Study on oil-water interface of Budate fracture reservoir in each block of Suderte Oilfield

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Abstract. It is well known that in addition to bound water in the reservoir, formation water mainly exists in the form of edge water and bottom water. Fractured buried hill metamorphic rock reservoirs are generally bottom-water reservoirs. In fractured reservoirs, rock blocks are cut by fractures and oil and water are distributed in fractures. Due to the low capillary pressure of fractures, the oil-water transition zone is also small. In the same fault block, there is relatively uniform oil-water interface. And oil-water interface to judge correctly or not will directly related to the determination of oil-bearing area and effective thickness division and well placement, thus correctly determine the position of the oil-water interface of oil field development is of great significance, through the variation of oil-water interface also presumably or some guidance on the seismic section can't precisely divide the small fault.

Key words: Buried hill oil-water interface.

1. Introduction
Budate reservoir in Suderte oilfield is a fractured and karst cave type reservoir, which is horizontally divided into eight blocks. According to the current research, the bottom water of four blocks has been seen, while the bottom water of other blocks has not been seen yet. Because the geological structure of Suderte oilfield is very complex, the large fault block is cut into many small fault blocks due to the existence of faults, which leads to one or several different oil-water interfaces in the same large fault block. In addition, faults which cannot be determined in seismic profile can also be pushed back by accurate oil-water interface. The most direct and effective method is to determine the oil-water interface by using oil test data. In the early stage, the oil-water interface is mainly determined by exploration and evaluation well, but it has certain limitations to judge the oil-water interface by using a single exploration and evaluation well because of the large control range of exploration and evaluation well and the relatively large perforation horizon span. In this paper, oil-water interface and oil-water interface uplift are determined based on the data of exploration and evaluation of well test and the dynamic changes of water cut of the oil Wells in operation, which provides a certain basis for the division of effective thickness of the oil Wells in later production and whether some slow drilling can be completed.

2. Fault sealing
The Budate group of Suderte oilfield is a metamorphic sandstone reservoir with abundant dual porosity and fractures, and the faults are extremely well developed. The fractures are mainly caused by the unified stress field during the formation of the faults and the derived stress field caused by the relative dislocation of the two plates during the fault action, so the fractures of the Budate group are also extremely well developed. For block-fractured reservoirs, there is the same oil-water interface in the same fault-block reservoir, but the underground structure is very complicated in practice, and there are often several oil-water interfaces in the same fault-block. Suppose in a hydrocarbon migration, after the entire block has the same oil-water interface, then for some reason makes two fault block edge is not closed, for secondary hydrocarbon migration, and as a result of the central fault closed, so in the same block formed different oil-water interface, for example well1,well2,well3,well4 reflect the same in different small fault block reservoir oil-water interface, all have independent oil-water interface; Wells A,B and C pass through different small reservoirs and reflect the transition zone between the two reservoirs. Wells 42-1 reflects the oil-water interface of the two reservoirs. In the blocky reservoir, oil and water co-produced in the upper part, while pure oil layer or oil and water co-produced in the lower part with thicker interlayer. Assuming that the central fault is not closed, Wells 2 and B will produce water from the upper part and oil from the...
lower part. Examples of the above situations have occurred in Sudert oilfield. Based on FIG. 1 and FIG. 2, this paper analyzes and speculates the oil-water interface of fractured reservoir of Budate Group in each block of Suderte Oilfield.

