

The Forming Condition of Tight Oil and Gas of J layer in South Depression of D Basin

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Abstract :Based on the latest laboratory test and prospect well data of G layer in south depression of D basin, the source rock, reservoir, cap-rock and preservation forming condition of tight oil and gas within research area is analyzed. The results indicate that the widely distributed dark mudstone of J layer has rather high organic content. II b and III types are the mainly genetic types of organic matter. The mature source rocks, which has reached the generation stage of cracked gas, providing rich material basis for forming oil and gas reservoirs. There are tight reservoir distributed in research areas and interbedded sandstone and mudstone are very common. Oil and gas are well preserved in local depression with stable tectonic condition. Therefore, South Depression of D Basin has certain exploration potential of tight oil and gas.

Key words: J layer; D basin; Tight oil and gas; Forming condition

I. INTRODUCTION

As unconventional reservoirs, tight oil and gas can not only compensate for the storage lack of conventional reservoirs, but also played an increasingly important role in the energy mix. The drilling data of YC 1 and Y 1 well in south depression of D basin indicates that there are tight reservoirs developed next to source rock and low-yield oil flow was achieved in YC 1 well. But the exploration degree of D basin is quite low, so it is necessary to analyze its forming conditions.

II. GEOLOGY

D basin is tectonically located at the proliferation area of Paleozoic continental crust in the east of Inner Mongolia, next to the west of S basin and the east of Great Khingan. As a NNE Mesozoic rift basins distributed as a long strip, it belongs to Inner Mongolia- Xing fold system. Under the influence of regional extension action, a series of NNE centripetal faults, which stepped fall to the furrow direction, was formed in the inner and edge part of D basin to control the development and evolution of basin. Thus the tectonic framework of abrupt east and smooth west, deep south and shallow north was constituted. Subjected to intense volcanic activity and with the erogenous infilling during volcanic activity, D basin mainly developed L, J, G layers of the lower Cretaceous above Jurassic substrate.

III. SOURCE ROCK CONDITION

3.1 Developed condition of source rock

With stable volcanic eruption, D basin was deposited as a whole during the sedimentary period of J layer. Deposition zone was substantially distributed in the whole basin without the control of basement faults. The dominant sedimentary facies are alluvial facies and limnetic facies. Multi-phase dark mudstone of J layer with coal seams and large thickness, which is widely distributed in the whole basin, is the mainly developed formation of hydrocarbon source rocks. The upper segment of J layer is semi deep - deep lake and shallow lake facies and the lower segment is semi deep - deep lake, shallow lake facies sandwiched volcanic sedimentary facies interbred with volcanic sedimentary facies while the middle segment is mainly ultra-shallow intrusive facies and volcanic overflow facies. Besides, Drilling data of YC 1 well in south depression indicate 240.5m

accumulative thickness of dark mudstone, confirming the wide development of hydrocarbon source rocks within research area.

3.2 Organic abundance

In research area, the TOC of dark mudstone of J layer values between 0.8% and 3.6%, with an average of 1.6% and most samples are more than 1%; the content of chloroform bitumen "A" is between 0.0404% and 0.4906%, with an average 0.1699%; S1 + S2 range for 3.25 mg / g to 5.68mg / g, with an average of 4.46mg / g. Overall, the abundance of organic matter reached the standards of better - exceedingly source rock.

3.3 Type of organic matter

The normal paraffin hydrocarbons of dark mudstone samples in south depression of D basin are mainly distributed around the peak of low carbon number (nC₁₉) and the hydrogen index(IH) is quite high. H / C atomic ratio range from 0.35% to 1.0% and O / C atomic ratio distribute between 0.06% and 0.23%.The mainly type of organic matter within research area are IIb and III type, providing good material foundation for oil and gas generation.

