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The Numerical Simulation Research of The Remaining Oil Distribution Regulation in Test Site of Low Permeability Oil Field

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1 Grid Partitioning of Test Site

Static data of the well network of Gaotaizi reservoir in the test site is collected and analysed. The data of 126 wells are analyzed in detailed screening. Then make facies control interpolation calculation by the modeling software, and establish the fine geological model for numerical simulation. The grid step size is 30 meters, and the grid nodes are divided into 106×53×115 = 646070.

According to fine geological research results for years, considering fully the plane heterogeneity of layers and the interlayer contradiction in the model. The number of separate layer is 114, which is divided into 114 simulated layers. Make facies control interpolation calculation of grid properties in model (porosity, permeability, effective thickness, original water saturation) by the modeling software. The result can reflect better the change trend of layers. The attribute models are shown in Fig.1, 2, 3, 4.

In order to improve the calculation precision and speed, we transform the corner-point grid exported into the block-centered grid by grid conversion module, and adjust the distance between the grid block for making the oil-water wells in the center of the grid.

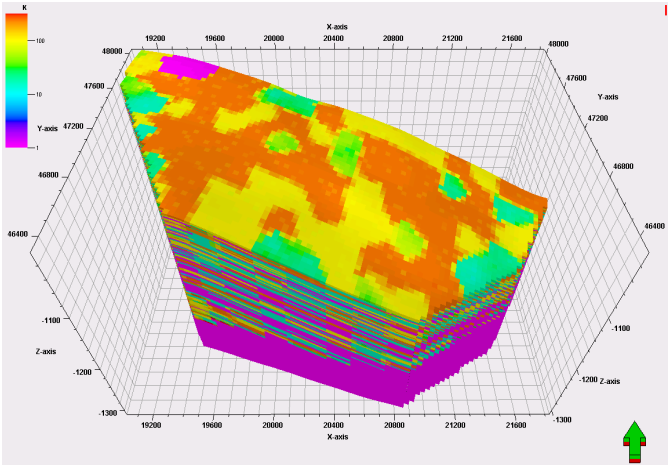

Fig.1 the permeability model of the test site

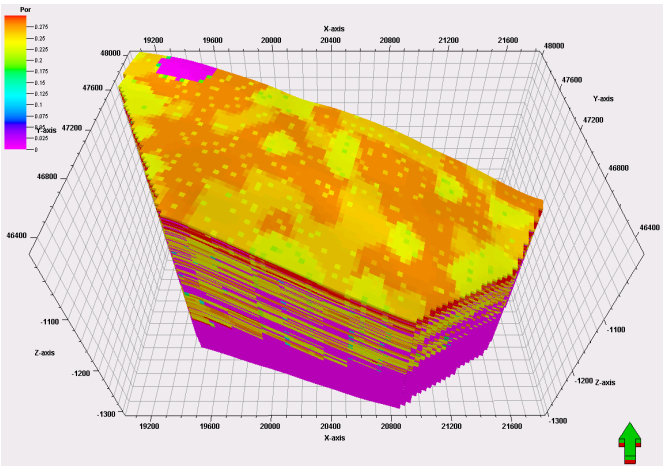

Fig.2 the porosity model of the test site

2 Fluid Properties and Selection of Layer Fluid PVT Parameters

For the relative permeability curve of the test area, The first is to process the data.Remove large offset point; add data points according to the overall trends and the curve shape; smooth the overall curve. That is to reduce the computing time and improve calculation accuracy. Different relative permeability curves are applied for different kind of sand bodies. Three relative permeability curves are adopted to correspond to three relative permeability partitions, of which the air permeability is respectively greater than $10\times10^{-3}\mu m^2$, $10\sim1\times10^{-3}\mu m^2$ and less than $1\times10^{-3}\mu m^2$.

3 History Matching for Development Stage

History matching of development stage is made for the key development indexes, such as the cumulative oil

