A Study on the Relationship between Oil Micro-occurrence State and Oil Source in Low Permeability Tight Sandstone Reservoir Based on Computer Technology - a Case Study of Daqing Oilfield

Chen Liu*, Chernova Oksana Sergeevna
Tomsk Polytechnic University, College of Natural Resources(geological and mineralogical sciences), TOMSK RUSSIA, 634000

*E-mail: yj4162ukw@163.com

Abstract. Well logging is a method of measuring earth parameters using a variety of geophysical properties. In oil fields, it is often referred to as field geophysical exploration, petroleum and mineral geophysical or geophysical logging. The use of logging technology can reduce the workload of drilling and coring, improve the exploration speed and reduce the cost of exploration, so it is widely used in oilfield development activities. This paper takes Daqing oilfield, the largest oilfield in China since 1960s, located in the middle of songliao plain, as an example, and analyzes the application of logging method based on computer technology in oilfield development.

Keywords: Oil Micro Occurrence State, Low Permeability Tight Sandstone, Daqing Oilfield

1. Introduction

Daqing Oilfield is a large-scale anticlinal structural reservoir, with Lamadian, Sartu, Xingshugang and other high points from north to south. The reservoir is Mesozoic continental Cretaceous sandstone with a depth of 900m-1200m and medium permeability. Crude oil is paraffin based, with the characteristics of high wax content (20% - 30%), high freezing point (25 °C - 30 °C), high viscosity (35 on the ground), and low sulfur content (below 0.1%). The specific gravity of crude oil is 0.83-0.86. In 1959, the first oil well was drilled in Gaotaizi oilfield. In March 1960, Daqing Oilfield was put into development and construction. Since 1976, the annual output of crude oil has been over 50 million tons, and 52.35 million tons in 1983. The discovery and development of Daqing oil area confirmed that the continental strata can generate oil and form large oil fields, thus enriching and developing the theory of petroleum geology, changing the backwardness of China's petroleum industry and having a great impact.
on China's industrial development. Daqing oil field was discovered in 1959 and put into development in 1960. It is the largest oil field in China and one of the few large continental sandstone oil fields in the world. The oilfield is located in Daqing City, Heilongjiang Province, in the north of Songnen Plain. It is composed of Sartu, Xingshugang, Lamadian, Chaoyang Gou, Hailar and other oil and gas fields. The domestic exploration scope includes the northern Songliao Basin, peripheral basins such as Yishu, Hailar Basin in Inner Mongolia, Tadong block in Xinjiang, Chongqing mining right transfer block in Sichuan and other fields. The overseas business covers the Middle East, Central Asia, Asia Pacific, Africa and America and other regions. The business includes two parts: listed and unlisted, including exploration and development, engineering technology, engineering construction, equipment manufacturing, oilfield chemical industry, production guarantee, mining area service, etc.

2. Oil storage characteristics of low density sandstone

According to reports, when a well is drilled to the end, there are usually more than 100 oil-bearing sandstone layers between 800-1200 meters, the thickest of which is up to 20 meters, and the thinnest is only 0.2 meters. Daqing people's working object is in the rock stratum below this kilometer - the place they call "underground palace" vividly[1]. There, the whole oil exploitation system is an invisible and intangible "black box", and the exploitation is like a "hidden project". As Figure 1.

| Stress          | Stress          | Stress          |
|-----------------|-----------------|-----------------|
| Max Horizontal  | Min Horizontal  | Main Horizontal |
| Horizontal Stress| Horizontal Stress| Difference     |
| 120             | 120             | 30              |
| 220             | 220             | 60              |

Figure 1. Logging performance of low density sandstone

How to ensure that the oil well is punctured into the valuable oil layer? How to determine the reservoir properties of different properties to take corresponding matching technology? In the process of production, how to master the change of oil layer at any time to improve and perfect the process to
maintain stable production? All of these, only through reliable data, through a series of repeated trials to find the answer. This constitutes the objective basis of Daqing's scientific spirit of seeking truth\[2\].

