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Building Geo-pilot Model, Increasing the Success of Horizontal Well

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Abstract: The technology of geo-pilot is very important in the development of thin, compact, implicated reservoir. This article takes B6h as the example, using the GeoSteerRT software, constructing the geo-model, renewing the real-time data, to revise and anticipate the pay-top, make sure the situation of the track, give the advice of next step. Through the method, you can make a reasonable decision, and you can profit from it. This method can give us a good reference in developing with horizontal wells.

Keywords Horizontal wells; Geo-pilot; Model; Analysis while drilling

INTRODUCTION

With the development of developing global oil and gas, remaining oil and gas is reducing. geological situation of new oil and gas field is more complicated. in order to improving the recovery rate and speeding up development and avoiding the risk of developing oil and gas field, using horizontal well to develop oil and gas field will become key direction around the world. Geological orientation is the main technical means to improve drilling of horizontal well. This essay takes XX oilfield well B6h as an example, discusses use of geological oriented model in detail and get very good result. The method of horizontal well drilling has very good guidance and reference for horizontal well.

XX oilfield is located in bo sea bay area, is located in the north of western liaoning bump in regional structure, is bounded to liaoning large fault in the west , is close to the western liaoning sag. It makes the transition to sag in the southeast in gentle slope. It adjacents to the Liaozhong sag in north depression, is in the vantage point of oil and gas enrichment.

Paleogene is the second member of the shahejie formation which is the main field of oil and gas formation. It is delta sedimentary. Oil field subject area mainly developed delta front subfacies. The lithology is sandstone reservoir.

B6h well is in the center of XX oilfield. Design objective layer is Shahe Street Group in second section of I oil group, in which the characteristics of the reservoir is the top gas. It faces double risk of gas and water cone drilling. It needs strict control of well trajectory. The well will drill into the objective layer in oblique depth 2850m (vertical depth 1692m) at the target stratum. The length of horizontal section design is 360m. When it drills reservoir bottom it finish drilling (Figure 1).

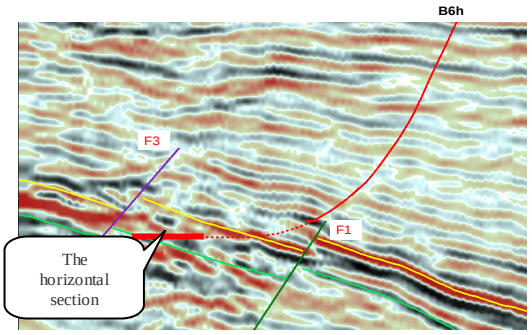

Figure 1. B6h well trajectory of seismic profiles

RISK ANALYSIS BEFORE DRILLING

Structure Risk

By the influence of faults (Figure 1), structure will change with large possibility. If the dip becomes large, drilling objective lays top surface a bit earlier. At this time, due to vertical depth is relatively shallow, in order to prevent the top gas from channeling, it must plug upper reservoirs. Reservoir affected loss. If the dip becomes small, drilling objective lays depth (oblique deep). Risk of drill increases.

Risk of Reservoir

Sha two section of I oil group in thin oil reservoir, horizontal distribution is not stable, and is clamped in the middle of the wide distribution of mudstone, and the current few drilling data, and seismic data in the Shahe Street Group is a low resolution, can only identify the relatively thick layer group, unable to identify a single sand, so sand two I oil formation layer with a certain risk.

In the process of drilling, drilling needs through real-time geological analysis timely and accurately predict the target layer, and make appropriate

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adjustments in deviation in advance, to minimize the adverse effects of structure and reservoir because of changes to the drilling produce.

GEOLOGICAL MODEL IS ESTABLISHED IN THIS PAPER

Geological guidance work can be divided into two stages: preparation stage before drilling, drilling track adjustment phase. The relative data of geologic guide to collecting, finishing, familiar with the adjacent wells and target well, the target horizon before work, clear geological objective. In addition, also need to be drilled between completion and reservoir geology communication in advance, consistent in the overall technological ideas.