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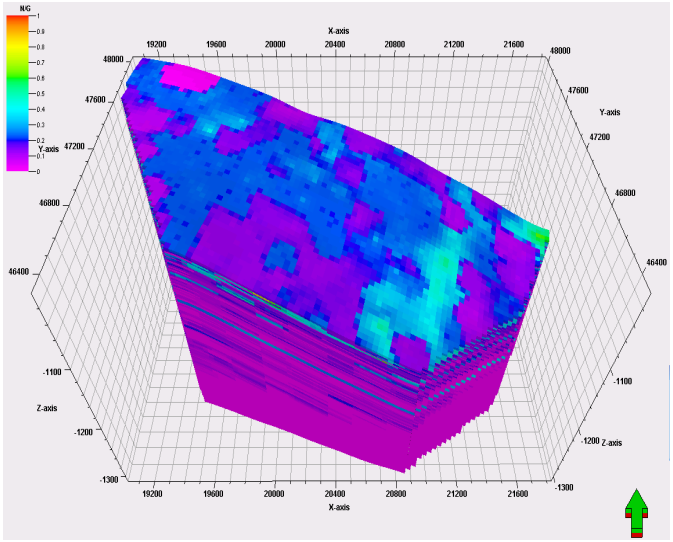

Fig.3 the NTG model of the test site

production, the daily oil production, water cut, etc. The model calculates with invariability liquid production. Actual liquid production is same as computational liquid production. Part of the development index matching curve maps of the test site are shown in Fig.5 to Fig.6.

4 The Summary and Analysis of Remaining Oil Distribution Regularity

According to the remaining oil distribution features after history matching, the types of remaining oil can be divided into the following remaining oil types:

4.1 The remaining oil of local-worse and channel-edge type

The remaining oil of this type is mainly distributed in strips in the river endings, the edge of mouth bar, the main sand body edge near the zero line of effective thickness. The physical properties of single sand body edge are poor, which the water absorption and liquid producing capacity of is low. Even if the current well pattern can control, the remaining oil often is formed due to vertical and horizontal interference, poor producing, etc. (Fig. 7)

4.2 The remaining oil of secondary-effect type

The remaining oil of this type is formed due to river closure of the original production well. Because the new well is placed in the secondary position of a original production well. (Fig. 8)

4.3 The remaining oil of stagnation-area type

The remaining oil of this type is mainly distributed in the middle place of the adjacent two or three wells, and is formed by pressure equilibrium zone in the process of development and production. (Fig. 9)

