Research on Application of Computer Technology in Petroleum Geophysical Exploration

Xiaoyu Feng
*Exploration and Development Research Institute of Daqing Oilfield Company Ltd.
Daqing, Heilongjiang, China, 163712

*Corresponding author e-mail: fengxiaoyu123@dqyt.cnpc.com.cn

Abstract. With the development of society, people’s demand for oil is increasing. Petroleum is a necessary resource for mankind, and the difficulty of geological exploration for petroleum resources has increased. In the geological exploration of petroleum resources, using geophysical exploration technology can improve the extraction efficiency and the quality of oil resources, this reduces the waste of oil resources to a certain extent.

Keywords: Petroleum Exploration, Geophysical Technology, Application Development

1. Introduction
With the development of society, the world’s demand for energy is increasing, petroleum has become one of the important energy sources for people's lives. International petroleum prices continue to rise, while our country is highly dependent on foreign petroleum. This phenomenon of high dependence on international petroleum is very detrimental to our national security and economic development. For this reason, improving petroleum and gas exploration technology is an important measure to ensure our country's oil safety [1].

2. Introduction of physical detection method software and hardware and detection method

2.1. Hardware and software part
In recent years, the equipment and instruments used in physical detection methods are mainly shown in Table 1. The software used for processing interpretation is shown in Table 2, mainly for some electrical, magnetic and heavy processing software.
Table 1. Main geophysical equipment

| Serial number | Equipment name         | Specification model | Production place |
|---------------|------------------------|---------------------|------------------|
| 1             | Gravimeter             | LCR, CG-3           | United States    |
| 2             | Magnetometer           | MP4, G-856          | United States    |
| 3             | Magnetotelluric        | V5-2000             | Canada           |
| 4             | Transient Electromagnetic Instrument | TDEM-67       | Canada           |
| 5             | Shallow Seismometer    | MARK6               | Sweden           |
| 6             | Geological radar       | CR-2000             | United States    |
| 7             | Ground penetrating radar | IDS               | Italy            |
| 8             | IP instrument          | PRS                 | Canada           |
| 9             | Dual frequency meter   |                    | China            |
| 10            | GPS                    | Trimble             | United States    |
| 11            | Total Station          | Nikon               | China            |
| 12            | Electrical method      | DZD-6               | China            |

Table 2. Geophysical prospecting electrical, magnetic and heavy processing software

| Serial number | Main software name                                                                 | Origin   |
|---------------|-----------------------------------------------------------------------------------|----------|
| 1             | LCT processing interpretation system                                              | United States |
| 2             | GMSYS processing interpretation system                                            | United States |
| 3             | MapGIS Geographic Information System                                              | China    |
| 4             | GMES Gravity, Magnetism and Electrochemical Processing                           | China    |
| 5             | Interpretation System                                                            | Australia|
| 6             | MGINV three-dimensional gravity and magnetic joint forward and inversion software  | United States |
| 7             | GeoToos processing interpretation system                                         | Canada   |
| 8             | Geosoft understanding sample software                                            | China    |
| 9             | MTIS processing interpretation system                                            | Italy    |
| 10            | Greswin2 radar processing system                                                 | China    |

2.2. Introduction to detection methods

Physical exploration of the earth is mainly divided into four types: ultra-shallow, shallow, medium-deep, and deep. The detection methods used in these four types are mainly: the main types of ultra-shallow layers are: geological radar technology and Two aspects of shallow seismic technology. The shallow layer is mainly divided into two methods: high-density resistivity and high-frequency electromagnetic imaging. In the middle and deep layers, it is mainly divided into two methods: electromagnetic detection with controllable sources and gravity measurement with precision. In the deep layer, it is mainly divided into three methods: high-precision magnetic measurement, natural magnetotelluric survey and deep seismic [2].

