Characteristics of water flooded layer in Minghuazhen Formation

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Abstract: In the process of oilfield exploitation, the water-flooded layer in the Minghuazhen Formation cannot be accurately identified, which has a great impact on the oilfield exploitation efficiency. If the water-flooded layer marker in the Minghuazhen Formation cannot be fundamentally defined, the oilfield may not be able to carry out normal exploitation operation. Based ON this, THIS PAPER expounds the basic characteristics of oil accumulation in the water-flooded layer of Minghuazhen Formation, puts forward the characteristics of the water-flooded layer, and analyzes the factors of low resistance for reference.

Key words: Oilfield Minghuazhen Formation; Water flooded layer; Characteristics analysis

1. Introduction

Once the reservoir is in service, it may be exposed to production water or groundwater from the reservoir, which can lead to waterflooding and formation of flooded zones. In order to maintain a stable reservoir pressure in the subsurface and generate sufficient fluid from the well, oil fields usually inject water into the Wells surrounding the production well after production, forming a pressurized network of production Wells. This measure of "filling oil" is the supplement of formation energy and plays an important role in improving production well productivity. However, water injection cementing measures have some modification effect on the original rock. Lead to changes in the content of material, electricity and oil and gas in primary strata. Therefore, the characteristics of water-flooded layer in Minghuazhen Formation should be further analyzed.

2. Overview of water flooded zone in oil field

In order to increase the recovery rate of oil fields, water injection is now a common way to produce oil fields, as shown in the following figure:

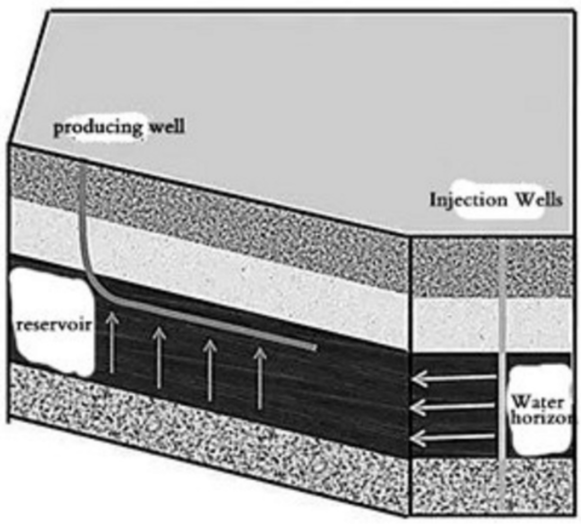

Figure 1: Schematic diagram of oilfield water injection

When the oil field is flooded, the physical properties of the deposit will change. Permeability, oil removal efficiency, resistivity, oil-water distribution, porosity, moisture, and temperature will vary. The quality of flooded layer is also affected by floods in different periods. Upon flushing, clays and clays degrade the formation. The saturation of bound water decreases with the increase of mean particle size. In some highly heterogeneous reservoirs, pumping methods, rates, and techniques vary due to uneven permeability and porosity. This process is mainly done by injecting water into highly permeable areas, which is very rapid. When the oil in the pore space is almost completely purified, most of the oil is mainly stored in the weak permeability zone. In the oil injection industry, oil removal is most common in large fractures, while large amounts of oil are retained in smaller Wells.

Therefore, areas with low porosity and low permeability become "potential reservoirs" for high oil production [1].

3. Basic characteristics of oil accumulation in water-flooded layer of Minghuazhen Formation

With the long-term development of the deposit and the continuous movement of water injection into the deposit, some changes have occurred which are obviously different from the original state of the stratum. Its main features are as follows:
(1) Increase the saturation of water. With the increase of flood intensity, the initial critical water saturation (equivalent to correlation saturation) gradually increases to any maximum value. (2) Change the physical characteristics of the layer. Flushing water washes or fills the clay on the surface of sandstone or sandstone particles, thereby increasing the pore radius (mainly the pore size). As a result, permeability increases significantly after extensive washing. At the same time, the water content of the rock changes, the hydrophilicity becomes hydrophilic, and the saturation index n also changes. However, flooding can also cause some clay minerals to swell, clogging pores and reducing the permeability of the producing formation. In general, water injection increases porosity; (3) Formation resistivity variation. At the beginning of filling, the collector resistivity decreases with the increase of water saturation. (4) The distribution of inundation area is closely related to the sedimentary rhythm. The upper part of the museum is the Yun dam and the point bar. When water is squeezed, a large channel is formed in the lithologic part of the lower reservoir, leading to local early water injection. (5) Reservoir inhomogeneity causes flooding and the difference between them. Due to the difference of reservoir material properties, reservoir heterogeneity is caused, and channels are formed in the middle and high strata of the reservoir, while residual oil is relatively abundant in the low-permeability parts and thin ground layers [2].

