Countermeasure Study on Deep-sea Oil Exploitation in the South China Sea——A Comparison between Deep-sea Oil Exploitation in the South China Sea and the Gulf of Mexico

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Abstract. The unpromising situation of terrestrial oil resources makes the deep-sea oil industry become an important development strategy. The South China Sea has a vast sea area with a wide distribution of oil and gas resources, but there is a phenomenon that exploration and census rates and oil exploitation are low. In order to solve the above problems, this article analyzes the geology, oil and gas exploration and exploration equipment in the South China Sea and the Gulf of Mexico. Comparing the political environment of China and the United States energy industry and the economic environment of oil companies, this article points out China's deep-sea oil exploration and mining problems that may exist. Finally, the feasibility of oil exploration and exploitation in the South China Sea is put forward, which will provide reference to improve the conditions of oil exploration in the South China Sea and promoting the stable development of China's oil industry.

1. Introduction
As the basis of chemical raw materials and power fuels, petroleum plays an efficient and irreplaceable role. Because it can grasp the energy pricing power, it is an important strategic material as well as a diplomatic priority for all countries. However, as China's economy has entered a new normal phase, its demand for petroleum and energy sources has rapidly risen. In 2016 alone, net oil imports in China reached 378.3 million tons, an increase of 9.9% from 2015. Moreover, China's oil import dependence reached 67.3%, which is an increase of 5.4% compared with 2015. This shows that China's oil supply and demand imbalance exists. At present, the petroleum industry is suffering from the recovery after the impact of low oil prices, and its industrial layout has become increasingly prominent.

As we all know, onshore oil and gas resources have limited growth and have shown a declining trend. The issue of its increasing mining costs has made it more difficult to explore onshore oil and gas resources. In the meantime, the industry generally acknowledges the fact that the world's vast oceans and oil-rich resources are abundant. Especially deep-sea, as a new field of global oil and gas resources development, it has become an important replacement area of global energy resources. China's deep-sea water is mainly distributed among the South China Sea, reaching more than 70% of its depth in more than 300 meters. Due to the limitations of geographical environment and political environment, our country is still at a relatively low level of exploration. The United States, as a big energy country, has discovered major oil and gas discoveries in recent years mainly in the Gulf of Mexico. Its intensive exploration activities have promoted the rapid development and progress of the oil industry, which has yielded many achievements so far. In order to realize the capability of developing marine resources proposed by the 19th National Congress of the Communist Party of China, this article will compare and analyze the situation of deep-sea oil exploration in the Gulf of Mexico and the South China Sea. Therefore, this article puts forward suggestions based on the
situation in our country, hoping to promote the development of oil in the South China Sea.

2. South China Sea and the Gulf of Mexico topography, oil and gas distribution overview

2.1 The Introduction of South China Sea

The South China Sea is an important place across the Pacific and Indian Oceans and has abundant fishery resources and waterway resources. In addition, the development of offshore energy resources in our country mainly starts from the South China Sea. Therefore, the basic situation and the distribution of oil and gas in the South China Sea are highlighted.

The South China Sea is about 2380 km long and 1380 km wide with a total area of 3.5 million square kilometers and an average depth of 1212 meters. According to the exploration, the South China Sea has petroleum geological resources $2.3 \times 10^{10}$ t to $3.0 \times 10^{10}$ t and natural gas geological resources $1.6 \times 10^{13} \text{m}^3$ in the sea area within the boundary of China. Moreover, the maritime area within China's borders are 2.01 million square kilometers, with oil and gas mainly concentrated in the north and oil mainly in the south. Among them, some basins mainly produce natural gas, such as Beibu Gulf Basin, Qiongdongnan Basin and Pearl River Mouth Basin. Some basins have rich reserves of petroleum resources, such as Zengmu Basin, Wan'an Basin, Brunei-Sabah Basin, Li Letan Basin, Palawan Basin in the northwest, and Nanwei Basin. In terms of the distribution of energy resources, there is a certain difference between the southern part and the northern part of the South China Sea. However, on the whole, the oil and gas resources in the southern part of the South China Sea are more abundant than the northern parts.

2.2 The Introduction of Gulf of Mexico

Gulf of Mexico flat terrain, broad shelves, and it contains rich species of marine flora and fauna, oil resources. So it has been receiving more and more oil companies' attention because of its abundant oil and gas reserves. In recent years, major oil and gas exploration in the United States have come from this. Therefore, the following mainly introduces the oil and gas distribution in the Gulf of Mexico.

