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Research Status and Trend of Natural Gas Hydrate in China

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Abstract. With the further development of national economy, people have become more concerned about the environment quality. Especially in recent years, due to the frequent occurrence of hazy weather, there has been a growing demand for clean energy[Fig. 1]. As one kind of non-conventional energy, natural gas hydrate, featured by large reserves and relatively clean products of combustion, is considered by the scientific community to be an alternative energy resource in replacement of coal and petroleum. This paper gives a brief introduction of the research progress of natural gas hydrate both at home and abroad, presents the research results and the obstacles in the next step to be taken for China, and then looks into the future development trend.

Introduction

Natural gas hydrate (“gas hydrate” for short), also referred to as combustible ice, is one kind of solid clathrate compound (more specifically, a clathrate hydrate) in which a large amount of methane is trapped within a crystal structure of water, forming a solid similar to ice[1].

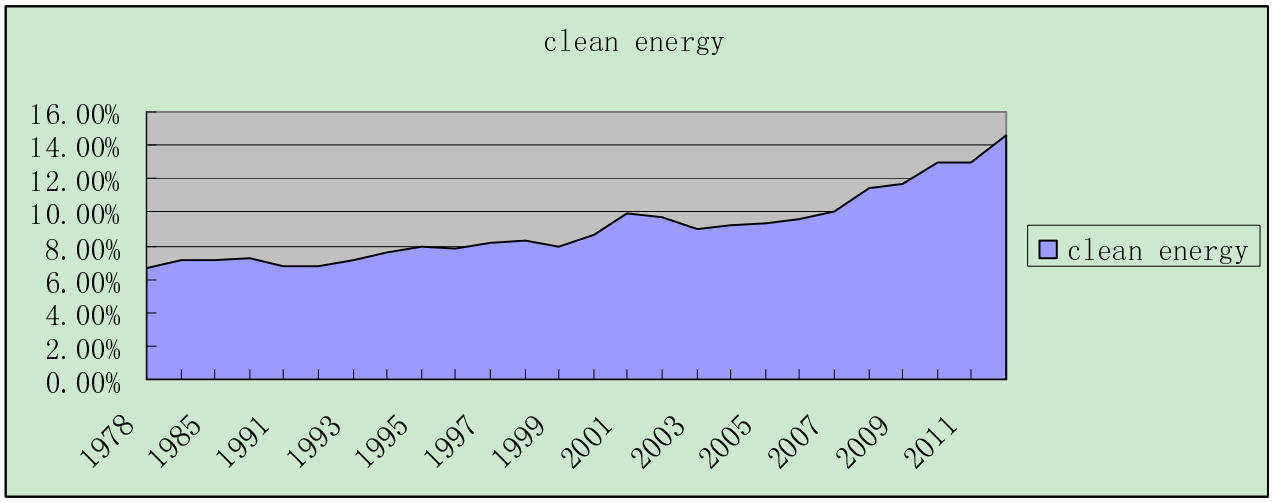

Fig. 1 Change of the Proportion of Chinese Clean Energy in Gross Energy Consumption（data from National Bureau of Statistics of the People’s Republic of China）

Development status

In 1934, American scientist Hammerschmidt first published some data of hydrates blocking the gas pipelines, but it was not until 1946 that this had been theoretically confirmed. With the launching of such scientific research activities as deep-sea drilling plans and international ocean drilling projects, gas hydrates were discovered in America, Japan and the South China Sea in the early 1990s after the former Soviet Union had started commercial exploitation of the natural gas hydrates in the Messoyakha gas field in the north of west Siberia in the 1960s and 1970s.

By far, relevant researches have been conducted in over 30 countries and regions, among which America and Japan have been successful in pilot mining and will realize commercial exploitation from 2015 to 2018 [Fig. 2].

Researches of natural gas hydrates in China began at the end of 1980s. Based on large amounts of exploitation materials introduced from abroad, physical samples of natural gas hydrates were collected in Shenhu area in the north of the South China Sea in May of 2007, making China the fourth country in the word that has acquired the samples through state-level research and development plans. Later on, another breakthrough was made in Muli permafrost regions of Qinghai province in September of 2009.

