgical Geology Bureau, Beijing 101300, China*

Natural gas hydrates are a chemical compound of methane and water molecules formed under low temperature and high pressure. The decomposition of 1 m^3 of natural gas hydrates can release about 0.8 m^3 of water and 164 m^3 of natural gas. Thus, natural gas hydrates are characterized by their high-energy density and huge resource potential. It is estimated that the world's total natural gas hydrates resource amount is equivalent to twice the total carbon amount of the global proven conventional fuels and can meet the human energy requirement in the future for 1000 years. They are thus the first choice to replace conventional energy of petroleum and coal.

From 10th to 18th May, 2017, the China Geological Survey first conducted an industrial pilot production of natural gas hydrates (from combustible ice) in the Shenhu area of the Pearl River Estuary in the northern South China Sea (Fig. 1). The water depth of the pilot production point is 1266 m, and the reservoir rocks of natural gas hydrates are 203–277 m below the seabed. The natural gas production reached as high as 3.5×10^4 m^3 per day, averaging 1.0×10^4 m^3 per day, and the methane content was up to 99.5%, with seven days and 19 hours of steady gas production, indicative of the successful pilot production of natural gas hydrates (Fig. 2).

China began to study natural gas hydrates in 1995, and obtained the first natural gas hydrates samples in May 2007, being only the fourth country to discover natural gas hydrates in the world.

At the end of 2010, the Guangzhou Marine Geological Survey Bureau of the China Geological Survey submitted a report on Drilling Results of Natural Gas Hydrates in the Shenhu Area of the northern South China Sea. This report suggests that about 22 km^2 of mining area had been delineated within the range of 140 km^2 of the Shenhu sea area, with 11 natural gas hydrate orebodies, 20 m of the effective thickness for a single ore layer, and 19.4 billion m^2 of predicted reserves. The gas content is mainly methane, accounting for up to 98.1%, and is of a microbiogenic origin. Till now, it has preliminarily been determined that about 5242 km^2 of the area is abundant with natural gas hydrates in the offshore area of the South China Sea, with 4.1 trillion m^2 of estimated resource amount (See also: Reserves of Natural Gas Hydrates Equivalent to 100–150 Billion m^3 Natural Gas Have Been

Fig. 1. On 18th May, 2017, the China Geological Survey announced the successful pilot production of natural gas hydrates (Photo from the Website of the China Geological Survey).

Fig. 2. Photo showing in-situ pilot production and ignition tests on natural gas hydrates (Photo from the Website of the China Geological Survey).

* Corresponding author. E-mail: haoziguo@126.com

Discovered in the Pearl Mouth Basin of the South China Sea, reported in 88(1):361 in this journal in 2014).

The tested natural gas hydrates in the Shenhu area are hosted in argillaceous-silty reservoir rocks. This type of reservoir rock occupies more than 90% in the world and is thus the main type for natural gas hydrates in China but it is very hard to mine. To ensure the successful pilot production in these argillaceous-silty rocks, China's geological experts have adopted many effective new technologies and methods in pilot production idea, well location selection, engineering geological exploration, key technology determination and production platform optimization. For example, for the low permeability of argillaceous siltstone, the hydraulic slotting method was utilized to transform the reservoir rocks, with a good slotting effect, which has greatly improved the permeability. In addition, innovative technologies such as narrow-density window balance drilling, deep-water shallow wellhead stability enhancement, the comprehensive development of soft and complex orebodies, transformation of low-permeability and low-velocity sensitive reservoirs, the lifting and sand-control of unconsolidated superfine reservoirs, prevention of the secondary generation of hydrates, and the integration of well completion and testing systems have also enhanced this successful pilot production of natural gas hydrates.

Acknowledgement

Thanks are given to Susan Turner for the improvement of English.