The Gulf of Mexico is 1609 km long from east to west and 1287 km wide from north to south. It covers an area of 1,543,000 square kilometers and has an average depth of 1,512 meters and a depth of 4,023 meters. The Gulf of Mexico consists mainly of coastal and continental shelves, continental slopes and deep-sea plains that contain many salt domes at different depths in the continental shelf and down the continental shelf, extending down to the deep-sea plain. The oil and gas reserves, which are economically important, are related to these salt domes. According to the exploration, the Gulf of Mexico has the petroleum geological resources $1.59 \times 10^{10}$ t, natural gas geological resources $7.35 \times 10^{12} \text{m}^3$. The area of the sea within the borders of the United States is 600,000 square kilometers. Its main oil and gas zones are: Northeast gas zone, Tampico oil zone, Veracruz oil zone and southern oil and gas zone. The new oil and gas region opened in 1975 is located in the southern oil and gas region of Campeche, which is currently Mexico's major oil and gas producing region. Most of the oil and gas resources in the Gulf of Mexico are distributed in the Gulf of Mexico Basin and are continuously moving towards the deep-water and ultra-deepwater areas of the Gulf of Mexico. The salt water reservoirs in the deep-water area have favorable reservoir forming conditions and have great exploration potential.

3. Oil and gas exploration in the South China Sea and the Gulf of Mexico

3.1 The situation of the policy situation

On August 3, 2016, the General Office of the State Council of China released the Guiding Opinion on Improving the Benefit Structure of Petrochemical Industry through Transformation and Transformation. The document pointed out that the petrochemical industry is an important pillar industry in the national economy and has put forward some guidelines. This is to regulate the petrochemical industry in our country has a great role in promoting. The government hopes to promote
the sustained and healthy development of the petrochemical industry, which has a effective boost for the regulation of China's petrochemical industry. On December 24, the National Development and Reform Commission promulgated the "13th Five-Year Plan for Petroleum Development," which pointed out that China should step up its exploration and development and ensure the supply of domestic resources. The policy aims to formulate a planned path for the development of oil industry.

On the U.S. side, the United States lifted the ban on oil exports on December 18, 2015. Since the ban was lifted to February 2017, the United States exported a total of 239 million barrels of crude oil, with exports up 35% sequentially. This policy exacerbates the global oil market oversupply situation, it will lead to fluctuations in international oil prices down. On January 20, 2017, Trump officially took over and released the U.S. Priority Energy Program that does not include "climate change." On March 28, 2017, Trump issued the " Presidential Executive Order on Promoting Energy Independence and Economic Growth." Encouraged by the Climate and Energy New Deal, the number of drilling rigs currently in use in the United States has been on a continuous increase of 12 weeks, reaching 672 at present, an increase of 90% over the same period in 2016. And this momentum is still continuing.

It can be seen that both governments attach great importance to the exploration, exploitation and utilization of petroleum resources.

3.2 The situation of oil service companies

From the tedious steps of exploration, exploitation and utilization of petroleum resources, many companies need to complete the oil resources together. In general, there is a need for oil companies, oilfield service companies, engineering companies and equipment installers to do their part.

China's oil companies have the following companies are integrated oil companies: China National Petroleum Corporation, China National Offshore Oil Corporation, China Petrochemical Corporation. But there's only one company that specializes in deep sea oil. Deep Sea Oilfield services company currently only China Oilfield Services Limited. Simultaneously, there is only one engineering company. It can be seen that the number of oil companies in China is relatively small.

There are many oil companies in The United States. Only large oil companies have Exxon Mobil, BP, Shell, BHP, Anadarko, Petrobras and so on. There are also many oilfield service companies such as Schummerge, Baker Hughes and others. The number of U.S. engineering companies, equipment companies and installation companies are even more, such as Technip, SBM Offshore. It can be seen that the capacity of the U.S. oil market is very large and the service market belongs to the high-end ranks. There are disparities in the number of oil companies and service companies, this makes the overall level of oil exploration and other differences.