Purpose Layer Basic Situation Analysis

First select a port adjacent wells B19w representative, wear sand two reservoir drilling the well B6h, distance of about 500m (Figure 2), in the actual drilling process can be used as a reference well stratigraphic correlation analysis. With thick mudstone deposited layer of internal stability as the symbol, Sha two section from top to bottom is divided into oil group, II group III oil, oil group of three oil group, B6h design objective layer as I oil groups, loose lithology, porosity development, better reservoir, sandwiched between two mudstone will I oil group divided, three small layer, the well is drilled through three layers (Figure 3).

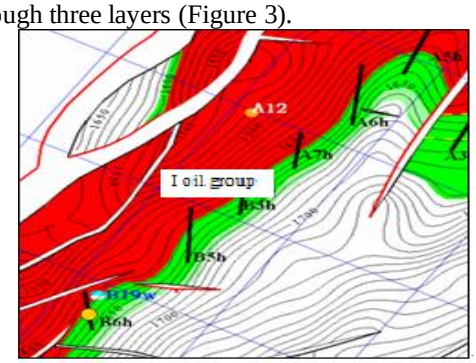

Figure 2. B6h well location map

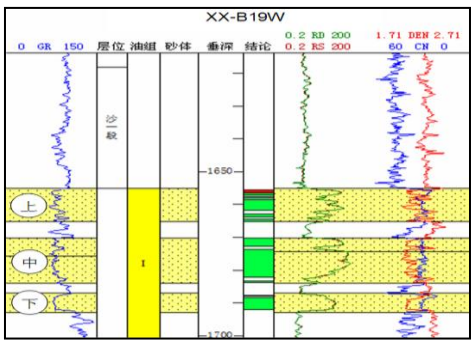

Figure 3. Objective layer in B19w well logging

Initial Model Established

Geological modeling based on geological hierarchical data, the regional stratigraphic division of upper, lower section of East East, Es1, sand I section, inversion modeling according to the gamma, pretreatment of the resistivity logging data. In order to be able to response the geological situation more intuitive, convenient drilling personnel to carry out comparative analysis of work, filling the lithology in different strata respectively, the initial model completes geosteering well B6h (Figure 4).

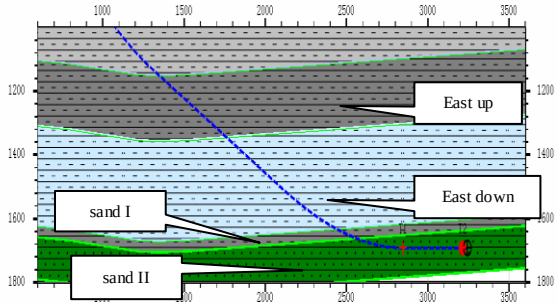

Figure 4. The initial model completes geosteering well B6h

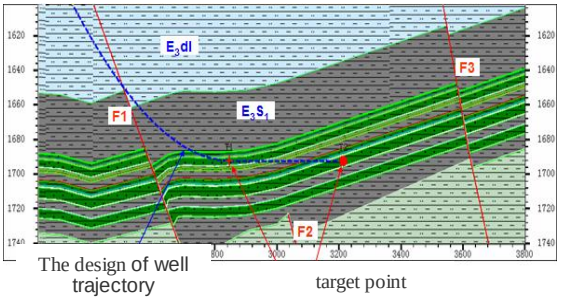

Figure 5. B6h fine geosteering model of horizontal well

Detailed Model

By comparing the regional data, inside member 2 of sand mudstone has the characteristics of stable distribution, according to the second paragraph I will sand oil formation is divided into the three parts, which six layers, namely "a three parts six reservoir oil group" (Figure 5).

Mudstone and sandstone thickness reference B19w well the actual formation drill in thickness, detailed data are shown in table 1.