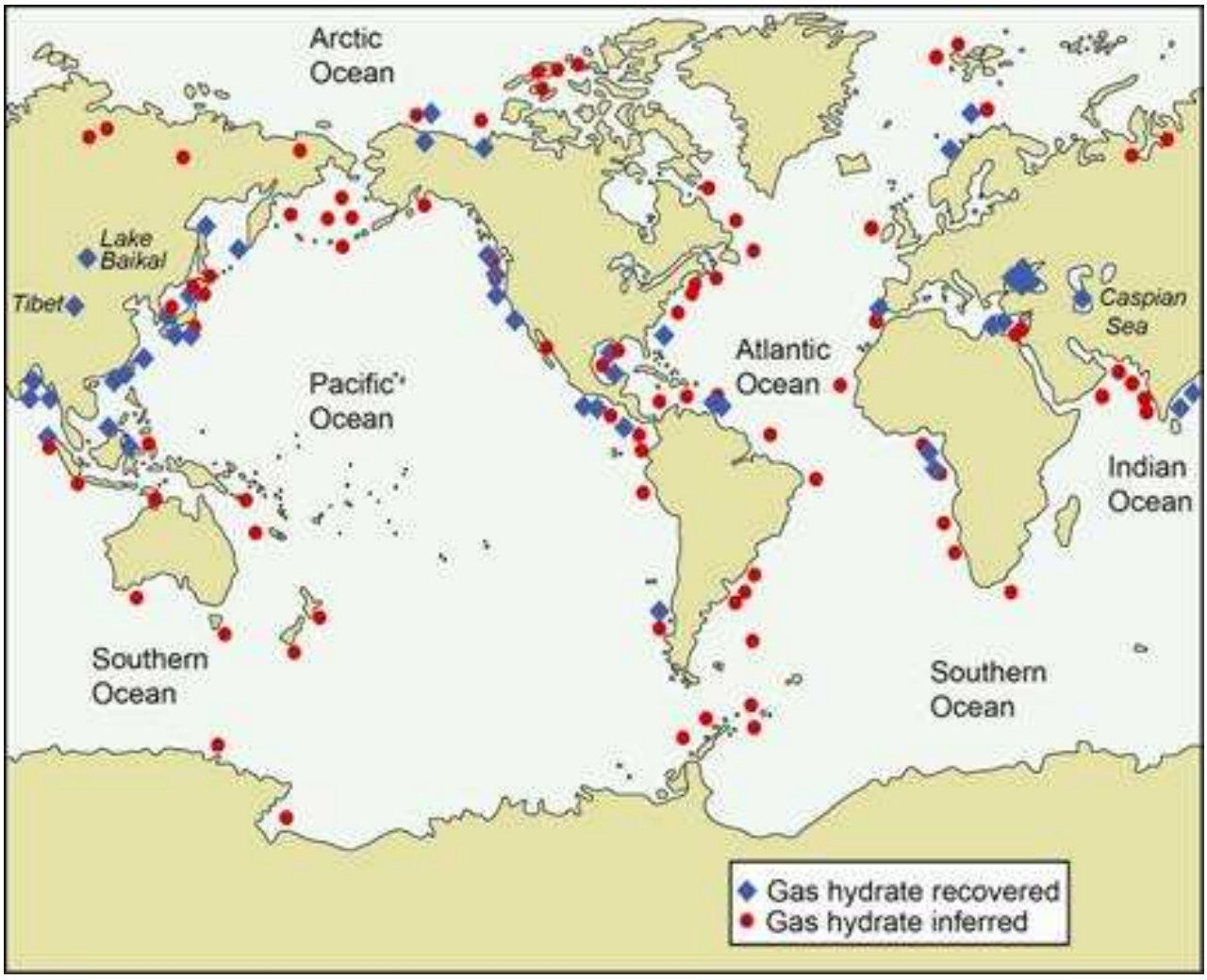

Fig. 2 Known and inferred locations of gas hydrate occurrence (drawn from USGS)

Methods and risks in the exploitation and development

In the exploitation of natural gas hydrates, the following methods are commonly used: depressurization, heat injection and injection of chemical reagents; but as the technology advances, methods like carbon dioxide replacement, microwave heating, deviated well constructing and hydraulic hoisting also emerge.

The method in exploiting natural gas hydrates is to decompose them through destroying their phase equilibrium conditions. In the process of exploitation, there will be some inevitable impacts on the seafloor environment. Some researchers think that the escape of methane will probably cause greenhouse effect, which is 21 times more powerful than that of CO_2[2-3]; some researchers connect the decomposition of natural gas hydrates with submarine landslide; while others hold that the large amounts of CH_4 released in the exploitation will react with O_2 and rocks in the sea and thus generate $Ca(HCO_3)_2$ that will affect the stability of marine ecosystem[5]. However, some scientists have different views[6].

Feasible measures

In the early period of exploitation, we should make the most of our accumulated experience, combine the geological conditions of the region, conduct comprehensive studies, make full estimations of the adverse effects of the exploitation and adopt multiple methods in order to look for suitable breakthrough points. In the later period of exploitation and in the process of exploiting, we should fully grasp the information about the work progress, geological conditions and bioturbation as well as carry out dynamic monitoring. Take Shenhu area in the South China Sea as an example[7], complex meteorological conditions should also be taken into account.

Conclusions

As one kind of clean energy that has not been exploited on a large scale, natural gas hydrate enjoys obvious advantages when compared with traditional fossil energies. China has made certain progress in this field, but to fill the energy gap in economic development, we should not only further explore the relevant properties of natural gas hydrates under laboratory simulations of storage environments, but also develop positive and effective cooperations with overseas institutions that have made certain achievements, striving to make more breakthroughs in the areas of basic theory research, exploitation and development, etc.

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