4. Characteristics of water flooded layer in oil field

4.1 Petrological characteristics

The core of Minghuazhen Formation is siltstone and fine sandstone, and the main mud is cement. Due to the relatively new age, shallow burial depth, less compaction and consolidation, the rock is relatively free. The latent layer is mainly composed of fine grained and medium grained sandstone with good separation and high structural maturity. This group of sands has many lenses with flat distribution, limited dispersion, large thickness variation and high heterogeneity. Analysis of rock logging data shows that the oil and gas in the reservoir are mainly fluorescent. Petrology has a certain correlation with gas. The higher the sandstone thickness, the better the oil and gas. And vice versa; The lower the shale content, the better the performance, and vice versa. The analysis of rock mineral composition shows that the average content of cement in underwater sandstone is 28.3%, of which clay cement accounts for 86.4% and calcium 8.1%. The content of clay cement depends on burial depth and decreases from top to bottom. The analysis of minerals in clay cement shows that these minerals are divided into illite, kaolinite, chlorite and illite/lignite mixture. The statistical analysis shows that clay minerals are mainly mixed line and kaolinite, accounting for 73.8% and 14.3%, respectively. In the mixed layer of montmorillonite, the average proportion of overall mixing is 81.2%.

4.2 Physical characteristics

The data of rock pore permeability test show that the reservoir porosity of Minghuazhen Formation ranges from 9.2% to 42.5%, with an average of 33.2%. The average pore size of 7.56μm permeability coefficient varies greatly, generally between 10x10-3μm~2~7500×10μm², the average permeability is about 500x10μm², heat collection performance has high, medium pore and high permeability. Generally good, the porosity is generally more than 30%, the permeability is generally more than 300×10.3μm-2, the porosity and permeability are relatively high. The analysis shows that the porosity types of sedimentary sandstone are mainly primary fractures, and the secondary porosity is small. The larynx is mainly composed of plates, layers and tubes. The physical and physical properties of the Minghuazhen Formation have two characteristics: with the increase of sedimentary depth, the physical properties of the rocks change; With the decrease of shale content, both shale quality and quality have a positive physical tendency to decrease. The analysis of the relationship between sandstone permeability and shale content shows that with the increase of shale content, the permeability value gradually decreases from high to low, and the decreasing trend is obvious. It can be seen that shale content has a great influence on the physical properties of water-flooded layers in Minghuazhen Formation [3].

4.3 Log characteristics

During the development and exploitation of oil fields, the curve logging data are mainly affected by the following factors: the oil content and water content of the reservoir change with the change of the exploitation degree; Formation salinity changes with the change of water; The physical and chemical properties of rocks vary with the amount of water under hydraulic impact. The vertical pressure of a well depends on the irregular pressure in the reservoir. These factors mainly reflect the changes of spontaneous potential, resistivity, acoustic wave propagation time, density, PFT and C/O ratio. The deeper the development of the deposit, the higher the degree of mineralization of the deposit, the higher the total salt content in the pore, and the higher the irrigation amount. However, this rule does not exist when the irrigation water is fresh. When water enters a certain level through chemical reactions such as ion exchange, mineralization is reduced. Due to the increase of water supply, the reservoir rocks are affected by different degrees of water, and the porosity structure of the reservoir changes to a certain extent, so as to improve the permeability and porosity of the reservoir. When water does not flow in, the pressure in the flooded layer is relatively lower. However, vertical formation pressures must be different due to the limitations of the use of collection nets, sandstone petrology, and existing enclosed emissions. The pressure coefficient of the original formation is higher than that of the sedimentary layer. Neutron gamma logging uses neutron gamma radiation to measure the amount of hydrogen and helium in the formation. As the amount of water injected increases, so does the mineral and chlorine content of the aquifer. The gamma-ray measurements of the seeds will also increase proportionally to the size of the unsubmerged collector.

4.4 Distribution law of water-flooded layer

Extensive geological research and production practice at home and abroad show that submerged strata do not mean that the entire strata have no potential. On the contrary, determining the distribution pattern of the submerged layer is very important for predicting the remaining oil distribution. The comprehensive analysis of more than 20 oil Wells in an oil field shows that the latent layer in the plane is mainly distributed in the well network development area. Only a few are new or incomplete; The remaining LPG in submerged formation is mainly distributed at the "waterline", which is the main direction of water injection. Therefore, accurate analysis of the waterline injection direction of the production well pattern is very important to determine the distribution pattern of the latent layer. From vertical aspect, there are obvious urban sinter inundation strata in this oilfield, which are mainly concentrated in the oil well section with settlement depth less than 1400 meters, showing the characteristics of surface inundation. In sand, water deposits are widely distributed at the bottom of rhythmic sandstone strata. The analysis shows that scintillation strata are mainly formed in fluvial sediments. The rock at the base of these rocks is usually well separated and has a high degree of structural maturity. The physical properties are generally high porosity and high permeability. The results show that high porosity, high reservoir permeability and good permeability are prone to the formation of flooded and submerged layers. Therefore, the distribution of submerged strata is closely related to petrology and sedimentary factors.

