

# **A brief discussion on technological innovation and development direction of petroleum geological exploitation in the new period**

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**Abstract.** Petroleum as one of the main resources affecting the development of national economic construction, as a result of our country's social economic development speed in recent years, more and more population growth, the demand for petroleum energy is increasing, which directly affects the development of the petroleum industry pace, and brings great challenges for petroleum exploration and exploration. In the increasingly competitive market environment, in order to ensure the steady development of social economy, researchers focus on petroleum geological exploration technology, increase technological innovation, improve the efficiency of petroleum geological exploration, in order to provide technical support for economic development. On the basis of understanding the development status of petroleum geological exploration and development technology in the new era, this paper mainly studies the innovation content of commonly used petroleum geological exploration and development technology, and deeply discusses the development direction of petroleum geological development technology in the new era, so as to further promote the innovation of petroleum geological exploration and development technology.

**Keywords:** New period; Oil; Geology; Developing technology; Technological innovation.

## **1. Introduction**

In the oil production work, geological development technology is mainly used to identify the specific location of oil storage in our country, to clarify the distribution of oil storage in the ground, in order to provide information support for oil exploitation and application. Nowadays, China's petroleum geological exploration and development technology lacks innovation as a whole, and there is a big gap compared with developed countries, which directly hinders the economic development of China's petroleum production field. Therefore, in order to improve the work efficiency in the field of petroleum production, we must comprehensively innovate petroleum geological exploration and development technology to provide technical support for China's modern petroleum exploration and development work. In essence, petroleum geological development technology belongs to the professional field of geology. By observing geological changes and distribution, it can comprehensively understand the earth's constituent elements, various substances in space and the entire evolution process, and accurately obtain basic information such as resource burial, geological state and geological structure in a certain area. It can play an important role in the monitoring, prediction and response to natural disasters. Because there are great differences in the rock strata that constitute the crust, this difference will cause local changes in the underground space, so a comprehensive grasp of the distribution and change characteristics of these differences can orderly complete the petroleum geology exploration and development work. The development of petroleum geological development technology has a positive impact on the construction and

innovation of petroleum field, and is the key technology to determine the location of oil storage and obtain the information of oil storage.

From the current application of petroleum exploration and development technology in China, the specific problems are reflected in the following points: First, the dependence on the international market is too high. China as a very rapid developing country, most areas of development and resource supply are indispensable, and many industries need oil resources as support. However, because the total population of China is too large, the relative per capita share is less, and there is still a big gap between the development technology and the developed countries, it leads to the serious shortage of domestic oil production and over-dependence on the international market. Second, there is insecurity in international oil supply. Due to the large security risks during oil transportation, most of the oil resources from the east and middle regions are transported by sea, which increases the risk of the development of China's petroleum industry. Therefore, it is necessary to continuously improve and innovate the existing petroleum exploration and development technology and comprehensively improve the quality of oil production. Finally, oil exploration and development technology is not mature. Although China has rich material resources, but the current exploration and development technology is not perfect, which appears the contradiction between the development of resources and technology, which directly limits the development level of China's petroleum industry. At the same time, China's petroleum exploration and development technology is relatively backward, and the exploitation efficiency of petroleum energy is too low, which directly affects the stable development of social economy. Therefore, this paper mainly studies the innovation and development direction of petroleum geological exploration and development technology in the new era, in order to provide technical support for energy exploitation and application in the new era.[1-3]

## **2. Method**

### **2.1 Geophysical exploration technology**

In petroleum geological exploration and development technology, geophysical exploration technology occupies a very important position. The traditional seismic exploration technology includes three contents, the first is the reflection seismic technology, the second is the three-dimensional seismic technology, and the last is the exponential seismic technology. With the steady development of social economy and science and technology in China, computer technology has been widely used in the field of petroleum geological exploration and development, and the market has gradually emerged high-resolution seismic technology, reservoir seismic description technology and three-dimensional prestack depth migration technology, and these advanced technical means have brought higher efficiency and quality for petroleum exploration and development. With the continuous improvement of the level of social and economic development, the petroleum geology industry has higher and higher requirements for exploration and development technology, and the existing technical means have made excellent progress in data collection, data analysis, data processing, equipment manufacturing and other aspects. In order to further improve the level of petroleum geological exploration and development and effectively control production and development costs, domestic and foreign scholars have developed more advanced technical means, such as three-dimensional seismic technology, empirical technology and three-dimensional visualization technology. According to the analysis of the 3D seismic monitoring

technology flow chart shown in Figure 1 below, as one of the most commonly used technical means for petroleum geological exploration and development, it can be prepared to receive the required data information by selecting the start-up mode and message format. If the relevant information is received, it should be stored after identification, and the identification end sign should be presented to the system user. Use the software interface to present or update relevant data information.[4-6]