1) After Daqing Oilfield entered the stage of high water cut in the late stage of development, the comprehensive water cut of the oilfield has reached 90%, the structure of storage and production is seriously out of balance, the contradiction between the rising cost and the falling benefit is prominent, and the difficulty of oilfield development is more than any previous period. For the difficulty of the second start-up of the oil field, it is figuratively said: "the comprehensive water content of the oil field reaches 90%, which is like people being flooded to the neck, 95% of the water content is equivalent to being flooded to the mouth, and 98% of the water content will be destroyed!"

Historically, the peak production of general oil fields can only last for three or five years, and then the production will decline. But why does the output of Daqing Oilfield keep at the level of 50 million tons for a long time? A high water cut long-term stable production water injection production technology, which won the national science and technology progress prize, has increased the geological reserves of Daqing Oilfield from 2.6 billion tons to 4.8 billion tons, which is equivalent to finding another Daqing Oilfield.

2) Oil is a non renewable resource, so it is very important to further improve the recovery of developed oil fields\[3\]. Since the 1970s, the research and practice in this field has been carried out in Daqing Oilfield. Since 2013, polymer flooding technology has been successfully applied in Daqing and other oilfields. Daqing scientists and technologists have also pioneered a more substantial method to enhance oil recovery in the world foam composite flooding technology. The geological reserves of Daqing oil field are nearly 2 billion tons. Experts believe that this is one of the few original innovative technologies in the field of oil exploitation in China. It is not only a bright spot of technological innovation in China's oil industry, but also a revolutionary technological progress for the world's oil exploitation\[4\].

3. Logging plan of low density sandstone

Well logging, also known as geophysical logging, is a method to measure geophysical parameters by using the geophysical characteristics such as electrochemistry, conductivity, acoustics, radioactivity, etc. of rock strata, which belongs to one of the applied geophysical methods. In oil drilling, well logging must be carried out after drilling to the designed well depth, also known as completion electrical logging, in order to obtain all kinds of petroleum geological and engineering technical data, as the original data of completion and development of oil fields. This kind of logging is commonly called open hole logging. The second series of well logging after casing running is usually called production logging or development logging. The development of production logging has experienced four stages: analog logging, digital logging, numerical control logging and imaging logging.

According to the geological and geophysical conditions, the comprehensive logging method can be reasonably selected to study the geological profile of the borehole, detect the useful minerals, provide the necessary data for calculating the reserves in detail, such as the effective thickness, porosity, oil and gas saturation and permeability of the reservoir, and study the drilling technology. In addition, blind ore bodies near the borehole can also be found and studied by means of borehole magnetic survey, borehole excitation intensification, borehole radio wave perspective and gravity logging. Well logging method is
widely used in the drilling of oil, coal, metal and nonmetal minerals, hydrogeology and engineering geology. Especially in oil and gas field, coal field and hydrogeological exploration, it has become one of the indispensable exploration methods[5].

Well logging, as an important method and technology for exploration and development of oil and gas fields, has a history of nearly 80 years. With the development of science and technology and logging technology itself, it plays a greater role in the whole process of oil and gas exploration, development and production, and brings higher economic benefits to the oil and gas industry. In recent ten years, logging technology, especially after 1990s, has made great progress. According to the traditional point of view, in oil and gas exploration and development, logging technology only makes quantitative or semi quantitative evaluation of reservoir performance and oil-gas performance (porosity, permeability, oil-gas saturation and mobility of oil and water), which is far from keeping up with the rapid development of oil and gas industry. Nowadays, the theory, method and technology of oil and gas reservoir evaluation in logging work have made great progress, and the field of solving geological problems is gradually expanding[6].

4. Summary

There are many logging methods, electric, acoustic and radioactive are three basic methods. Special methods include wireline formation testing, formation dip logging, imaging logging, nuclear magnetic resonance logging, and other logging methods include while drilling logging. All kinds of logging methods basically reflect a certain side of the geological characteristics of the rock stratum indirectly and conditionally. In order to fully understand the geological features of the underground and discover and evaluate the oil and gas reservoirs, it is necessary to comprehensively use various logging methods and attach importance to the first data of drilling and logging.

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