3. oil-water interface analysis

3.1 Analysis of Oil-water interface in Budate fault Block bei16:

3.1.1 Structural characteristics

The top structure of the Xing'anling Group and Budate Group was explained by suderte structural belt in 2004. The top structure of the Budate group in De1 fault block is a fault block surrounded by faults on three sides. The top structure of the Budate group in De1 fault block is a nearly east-west fault-uplift belt, and the high parts of the uplift are in De1 and De2. The first line of well 2 is northeast, and the high point is about -1075m above sea level. After drilling the development well, the structure of the top surface of budate Group was reinterpreted. De1 fault block is a fault block surrounded by faults on three sides. Within the fault block, an NE to NE chevron fault cut into three small fault blocks, among which the two small fault blocks close to the large fault in the north are closed independent fault blocks, and the southern fault block opens to the southwest. There are three Wells in the north west fault block, De3, Bei1 and Bei2. Within the fault block there is a nearly north-south trending fault ridge, high in the middle, lower to the west and east, and the high point is in the Bei2 well area in the east is a negative structure construction; there is only one well Bei3 in the eastern fault block in the north, and there is a nose-breaking machine in the fault block that always dips southward. The main body of the southern fault block is a nose-breaking structure that dips southward. According to the drilling data, the BIII term plane structure map is drawn. According to the map, the structural high point of the western fault block in the north is still in the Bei1 well area, which is a broken nose structure dipping south and east, and the eastern wing is a slope dipping east. The NE fault block is an eastward dipping monocline. The southern fault block is a broken nose structure that dips southward.

3.1.2 Distribution of oil and water

Budate buried-hill reservoir in Block De1 is considered to be a massive bottom-water reservoir at present. According to the oil test data, it can be seen that the oil and water distribution of fault block De1 is oil-loading and water entering, and the energy of edge and bottom water is sufficient, among which De4 shot 14.5m from 19333.0-1947.5m. The average daily water test was up to 106.8m3.

3.1.3 Development of fractures

According to the coring data of Well De1, the Budate oil layer is extremely well developed, with an average of 14 fractures/m and a maximum of 24 fractures/m (Table 2-2). It can be seen that microspheres in some sections of Budate oil reservoir in De5 are obviously smaller than dual direction finding and have obvious inverse display, and the acoustic time difference curve shows cycle jump phenomenon, the density and neutron curve are abnormally low, and the fractures and holes are abundant.
Table 1. Reservoir fracture parameters of Budate Group in well De1

<table>
<thead>
<tr>
<th>Serial number</th>
<th>Well section (m)</th>
<th>Thickness (m)</th>
<th>Number</th>
<th>Density (crack/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1777.0</td>
<td>1818.0</td>
<td>41</td>
<td>674</td>
</tr>
<tr>
<td>2</td>
<td>1818.0</td>
<td>1823.5</td>
<td>5.5</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>1823.5</td>
<td>1875.0</td>
<td>51.5</td>
<td>637</td>
</tr>
<tr>
<td>4</td>
<td>1875.0</td>
<td>1881.0</td>
<td>6</td>
<td>42</td>
</tr>
<tr>
<td>5</td>
<td>1881.0</td>
<td>1891.0</td>
<td>10</td>
<td>82</td>
</tr>
<tr>
<td>6</td>
<td>1895.0</td>
<td>1906.0</td>
<td>10.5</td>
<td>251</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td></td>
<td>124.5</td>
<td>1699</td>
</tr>
</tbody>
</table>

3.1.4 Reservoir connectivity

Through the pulse interference well test, the fracture connectivity of De1 fault block is very good. In 2005, the pulse well test was carried out with the self-gusher well De1 as the excited well and the self-gusher well De5 as the reaction well. The distance between the two Wells is 1118 meters. 27 Wells of the exciting cycle. The periodic fluctuation indicates that Well De5 is connected with Well De1, and the time delay between them and the agonist well is 73.60h, the force response amplitude is 0.0448685MPa (Figure 2-2).

Fig. 3 Interpretation results of pulse interference well test

3.1.5 Production status

In October 2005, all the 8 development Wells in fault block De1 were put into operation. Excluding the inter-pumping well De2 well and high-containing well Bei3, the average daily output of liquid was 36.1t, the daily output of oil was 31.7t, the water cut was 12.1%, and the flow pressure was 13.75MPa. After one year of elastic exploitation, the daily output of fluid was 27.0t, and the flow pressure was still 8.70MPa.