3. Application of some new algorithms and new theories in geophysical exploration

1) Carrying out the theory of geometric fractal. Fractal theory reveals the similarity of different scales between phenomena and objects in nature, and also reveals the similarity between the whole and the part, so the information on the surface and space can be Make predictions based on the information on the point. This method is mainly aimed at the study of irregular, unstable and relatively common phenomena in nature. Fractal dimension can also be called fractal dimension, mainly to describe the complexity.

2) Wavelet theory system. The analysis of wavelet theory is mainly based on the analysis of Fourier theory, and a new theoretical branch has gradually developed. This theoretical branch is
mainly suitable for numerical solution of difference equations in processing signals, data compression, imaging, wavelet Algorithms, and some data processing methods to improve resolution and signal-to-noise ratio;

3) Neural network calculation theory. This calculation method is a simulation of human brain thinking. Through the analysis and study of sample data, unprocessed data can be judged, and important parameters can be obtained by processing and calculating based on sample data;

4) Chaos theoretical system. The application of this theory is mainly in the description of nonlinear systems. It is closely related to the theory of fractal. There are also hierarchical basic scales between them, and there are also different scales. With the scaling law and similarity, at the same time, non-uniformity and difference assumptions also exist;

5) Geographical information system theory. This is a computer system. Wang Yao's application method is to output, query, manage, store and collect spatial data through the support of computer hardware and software, and apply it in geophysical exploration technology. The principle of geographical information system, the ability to quickly output, query and analyze data is also an important development direction in the future [3,4].

4. Specific application of geophysical prospecting technology

4.1. Physical exploration of energy
It is mainly for the exploration of natural gas and oil in difficult areas, comprehensive exploration for the entire basin, alternative seismic exploration for energy, and preliminary census. In the specific implementation of the above-mentioned petroleum exploration work, the magnetotelluric and high-precision gravity exploration technology was used to evaluate the blocks and detailed structures of each oil and gas area, and directly find out the oil and gas storage locations. Solve the difficult problem of oil [5].

4.2. Physical detection of metallic minerals
When detecting metal minerals, the main methods used are electrical and magnetic methods.

4.3. Physical detection of the project
With the rapid development of modern economy and the gradual prosperity of engineering construction, this kind of method is in increasing demand, and the fields used are wider. The main engineering projects used are the inspection of water conservancy projects, pipelines, railways and other constructions. The main detection methods used generally include shallow seismic, electrical methods, ground penetrating radar, etc.

5. Application of geophysical technology in petroleum exploration
Geophysical technology has been continuously developed along with the development of oilfields, from a single technical measure to a multiple combination of forms, which promotes the optimization of geophysical exploration methods. It has played a huge guiding role in petroleum exploration. Geophysical technology combines seismic technology, gravity method, magnetic method, and electrical method, comprehensively analyzes geophysical data, and obtains geological data information, drilling information, and test data to continuously meet the needs of petroleum exploration and development. With the continuous development of geophysical technology, a series of new technologies have emerged [6]. The use of three-dimensional seismic technology measures to obtain reservoir imaging data can provide more realistic information for rational interpretation of the stratigraphic structure and promote the development of geophysical exploration technology. Provide safeguard measures for the development of petroleum exploration.

5.1. Application of gravity exploration technology
The technical measures of gravity exploration are mainly based on the different density of the material composition of rocks and minerals in the earth's crust, which causes the difference in gravity, and the means of exploration. Compare and analyze the density of the rock being explored with the density of surrounding stratigraphic materials to clarify their differences. By measuring the gravity of the geological body and the surrounding rocks to obtain the difference, combining the geological data and other test data to explain and analyze the gravity anomaly, the rock structure of the oil and gas display can be found, laying the foundation for petroleum exploration.

5.2. Application of magnetic exploration technology and electrical exploration technology
The rocks or ore in the earth's crust have different magnetic properties, and different magnetic field strengths can appear. If abnormal geomagnetic conditions are found, the display of oil and gas can be judged. Using magnetic field strength testing equipment to find areas with abnormal magnetic field strength in the crust, combined with other exploration data, the existence of oil and gas can be explored [7].