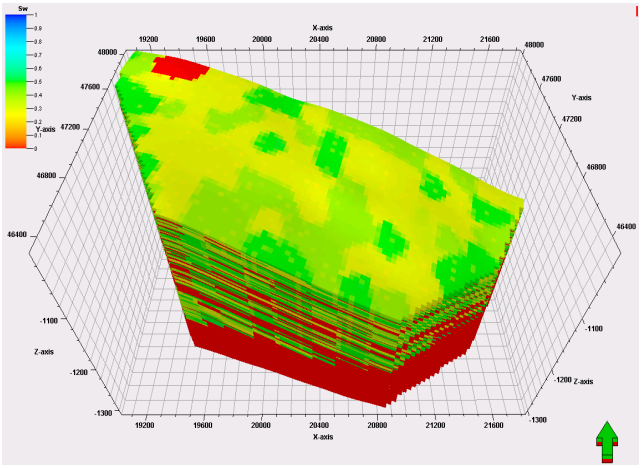

Fig.4 the Saturation model of the test site

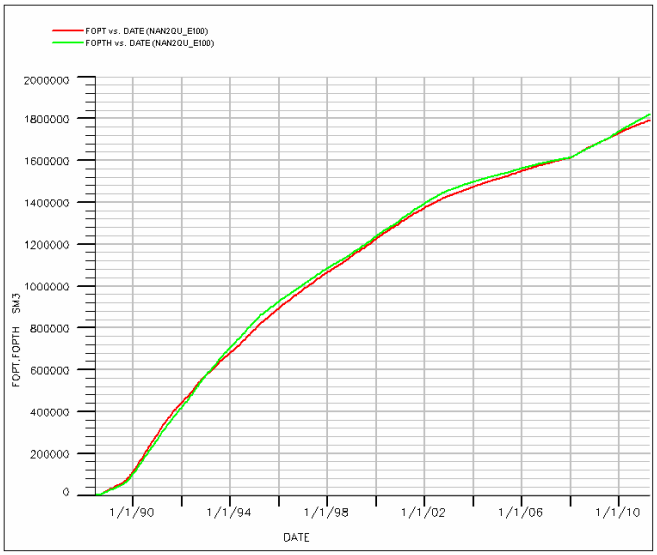

Fig.5 the cumulative oil production curve of the test site

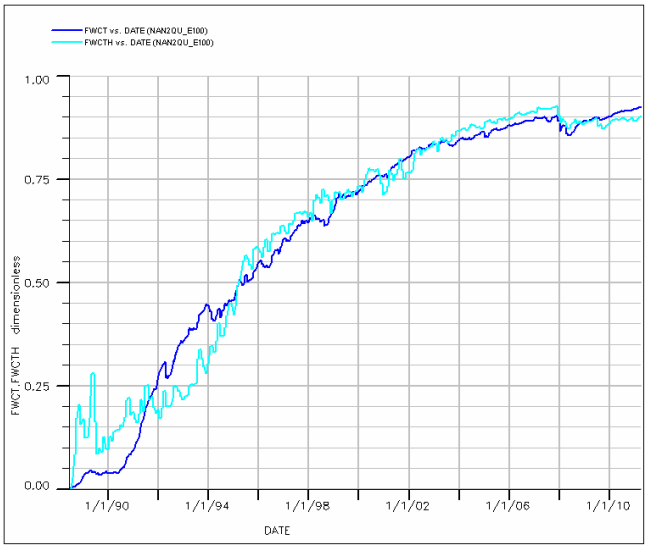

Fig.6 the comprehensive water cut curve of the test site

4.4 The remaining oil of injection-production

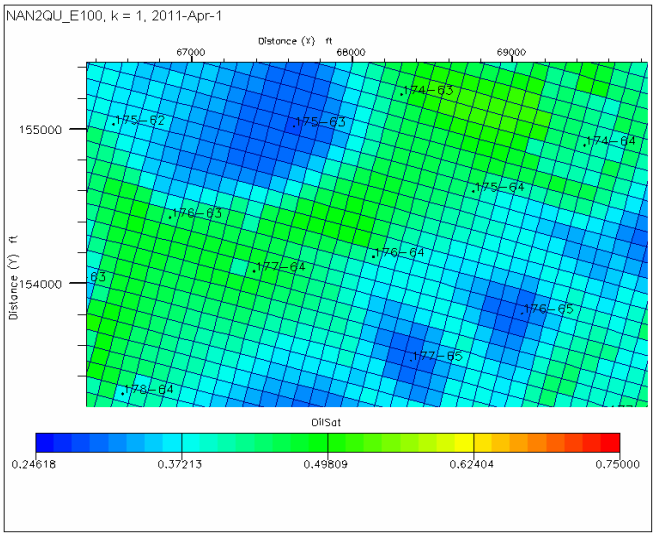

Fig. 7 the remaining oil of local-worse and channel-edge type

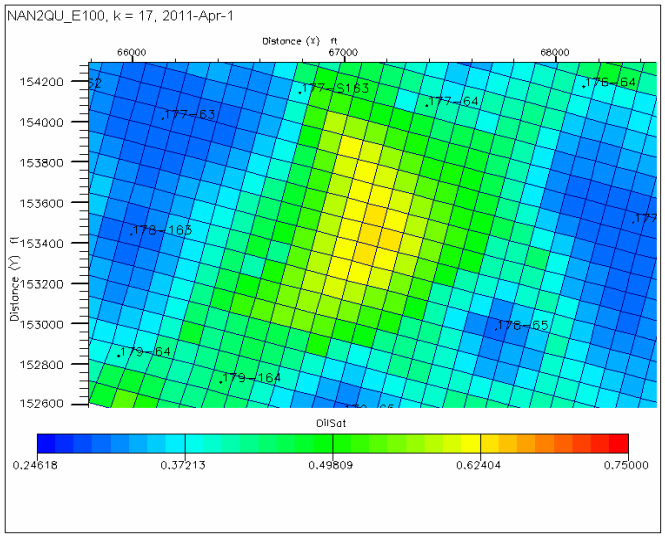

Fig. 9 the remaining oil of stagnation- area type

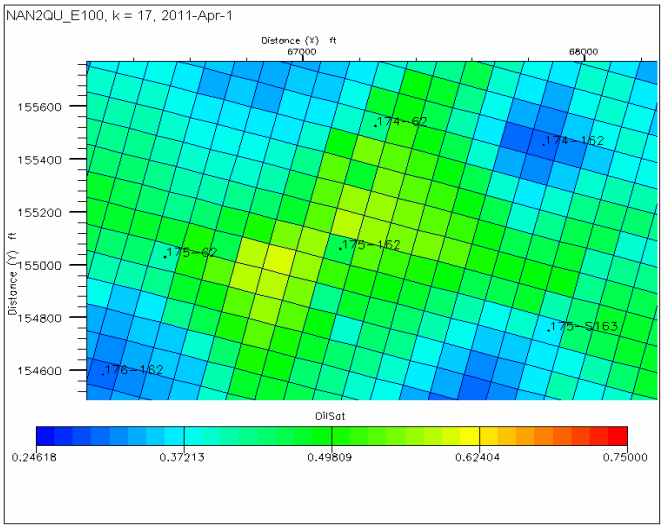

Fig. 8 the remaining oil of secondary- effect type

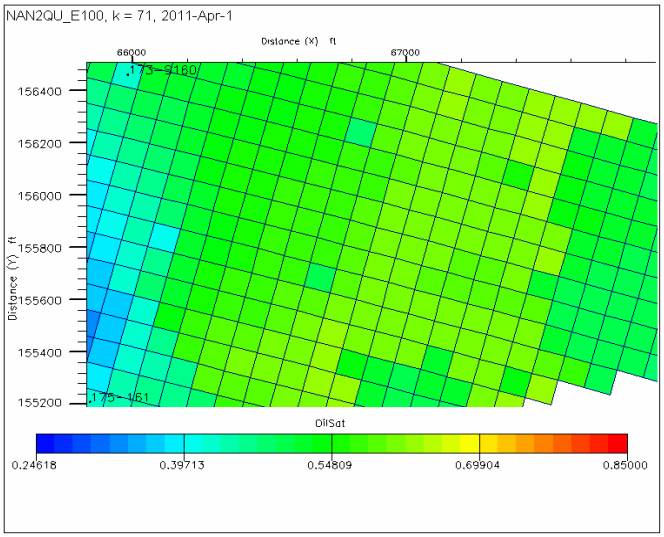

Fig. 10 the remaining oil of injection- production imperfection type

imperfection type

The cause of the remaining oil of this type is mainly: although the original well pattern is there, but there is no perforation. So that this remaining oil type is formed. (Fig. 10)

5 Conclusion

According to the real data in the test site of low permeability oil field, the fine geological model and the numerical simulation model are established. Then based on geological reserves matching of the test site, history matching of development stage is made by the numerical simulation software.The remaining oil distributed regularity is summarized and analyzed. The remaining oil types include: the remaining oil of local-worse and channel -edge type; the remaining oil of secondary-effect type; the remaining oil of stagnation-area type; the remaining oil of injection-production imperfection type. We analyse the cause of each remaining oil type. In view of the potentialities of different remaining oil types, we should take different measures in the next step, which can better improve the development effect of the test site.

Acknowledgements