Table 1. B19w Sand II Oil Group I Segmentation Layer Data

Oil group	Top depth (m)	Bottom depth (m)	Thickness (m)	Lithology
I	1655.31	1657.31	2	Fine Sandstone
	1657.31	1658.63	1.32	Mudstone
	1658.63	1663.36	4.73	Fine Sandstone
	1663.36	1664.72	1.36	Mudstone
	1664.72	1666.07	1.35	Fine Sandstone
	1666.07	1670.82	4.75	Mudstone
	1670.82	1673.53	2.71	Fine Sandstone
	1673.53	1674.88	1.35	Mudstone
	1674.88	1681.39	6.51	Fine Sandstone
	1681.39	1687.22	5.83	Mudstone
	1687.22	1692.72	5.5	Fine Sandstone
	1692.72	1701.73	9.01	Mudstone

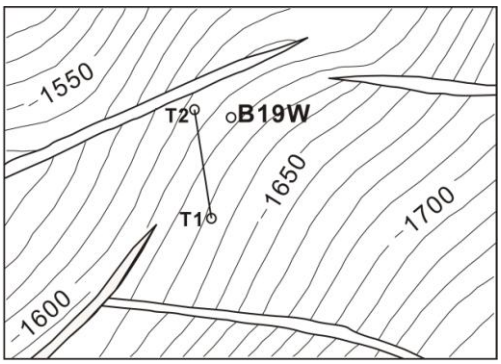

Figure 6. Contour map of XX oil gas field I oil group of top structure

Purpose Layer or Depth Prediction

According to the data from seismic structure interpretation, I at the top of the oil group structure contour map, using regional has drilling oil group I real drilling depth data constraint, the fixed end face contour map, to be able to accurately predict oil group of top surface depth, T1, T2 and then B6h well target coordinates on the contour map projection in the I oil group (Figure 6), predict the T1 target vertical depth of 1680m (inclined deep 2670m), reference B19w I oil group thickness, in combination with regional stratigraphic dip (12°) and predict T2 target vertical depth of 1680m (well depth 3213m) deep.

REAL-TIME TRACKING

Purpose Layer of Judgment

In order to ensure accurate horizontal well drill into the window layer in purpose, and in the landing site of reasonable finished, choose contrast layer is particularly important. Logo layer selection principle is stable distribution, rock electrical characteristics in construction area, is apart from the objective layer above a certain distance, also can select multiple layers of lithology combination as a sign, from top to bottom "layers of contrast".

Application while drilling for the first time this well real-time stratigraphic correlation analysis technology, the technology can is drilling logging while drilling and well logging data and adjacent static data at the same comparative study on the geological analysis platform, real-time, fast division formation, anticipate purpose layer depth, according to the forecast results in a timely manner to adjust the trajectory, to ensure that the geological drilling to achieve.

From top to bottom layers of contrast, the nearest purpose layer stratigraphic correlation is most important, is also a key, in the adjustment of locus plays an important role in successful landing. This well in measuring the depth of the MD: 2660.5 ~ 2703m gamma value is low, depending on the vertical thickness decrease obviously, compared with B19w forecast will drill encounter purpose layer ahead of time. In the deviation of current depth point of data (2703m deep Angle, hole deviation 84.3°) for borehole trajectory calculation, must be in accordance with the dogleg degree 2°/30m to continue drilling, is expected to drill in the target layer within 60m.

B6h well in well deep MD: 2724m, TVD: 1687.5m while drilling gamma value markedly reduced (about 66 API), resistivity increased dramatically, while drilling resistivity about 117 ohms, MR1, gas logging value increased significantly, the preliminary judgment drill in target I oil group member 2 of the top layer of sand. In addition, by analyzing real-time stratigraphic correlation with adjacent Wells (F Figure 7), can also certify that the above judgment. Both drilling and well completion, well depth after confirm to enter purpose layer MD: 2751m, TVD: 1689.5m 2 out in the open, 86.68° Angle, to lay a good foundation for the smooth along the horizontal section construction.