3.1.6 Analysis of Oil-water interface of each fault block

The Budate buried-hill reservoir in block De1 is a massive bottom-water reservoir. The Reservoir is divided into three parts by a large fault in the middle. There is no unified oil-water interface in the whole area, but the same fault block basically has a relatively unified oil-water interface. Therefore, it is considered that the oil-water interface of this fault block is above the perforation top limit of this well or there is no oil layer in this fault block. There are three Wells in the north west, and the oil-water interface is about 1915m by comprehensive analysis. A total of 7 Wells in the south (among which the appraisal wells De4 and De6 have been used as water well injection in Xing’anling of Bei16 main block) were preliminary analyzed the oil-water interface is located between 1980 and 2050m, with an average depth of 2015m. There is obvious dynamic and static discrepancy between De2, which should be further studied in geology (Table 2).

Table 2. Statistical table of oil-water interface of fault block De1

3.1.7 Conclusions and Suggestions

(1) Through the current production data can be seen that the north west fault block oil-water interface has been handled by about 1915m in the early rise to about 1833m, up nearly 80m so, the oil-water boundary is close to or reach Bei1 perforation bottom, at this point if this well for large production will form water cone, causes water to rise faster, so this well should not be adjustable Large parameter production.

(2) De5 when testing in the bottom water layer, at the beginning of the production of the Inter-layer interference has been no water, with declining formation energy, and upper reservoir cannot suppress lower water layer, lead to water cut rising, due to the perforation layer 1 and layer 2 176m of interlining, in order to control water cut increase, keep the formation energy, suggest to lower 2052.0-2128.0 m for water shutoff.

(3) The perforating top boundary of well De3 is above the oil-water interface, so the water injection intensity must be controlled to prevent the injection water from forming flow check along the fracture, leading to premature and rapid flooding of the oil well. This has been fully taken into account in the injection scheme.

(4) Due to the obvious dynamic and static differences between De2 and Bei3, preliminary analysis suggests that De2 is a single block or on the same fault block as Bei3. In that case, since there is no oil well connected to it, De2
should not be designed as an injection well. If it is
designed as a water well, it is necessary to study the fault
distance and water injection at the bottom of the fault. If
it is completely disconnected, the surrounding oil wells
will not be affected. It is considered that the geology
should be further studied.

(5) It is suggested to drill observation wells in favorable
areas to study the uplift of the oil-water interface.

(6) Once the fractured oil reservoir after water
breakthrough in oil and water phase viscosity and pressure
formed by the comprehensive water cone or bottom water
along the development degree of good inter porosity flow
causing crack, the well water cut rising rapidly, but due to
the crack of the capillary pressure is small, the gravity
differentiation is obvious, so before forming water cone
or channeling Wells stop mining, make water cone cannot
form or make water cone height To the minimum, so as to
control the rate of water rise. It is suggested to adopt cycle
production test for high water content well Bei2.
According to the production data in November 2006, well
B4 has a daily fluid of 30.4t, a daily oil of 5.2t, water
content of 82.9%, the efficiency of pump is 38.5%.
Therefore, it is suggested to adopt the working system of
pumping in three days, comprehensively track the change
of water cut and timely adjust the oil recovery cycle to
find out the best oil recovery cycle, so as to provide
experience for whether it is the feasible to adopt the cycle
oil recovery after water is found in other fault blocks.

(7) At present, the oil production rate of the western north
fault block is as high as 9.2%, and the water cut has risen
to 27.8%. In order to improve the final recovery factor,
the oil production rate of the western North fault block
should be controlled.

References

1. Lou Zhanghua, Gao Ruiqi, CAI Xiyuan, on
groundwater dynamic field evolution and
hydrocarbon migration and accumulation in Songliao
Basin [J]. Acta sedimentologica sinica, 1997,
15(4):116-120.

2. Kang Yongshang, Pang Xiongqi. Principle and
application of fluid dynamic system analysis for
hydrocarbon accumulation [J]. Acta sedimentologica

3. ZENG Jianhui, Dynamic characteristics of
groundwater and its influence on hydrocarbon
migration and accumulation in Taibei Sag [J]. Acta
sedimentologica sinica, 2000, 18(2):274-278.

Discussion on the hydrodynamic mechanism of
reservoir forming dynamic system [J]. Earth science