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References

Shimada. M and Hoshino. K, 2007. Evaluation Method of Remaining Oil Properties in a Sunken Ship Using Ultrasonic Technique, Underwater Technology and Workshop on

Scientific Use of Submarine Cables and Related Technologies, pp.677-681.

Bing Wang and Huan Wang. 2012. *The Integrative Research of 3D Geological Modeling and Reservoir Numerical Simulation*, Consumer Electronics, Communications and Networks, pp.674-677 (in Chinese).

Wang Mingchuan, Zhu Weiyao, and Shi Chengfang, 2012. *Numerical Simulation Study on Remaining Oil Distribution for L Thick Reservoir*, International Conference on Computational and Information Sciences, pp.147-150 (in Chinese).

Latiff. N.R.A., Yahya. N, Zaid. H.M, and Demiral. B, 2011. Novel enhanced oil recovery method using dielectric zinc oxide nanoparticles activated by electromagnetic waves, National Postgraduate Conference, pp.1-7).

Congjiao Xie, Zhenliang Guan, Guoping Luo, and Xiyu Li, 2010. *Decline Analysis of Oil Well Stimulation Rule Using Matlab*, Web Information Systems and Mining, pp. 231-234 (in Chinese).

Daiyin Yin and Weiming Huang, 2009. *A Computer Numerical Simulation Study Considering Starting Up Pressure Gradient for Low Permeability Reservoir*, International Conference on Information Science and Engineering, pp.4631-4635 (in Chinese).

Lanfang Dong, Detang Lu, and Meng Li, 2011. *Parallel Algorithm of Visualization of Reservoir Numerical Simulation Based on PEBI Grids, Parallel Architectures*, Algorithms and Programming, pp.302-305 (in Chinese).

Chengli Zhang, Huan Wang, and Mingguo Wei, 2010. *Numerical simulation study on law of steam flooding in oil reservoir with directional fractures*, International Conference on Advanced Computer Theory and Engineering, Vol. 3, pp.375-378 (in Chines).