3.3 The situation of oil and gas exploration

China's oil and gas exploration in the South China Sea began in the 1960s. In 2000, such basins have proven reserves of about 7 billion barrels, or $9.8 \times 10^9$ t. It is known that there are over 200 oil and gas structures and 180 oil and gas fields in this area. Only in Zengmu Basin, the Shaba Basin and Wan'an Basin have nearly $2 \times 10^{11}$ t of total oil reserves and more than half of the reserves are located in the waters that should be under Chinese jurisdiction. However, 70% of the oil and gas resources are in the deep sea. At present, exploration in our country is basically focused on the shallow waters near the continental shelf in the northern South China Sea.

In the 1940s, the exploration of the Gulf of Mexico in the United States was already started. And the exploration peak of oil and gas reserves appeared in the late 1980s. The depth of oil and gas exploration in the Gulf of Mexico in 2000 had more than 2500 m. 112 oil and gas fields were discovered in the deepwater area of the Gulf of Mexico and the degree of exploration is also gradually increasing, resulting in a steady increase in oil and gas production in the area. In 2006, the United States found a total of eight major deep-water oil and gas. They are all in the deepwater Gulf of Mexico. According to statistics, the region's oil production in 2017 will reach an average of $8.95 \times 10^3$ tons / year. At present, it is clear that there is a wide distribution of usable resources in the Gulf of Mexico basin, and that reserves and production in the deep-water area are continuously rising.
In conclusion, oil and gas exploration in the South China Sea lags far behind the Gulf of Mexico. Our country still needs further adjustment to make up for the gap.

3.4 The situation of oil and gas exploration equipment
A wide range of oil and gas extraction equipment. If you want to get deep-sea oil and gas resources in the ocean, then deep-water mining equipment is one of the essential conditions. In general, mainly include water equipment and underwater equipment. Water equipment, including drilling rigs or ships, production of fixed platforms, floating platform, FPSO and so on. Underwater equipment includes underwater wellheads, Christmas trees, manifolds, couplings, umbilicals, control systems, flow meters and more. Below, this article compares and analyzes the existing deepwater extraction equipment.

In 2010, China's "Dragon" deep sea manned submarine 3000 meters sea trial success, its maximum dive depth of 3759 meters. Until May 2012, known as the offshore carrier aircraft carrier "Offshore Oil 981" drilling platform officially started drilling in the South China Sea. This event ended the situation of China without deepwater drilling equipment and made up for the lack of water depth within most of the long-term operational seas within 300 meters. Offshore Oil 981 is a deepwater semi-submersible drilling rig that can extract oil at a depth of 1,500 meters.

The United States in 2005 already has advanced drilling equipment and leading mining technology. Its semi-submersible drilling platform, deep-water drilling vessel drilling depth of more than 10,000 meters. Moreover, The United States engaged in offshore drilling contract the largest number of companies. Only Transocean, the US company, owns about 30% of the world's deepwater drilling rigs. As a result, the United States owns 70% of the world's deepwater drilling rigs, and records of the depth of operation of the equipment are constantly being refreshed by the United States. This shows that the US oil industry leading technology level.

This shows that the Gulf of Mexico South China Sea not only exists in the oil and gas exploration, the company investment gap, it is also in the oil and gas mining equipment in the backward phase.

3.5 Comprehensive situation
In order to more fully compare the oil exploration in the South China Sea and the Gulf of Mexico, this article presents a table that gives a comprehensive analysis of the specific conditions in the two places.

| Table 1. The form of South China Sea and the Gulf of Mexico comparison |
|---------------------------------------------------------------|
| **Compare content**                                           | the South China Sea | the Gulf of Mexico |
| Sovereign area(10,000 square kilometers)                      | 201                | 60                |
| The deepest depth of the sea (m)                              | 5559               | 4023              |
| Geological survey census rate(%)                             | 8                  | 70                |
| In the production of deep-sea oil fields (individual)         | 3                  | 564               |
| Drilling platform                                            | 2                  | 32                |
| Oil and gas production in 2016(Billion tons)                  | 0.19               | 1.05              |
Figure 1. The figure of annual production of oil & gas in the Gulf of Mexico and the South China Sea.

In addition, combining the Oil and gas production chart of the Gulf of Mexico and the South China Sea, it can be found that the area of sovereignty in the South China Sea is about five times that of the Gulf of Mexico and the depth of the seabed is even deeper. However, China's exploration in the South China Sea started late and its output was small. The reason is mainly due to the lack of extensive geological exploration in our country and the large number of unexplored resources. Moreover, there are fewer oil service companies, drilling equipment and underwater production equipment than the United States. The backward of core technology and the lack of key equipment make our oil and gas production in the South China Sea only 18.1% of the Gulf of Mexico.