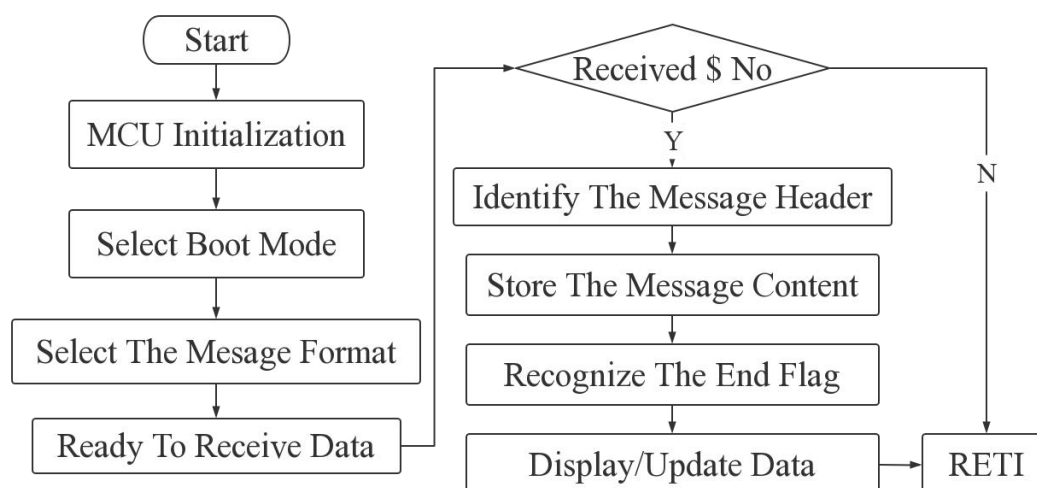


FIG. 1 Flow chart of 3D seismic monitoring technology

## 2.2 Logging Technology

With the rapid development of computer technology and electronic equipment technology, both have been widely used in petroleum exploration and development. By applying computer technology to data collection, data processing and data analysis in logging work, logging technology can be transformed from data type to imaging type, and the research and operation of imaging logging technology can improve the transmission speed of measurement data. Multiple downhole instruments are integrated during each downhole survey to expand borehole coverage and improve exploration depth and efficiency. At present, a large number of innovative logging technologies have been widely used in the field of petroleum geology, such as fast platform technology, casing technology and nuclear magnetic resonance technology, among which the most widely used is nuclear magnetic resonance logging technology, whose measurement accuracy and application speed have been recognized by technical personnel. Today, nuclear magnetic resonance instruments are divided into two types according to the way the RF field is applied in the NMR Pop-in experiment: one refers to continuous wave NMR spectrometer, and the other refers to pulse NMR spectrometer. From the perspective of practical application, the spectrometer has the technical standards as shown in Figure 2 below. The principles applied in the field of logging are as follows: Hydrogen nuclei have a large magnetic moment, and the water and oil in the rock pores are rich in hydrogen nuclei. After adjusting the emission frequency of the NMR logging instrument, the hydrogen nuclei in the oil and water can resonate, so as to accurately measure the amplitude and attenuation of the NMR measurement signal. The amplitude of the NMR signal is proportional to the number of hydrogen nuclei in the measured range, and the length of the decay time is determined by the size of the pores, the smaller the pores, the shorter the decay time.[7-9]