4.5 Logging mode characteristics of flooded layer

In order to interpret the flooded zone log, multiple factors become more and more difficult as the drilling depth deepens. Pool logging interpretation: During the pouring process, the moving oil is washed away by water, but in some places, even after pouring, the moving oil is not washed away, but only "washed away". Therefore, mineral saturation is an important criterion to evaluate the degree of submergence and mineral saturation. The residual saturation and correlation saturation can be measured by analyzing the liquidity problem. (1) The theoretical approach to fluidity analysis is based on the dynamics of mixed liquids, allowing the sum of fluid flow rates in the reservoir from different phase drift equations. Under constant differential pressure, the oil, gas and water contents and their industrial properties are determined by phase permeability, permeability profile and liquid properties. It's all about effective penetration. Each phase liquid is measured in terms of the volume of the rock, which depends on the viscosity, humidity, and porosity of the rock; (2) With the help of natural potential, the unevenness and filling degree in the formation are also very uneven, and it is easy to deviate from the base naturally. The main cause of the potential baseline shift is local salinity variation due to drainage and desalination. The base shift is determined by the formation salinity ratio before and after pouring. This process is mainly an ion exchange between water injection and melting, so the formation resistance increases accordingly. Due to the low permeability of the formation, the ion exchange time is prolonged. The closer the ion exchange rate is to the reservoir, the faster the transmission speed of the potential bottom to the reservoir is. Advanced carbon and oxygen recording methods are based on the principle of fast inelastic neutron scattering. In this method, the neutron source is a controlled neutron accelerator that forms high-energy neutrons through hydrogen-sensitive reactions.

5. Low resistance factor analysis

Based on the study of low resistance deposits in other areas, the causes of low resistance deposits are analyzed. Geologists usually attribute the low resistance of a stratum to rocks. There are two "internal causes", such as porosity and hydraulic properties, and three "external causes", such as formation distribution in adjacent layers, formation salinity and drilling fluid properties. In the context of the formation of large areas of sedimentary layers and oil reservoirs, low resistance oil reservoirs may be formed in areas with low fluid dynamic capacity, low amplitude and low oil saturation [4].

5.1 Internal factors

The low resistivity of Minghuazhen Formation has two internal factors: (1) High lithology fineness, high clay content, more clay minerals, and high formation rate of bound water, which lead to the increase of rock conductivity and the decrease of formation resistivity; In particular, the logs show a decrease in the natural gamma potential relative to the aquifer, while the resistivity between the normal formation and the aquifer increases by less than a factor of two. This is caused by the formation of low resistance reservoirs in the area; 2) The relatively weak material and complex pore structure means that the total oil content is reduced, resulting in lower reservoir resistance.

5.2 External factors

The three external factors leading to low resistivity of Minghuazhen Formation are as follows: (1) weak reservoir. In formation logging, due to the limited vertical resolution of the logging instrument, the logging value is affected by the upper and lower layers (clay or aquifer), resulting in low formation resistance. Considering that sediments in curved rivers are easy to form thin reservoirs, this is also one of the main reasons for the formation of low specific oil-resistant reservoirs in this area. (2) In areas with small tectonic amplitude, reservoirs are low in height and easy to form in the same reservoir. The resistance of the formation depends on the aquifer, resulting in low resistance; There are many oil, gas and water systems in the west flank of Port of Spain oilfield, and the separation of oil and water is not uniform. The local development of the same reservoir is one of the reasons for the low resistance. (3) For drilling reasons, some Wells use high-conductivity saline solutions. As it enters the formation, the resistance of the formation decreases.

5.3 Conclusion analysis

From the above analysis, it can be seen that the distribution of the Minghuazhen Formation with low resistivity is largely related to sedimentary factors such as petrology and sedimentary environment. The analysis shows that the sedimentation of Shimminghua Formation is fluvial curve deposition, the reservoir is positive circulation, and the recombination of sedimentary cycle is mainly heterogeneous. The distribution of KMG low resistivity strata is related to the sedimentary period. In the upper part of the positive circulation and the bottom of the reflux, due to the thin sandstone layer and thin rock, the shale content is relatively increased, and the bound water is more saturated, forming the stratum with lower specific resistance [5].

6. Conclusion

In a word, the following conclusions can be drawn from the analysis of water-flooded layer characteristics of Minghuazhen Formation in the above oilfield:
(1) There is a nonlinear relationship between water saturation and resistance, and an inverse relationship between resistance and humidity; (2) The curves of spontaneous potential and induced resistance of submerged layer changed obviously;
(3) Use low salinity dielectric logging to measure oil content.
(4) For Wells with uncertain formation salinity, formation saturation can be obtained by carbon and oxygen logging to determine water flooding and water flooding levels;
(5) RMT measures the reservoir mainly through two models to assess the degree and nature of the flooded layer.

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