3.4 Organic maturity

Geochemical test data of Dark mudstone samples indicates that Ro of J layer within research area ranges from 0.56% to 1.64%, with an average of 0.83%. And the Ro of YC1 well mudstone samples mostly distributed between 0.5% and 1.2%, only a small part of them between 1.2% and 2.0%;all the data of Y 1 well range from 0.5% to 1.2%. Organic matter reaches the peak of oil and gas generation in the depth of 1640m and organic maturity increase with increasing depth, gradually transformed from oil to gas generation. Vitrinite evolution phasing standard shows that most of dark mudstone samples of J layer in the study area at the stage of low maturity - maturity.

IV. RESERVOIR CONDITION

Drilling and Integrated Geophysical interpretation results show that the reservoirs in D basin have a variety of lithology type, including siltstone、 volcanic rocks、 diabase and tuff. And reservoirs are commonly developed in L、 J and G layers. There are two kinds of reservoirs(siltstone and volcanic rocks) in the target layer-J layer in south depression of D basin, which mainly store oil and gas in pores and cracks. The uneven size and irregular shape of pores and cracks in volcanic rocks provide the porosity ranges from 0.3% to 14.25% , with an average of 7.4% and the permeability ranges from 0.01 mD to 20.6mD, with an average of 2.1mD. Siltstone reservoirs, including fine-grained sandstone、 muddy siltstone and tuffaceous siltstone, have the porosity between 3.6% and 12.2%, with an average of 7.2% and permeability between 0.05mD and 12.2mD, with an average of 1.5 mD. Therefore, there are tight reservoirs in J layer. In addition, the developed sets of interbedded sandstone and mudstone in upper and lower segments of G layer can not only make the oil and gas formed in source rocks transport to the tight reservoirs next to source rocks, but also have a certain cover and sealing effects to the oil and gas stored in lower reservoir, which helps the accumulation of oil and gas.

V. CAP-ROCK CONDITION

The mainly cap-rock in research area are tight block basalt of G layer and mudstone of J layer. With a general thickness of 300 to 500m, the tight block basalt of G layer is stable and extensively developed. Latest results of integrated geophysical interpretation consider it to be the good regional cap. The drilling data of J

layer in YC 1 well shows accumulative thickness of 72.5m in upper mudstone segment, with the largest single group thickness of 12.5m when the corresponding number in lower mudstone segment is 148m and 11.5m. Combined with the interpretation results of geophysical exploration, it turn out that the mudstone of J layer is stable and widespread, which makes it a good regional cap. Besides, basalt、diabase and other kinds of igneous, developed in the middle part of J layer, have certain effects due to its tight lithology and hardness. But the impact of cap-rock on tight reservoir cannot be determined.

VI. PREAERVATION CONDITION

Structural condition is an important factor in controlling the formation of tight oil and gas reservoirs. D basin is rift basin under the background of multiperiodic volcanic activity, which present the double-break structure and the tectonic framework of abrupt east and smooth west、deep south and shallow north . Traps mainly exist in the central part of depression while faults are well developed in the whole research areas. Thus the relatively small area of deep depression with relatively stable structure determines that tight oil and gas reservoir of large contiguous areas similar to Alberta basin could not formed in D basin. But the south depression of D basin was in the mid-rift stage during the sedimentary period of J layer. With stable volcanic eruption, D basin was deposited as a whole and the storage areas are largely increased. Alluvial deposition system is well developed in deposition zone without the control of basement faults. And well indication of oil and gas has been showed in reservoir in J layer from the drilling and logging data of YC 1 and Y 1 well. Though belongs to rift basin, there are local depressions with stable tectonic conditions. And the tight reservoir, next to source rock, surely has certain exploration potential of tight oil and gas.

VII. CONCLUSIONS

1. The dark mudstone with high organic abundance of J layer in research area are widely distributed. Type IIb and III are the mainly type of organic matter and most of dark mudstone samples are at the stage of low maturity - maturity.
2. Siltstone and volcanic rocks are the mainly lithology of reservoirs, which store oil and gas in pores and cracks. There are tight reservoirs in J layer. The mainly cap-rock in research area are tight block basalt of G layer and mudstone of J layer.
3. Though belongs to rift basin, there are local depressions with stable tectonic conditions. And the tight reservoir, next to source rock, surely has certain exploration potential of tight oil and gas.

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