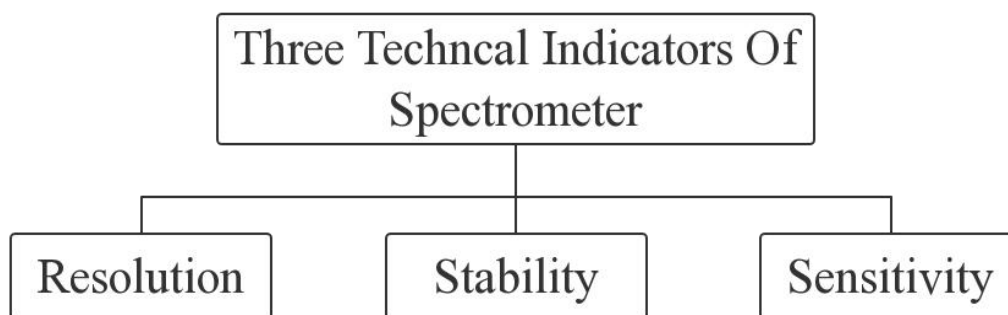


FIG. 2 Technical standard of spectrometer

### 2.3 Drilling Technology

In petroleum geological exploration and development, the cost of drilling accounts for 50% to 80% of the total cost, so how to control the cost of drilling is an important work to reduce the total cost. Nowadays, large oil companies around the world are focusing on advanced drilling technology, and the traditional drilling technology originated in Canada. The biggest advantage of underbalanced drilling technology is that it can reduce the damage degree of the bottom layer, improve the speed of drilling and development, and avoid problems such as omissions and delays. It is one of the effective methods to exploit depleted oil formations. However, more technical equipment needs to be applied during on-site work, and the requirements for technical safety and anti-corrosion are not perfect. Therefore, at present, more advanced technical means have been proposed in petroleum geological exploration and exploitation, such as ultra-deep well drilling technology, three-dimensional serious technology, multi-branch well drilling technology and visual drilling technology, among which the most widely used is multi-branch well drilling technology. According to the conclusion and analysis results of the technical level of multi-branch Wells at different levels in Table 1 below, it is the result of communication between the world's major oil companies and professional service companies, and the evaluation and analysis are mainly carried out according to the three characteristics of multi-branch Wells.

Table 1 Analysis results of technical level of multi-branch Wells at different levels

grade	1	2	3	4	5	6	6s
Interface support	Unsupported	Unsup ported	Mechanic al support	Cement support	Cement support	Casing support	Casing support

From the perspective of practical application, multi-branch drilling technology has the following advantages: first, it can effectively increase the production number of single Wells, and truly achieve the work goal of fewer Wells and high yield; Secondly, it is helpful to improve the fracture drilling rate and the longitudinal exploitation degree of oil and gas reservoir. Finally, the surface wellhead or offshore well trough continues to decrease, reducing the construction and application costs of the platform, reducing the cost of well management and environmental protection, and further improving the economic benefits of enterprise development.[10-13]

### 2.4 Computer simulation technology

For petroleum geological exploration and development, computer simulation technology is widely used, which can accurately predict the oil field situation in the region according to the global positioning technology GPS, comprehensively evaluate the amount of oil and gas contained in the

oil field, and simulate the operation directly on the platform through the computer-generated model after the measurement, and finally select the appropriate mining method. Lay a solid foundation for the next oil exploration and oil exploitation. According to the GPS flow chart shown in Figure 3 below, the exploration and analysis of the petroleum geology in the region can help the staff to accurately assess the potential oil resources, accurately and vividly understand the spatial layout and application characteristics of oil and gas resources, and then propose a scientific and effective exploration and development work plan, and finally quickly seize the initiative in the market. It should be noted that after collecting a variety of data, the staff should classify and process these resources according to the characteristics of objectivity, so as to facilitate subsequent application and maintenance.

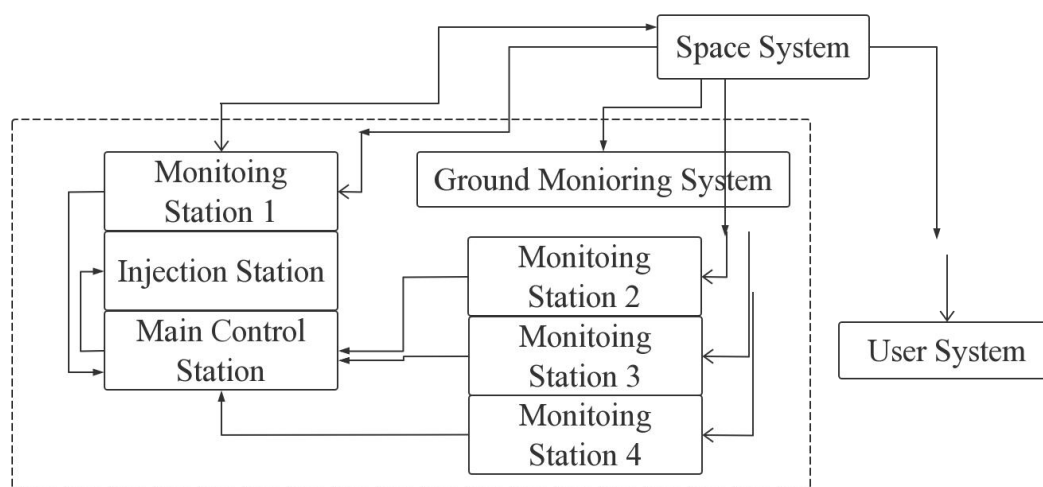


FIG. 3 Application process of GPS in petroleum geological exploration and development