Due to the different electrical properties of rocks and minerals in the earth's crust, the difference in electric and magnetic fields measured by testing instruments can be used to determine whether the oil storage rock or the stratum rock is present, and it is also one of the means of geophysical exploration.

5.3. Application and development of seismic exploration technical measures
It mainly uses artificially launched seismic waves, which have different vibration effects on the formation. When encountering different rock structures, reflected waves and refracted waves are returned to the ground. Through the analysis of various waves, the difference between oil and gas layers and conventional formations can be distinguished. Seismic exploration technical measures generally use seismic exploration instruments. The key technology is the interpretation and analysis of reflected waves and refracted waves. Differential treatment of underground strata with different elasticity. Seismic exploration instruments are used to record the waves propagating to the ground and apply various interpretation software. Interpretation and analysis can correctly judge the lithology of the formation and analyze the effective thickness and buried depth of the reservoir, which can become the main oil search method.

With the development of seismic technology, high-density seismic technology measures have emerged. High-density seismic exploration technology is one of the fine seismic exploration technologies. Geophysical exploration can be carried out through the channel density of small track spacing and high imaging, or the application of single-point receiving indoor digital combined high-density seismic technology can achieve more refined exploration research [8].

After the oil and gas field development enters the middle and late stages, high-resolution, small-amplitude structural identification technical measures are used to conduct structural technical research on thin and poor reservoirs. Through seismic exploration technical measures, the remaining oil can be effectively searched, and the remaining oil distribution law can be grasped to improve Contribute to the oil recovery factor. It can be seen that seismic exploration technology is not only widely used in the early stage of oilfield development, but also has a very good application effect in the middle and late stages of oilfield development.

5.4. Application of new technical measures for multiwave seismic
In petroleum exploration, the application effects of various geophysical technologies are different. The application of multi-wave seismic technology measures, the use of vertical and horizontal wave sources, the use of multi-component geophones, and the monitoring of wave component frequencies in various directions. Analyze the rock structure, lithology characteristics and oil and gas information of the formation to provide help. The application of multi-wave seismic exploration technology can make up for the problem of insufficient longitudinal wave imaging, increase the accuracy of reservoir prediction, increase the ability of fluid identification, and accurately evaluate the physical properties of fluids in the formation, providing a reasonable exploration and development of oil and gas display Reliable seismic data. Improving the exploration effectiveness of low-permeability reservoirs has laid the foundation for the effective development of low-permeability reservoirs [9,10].

6. Conclusion
With the development of science and technology, the application of geophysical detection technology has gradually become more extensive, it gives full play to its advantages, which improves the level of oil exploration, and it also promotes the development of petroleum exploration work.

References
[1] Yuan Xiaoying. Application research and exploration of computer technology in petroleum exploration [J]. Information Systems Engineering, 2018:116.
[2] Zhang Lei. Research on the application of computer technology in petroleum exploration [J]. China New Communications,2014:71.
[3] Dong Zhigang. Research on Application of Computer Network Technology in Petroleum Exploration and Development [J]. Computer Knowledge and Technology,2016:48-49.
[4] Xie Tianhu. Application of computer network technology in petroleum exploration and development [J]. China New Technology and New Products,2012:49.
[5] Li Tao. Application and development of geophysical technology in petroleum exploration [J]. Chemical Engineering Design Communication,2017
[6] Hu Zeyang. Application and development of geophysical technology in petroleum exploration [J]. China Petroleum and Chemical Industry Standards and Quality,2014:145.
[7] Lv Xinxin. Research on application of geophysical technology in coalbed methane exploration [J]. Inner Mongolia Coal Economy,2017
[8] Zhang Jianren. Discussion on the application of geophysical exploration technology in oil and gas exploration and development [J]. China Chemical Industry Trade,2017
[9] HU Lin. Research and application of petroleum exploration technology based on high performance computing [J]. China New Communications,2016:100.
[10] Zhang Han. Research on the development and application of geophysical exploration technology [J]. Science and Technology Communication,2013:128-129.