4. Proposals for deep-sea oil exploration in the South China Sea

Through the above comparison of the deep-sea oil exploration, mining and equipment, we can see that there is a certain gap. Based on the above situation, this article has made targeted recommendations, hoping to arouse the attention of each session, increase investment, improve exploration efficiency, and strengthen the deep-sea oil exploration in the South China Sea.

4.1 Make full use of foreign resources, go out and bring in

The oil companies in China have more than 20 years of "going out" experience and have achieved relatively brilliant results. At present, the unique exploration technologies of Chinese oil companies are more competitive in Africa, the Middle East and others. However, they should still learn from the advanced experience of the advanced countries and participate in the exploration of offshore energy.

4.2 Adjust the industrial structure, improve the market mechanism

Deep-sea oil exploration and development are characterized by high investment, difficult technology, risky, big profit, and it is hard to resist the risk of exploration and exploitation by relying solely on a single enterprise. Just in the recent oil demand in the medium and low-speed growth from the medium-to-low-speed transition period, it is a recovery period after the oil industry suffered from the impact of low oil prices. Therefore, this paper suggests that the government should adjust the structure and the layout of the energy industry based on the current low proportion of petroleum in China's energy structure. Moreover, the government should increase financial and financial support and improve the oil market mechanism. The government should create conditions to attract the intervention and docking of various types of investment, revitalize the market and create a win-win situation for both enterprises and venture capital. This article hopes to promote the improvement of competitiveness and structure, and promote the healthy development of China's oil industry.

4.3 Strengthen geological exploration, census of oil resources
The proven rate of petroleum geology resources in China is 29.6%, and that of the South China Sea is only 7%. It is still in the early stage of exploration and the accurate oil reserves are still unknown. However, China's deep-sea waters are mainly distributed in the South China Sea. With a depth of more than 300 meters, it has an area of more than 70%. Obviously, the deep-sea area of the South China Sea should become the key target for developing energy resources in our country. Only through geological exploration and census can the location and reserves of deep-sea oil be clear. Therefore, China needs to increase its domestic investment in petroleum exploration and change the situation of insufficient investment in petroleum exploration in recent years. The government needs to increase investment in the geological survey of financial capital, set up a national risk exploration fund, encourage exploration and development of deep-sea oil and give tax support for investment in risk exploration.

4.4 Learn key technologies and invest in core equipment
Technology and equipment are the core elements that support deep-sea oil exploration and development. Technological factors are not only the major bottleneck in the development of deep-sea petroleum resources, but also an important driving force. Therefore, the active development of high-tech marines and equipments have become the primary task for all countries in developing offshore oil and gas resources. At present, the horizontal wells in our country have been applied in large scale. The drilling technology is mature. The progress of drilling speed and efficiency has been continuously progressed and the drilling cycle has been continuously shortened. However, the number of oil companies in China is small and the problems of lack of drilling equipment and submarine underwater production equipment are increasingly prominent. There is still a big gap compared with the United States on the comprehensive level. Therefore, China’s deep-sea oil exploration and exploitation of the technical level, equipment level, operational capabilities and management capabilities need to be further improved. At present, it is necessary to take all-round measures to promote deep water development as the goal, in order to increase investment in constructing supporting deep-water facilities, and vigorously strive for the initiative in developing deep-water resources in the South China Sea. This paper suggests that we can improve the informatization level of drilling, build multiple remote real-time work centers, improve decision-making efficiency and quality, and provide strong technical support for offshore oil exploration.

5. Conclusion
This article analyzes the basic geology and oil reserves in the South China Sea and the Gulf of Mexico. In addition, comparing the policies promulgated by China and the United States in the oil and energy industry, the situation of oil service companies, the situation of oil and gas exploration and the situation of energy exploration equipment in the South China Sea and the Gulf of Mexico. This analysis shows that China's current deep-sea oil exploration and development at a disadvantage. The main reasons include the lack of geological exploration, lack of oil and gas exploration equipment, key technologies and backwardness. In view of the existing problems, this paper proposes four feasible suggestions aimed at accelerating the exploration and development of deep-sea oil in the South China Sea and promoting the orderly development of China's petroleum industry.

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