### 3. Result analysis

Generally speaking, petroleum geological development technology will use the properties of rocks deep in the earth as the basis, by understanding the information of rock conductivity, density, permeability and elasticity, etc., to provide an effective basis for the next geological development. Nowadays, common petroleum geological development technologies include seismic exploration technology, electrical exploration technology, magnetic exploration method and well logging exploration technology, etc. According to the spatial location and region of petroleum geological development technology application, it can be divided into Marine petroleum geological development technology, aviation petroleum geological development technology and surface petroleum geological development technology. According to the development and application trend of geophysical exploration technology as shown in FIG. 4 below, different technical means are proposed at different stages, and different technical means have different operational characteristics. Therefore, it is necessary for staff to select suitable technical means according to the actual situation of the exploration area, so as to ensure that it plays an important role. At present, the innovative research on petroleum geological exploration and development technology has unique practical significance, and has a positive impact on improving the exploration quality, exploitation level and oil and gas production, so future scholars should continue to innovate petroleum geological exploration and development technology according to the development needs of petroleum geology

in the new era, so as to provide technical support for energy protection and economic development.[14-15]

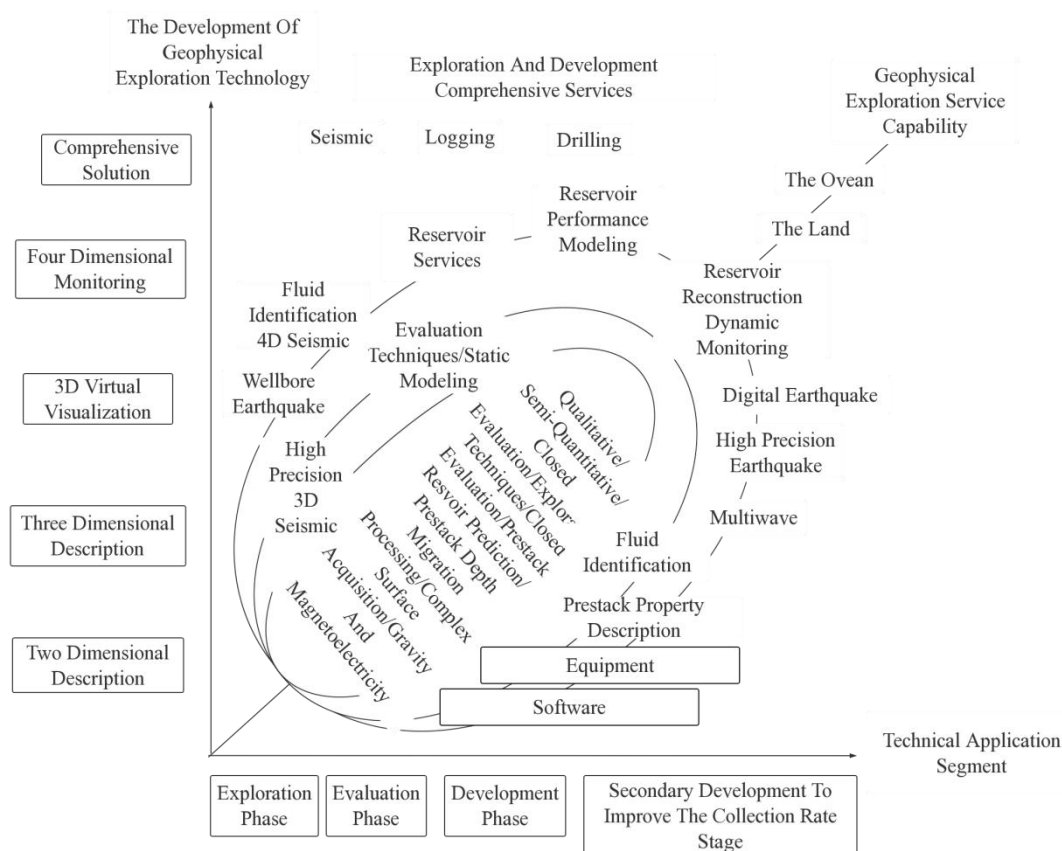


FIG. 4 Development and application trend of geophysical exploration technology

## Conclusion

To sum up, in the face of the current development trend of limited social oil resources and rising demand, China should provide rich experience capital and human resources while encouraging and supporting technological innovation, so as to improve China's oil and gas production and lay the foundation for the steady development of social economy.

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