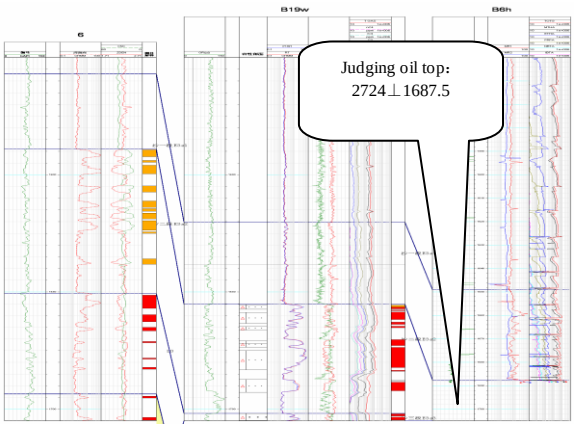

Figure 7. B6h drilling real-time formation comparison

Wellbore Trajectory Prediction and Adjustment

In the process of geosteering, predict the drill in the next special strata (reservoir or mudstone) depth, adjust trajectories, can effectively avoid the drilling risk. This risk is mainly to change, structure and reservoir accurately predict changes and dip Angle of drill wear a small layer depth is the key to the success of this well.

Smoothly into the window, through the well trajectory prediction, the dogleg degree of a given 2°/30m, Angle of 90°, keep horizontal drilling. In the depth of 2835m of drill wear at the bottom of the reservoir, into the mudstone formation. Depth of 2950m, hole deviation 90.04°, resistivity decrease obviously, gamma value increases slightly, preliminary judgment drill when I group oil reservoir in the middle of the central thin layers of mudstone, forecasts coincide well with the real drilling. In the depth of 3050m, through the analysis of real-time data, behind the forecast of dip, may advance drill wear at the bottom of the reservoir, to predict a drill to drill 50m in the last oil reservoir. Real drilling condition and prediction before drilling basic consistent, keep track the same not to adjust.

Finish Drilling Effect

Well depth 3110m from the analysis of characteristics of electrical think drill in the last oil reservoir, and before the analytical predictions. Given the accurate prediction of the geological condition, before the first accurate judgment in the depth of 3138m last oil drill wear (Figure 8), suggest finishing drilling, eventually finishing drilling in the depth of 3152m, saving 61m of penetration design depth (3213m), of no purpose was to avoid blind drilling, drilling cost saving about $600000. Horizontal section length of 401m, the well is a reservoir of 182m, oil reservoir encountering rate of 45%, initial production of 400m^3/ day, achieved good drilling result.

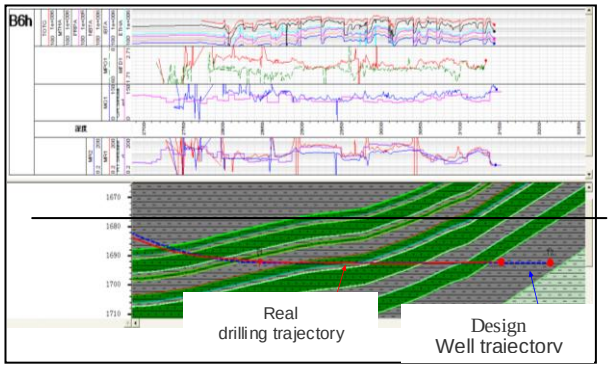

Figure 8. B6h geosteering drilling end model in XX Oilfield

CONCLUSION

(1) real-time geosteering technology play an important role in horizontal well landing phase, is based on the drilling geological information real-time contrast with adjacent Wells, can quickly and accurately predicting purpose layer depth, to ensure that the scientific nature, rationality of landing and 7.

(2) after the elaborate leading geologic model building is not fixed, but according to drilling data, enrich unceasingly the leading model for optimization and adjustment of help geosteering personnel with drilling bit position in formation, fast and accurate analysis provide reliable decision basis for well track adjustment.

(3) before carrying out the geological reservoir with horizontal well drilling and well completion requires full communication, maintain consistency, and likely to make a plan, ensure the geosteering work orderly, to improve the working efficiency and development of the field effect.

REFERENCES

Kui Mingqing, Jiang Tao li, Yang Shengbing, et al, 2009, "Horizontal well geosteering technology in Taiwan H5-1 application". Journal of natural gas exploration and development, No.3.

Shi Pengcheng, Xu Lei, 2000, "Geosteering application oriented leading simulation technology research". Journal of logging technology, vol.24, No.6.

Su Yinao, 2005, "General situation of geosteering drilling technique and the research progress of our country. Journal of petroleum exploration and development", No.3.

Su Yinao, Zhang Runxiang, 1998, "The principle and method of geosteering". Beijing: petroleum industry press.