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Reservoir Types and Distribution Characteristics of Wuxun-beir Sag

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Reservoir Types and Distribution Characteristics of Wuxun-beir Sag

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Abstract. The distribution of Cretaceous lithologic reservoirs in Wuxun-Beir sag of Hailaer Basin is mainly controlled by paleotopography, distribution range of effective reservoirs, and distribution range of effective source rocks, stratigraphic unconformity surface and structure. Oil and gas are mainly concentrated in the margin of sedimentary trough, large gentle slope break zone and low uplift in trough area. The abrupt slope break zone of the belt and the fault type is distributed in a circular shape around the depression trough. On the plane, there are many oil-generating troughs in the Wuxun-Beir depression, which provide abundant and high-quality resource basis for the formation of reservoirs. The hydrocarbon generated from the source bed migrates and accumulates to various types of traps around it through sand bodies, faults or unconformities. Various types of reservoirs, such as structure and lithology, coexist in the depression, forming a transverse superimposed contiguous sheet. The compound oil and gas accumulation zone is mainly distributed in the hydrocarbon generation depression trough or the surrounding fault structural belt. The large area hydrocarbon-generating troughs usually have large oil and gas reserves, such as Surenuoer, Wunan and Beizhong oilfields; the troughs developed in the middle of the depression are easy to form "full depression oil-bearing" oil-rich troughs, such as Beizhong sub-depression reservoirs. Exploration practice has proved that the discovered reservoirs are located in or around the source rock. Therefore, exploration and deployment around the source rock will be the key direction of exploration in the future.

1. Introduction

Lithologic and stratigraphic reservoirs have the characteristics of concealment, difficulties of exploration and discovery. So it is still a difficult problem in the world [1]. In recent years, lithologic reservoirs are continuously discovered and much accounted by geologists due to the high degree exploration and the improvement of cognitive geology [2-3]. In the east basins of our country, for examples, Bohai Bay basin, Songliao basin and Erlian basin, where subtle reservoirs and lithologic reservoirs have been the main exploration targets with the degree of exploration difficulty [4].

Hailar basin is the biggest peripheral oil bearing basin of Daqing exploratory area. Wuxun sag and Beir sag are the biggest two potential sags in Hailar basin; they have been one of the strategy reserves of Daqing oil field [5]. Hailar basin has finished most traps exploration of large scale, shallow buried depth, and simple in structure. It becomes difficult to find structural traps with good shape, big area, and good reservoir forming conditions. The exploration of block complex reservoirs has run up to a high degree. The severe situation has appeared. So we should change old and build new ideas of exploration, and explore consciously lithologic and stratigraphic reservoirs. Since 2005, we have found some full-scale the lithologic and stratigraphic reservoirs (Fig. 1).



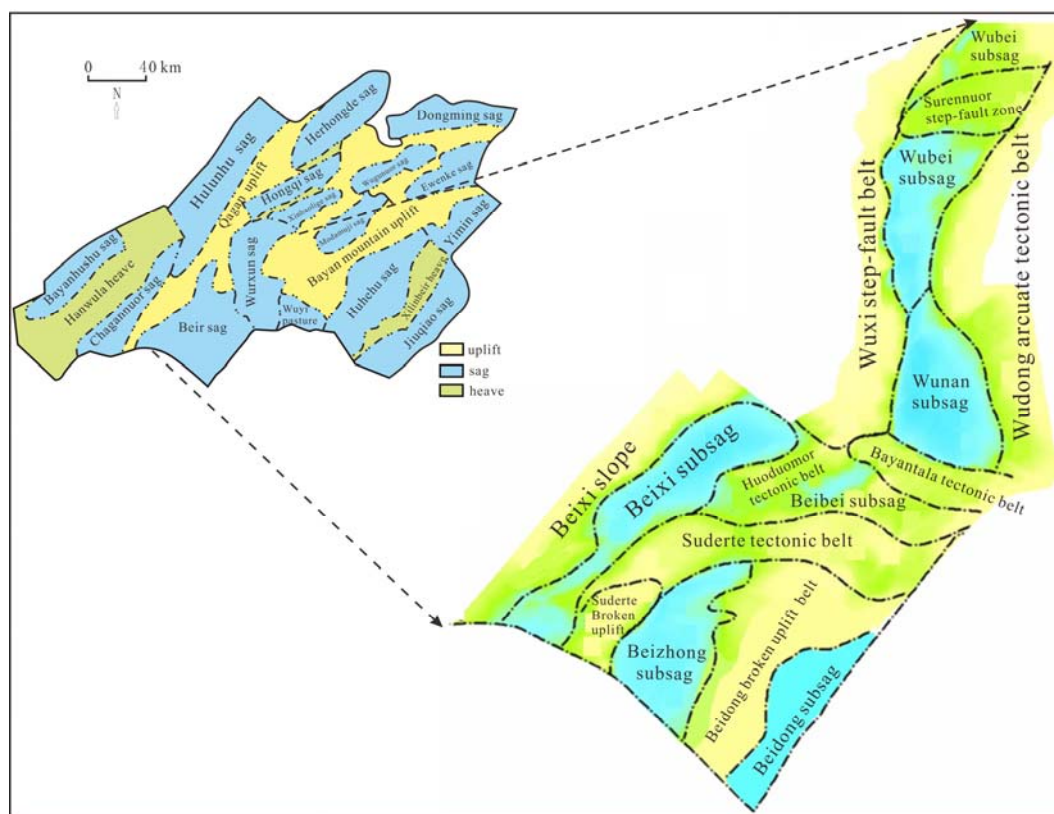


Figure 1. Stratigraphic column with location of Wurxun-Beir Sag

2. Geological Conditions Forming Lithologic and Stratigraphic Reservoirs

The characteristics of basin are small trough, multi-source, near source, narrow facies, and facies changing fast. There are six types of sedimentary system including alluvial fan, fan delta, braided river delta, river delta, sublacustrine fan, and lacustrine facies (Fig. 2). Different types of sand body in structural unit have different distribution controlled by boundary faults and syngeneic faults in sag. Boundary faults control the steep slope belt. The formations have a high slope in steep slope belt, and the sediment can go into the lake quickly then form alluvial fan, fan delta, and deep water turbidite fan deposits. A single sand body distributes in limited range, but there are more quantity and large thickness, so large lithologic reservoirs can be formed. Multilevel fault slope break control the gentle slope zone. The sand bodies extend far. There are braided river deltas or fan delta, some sand dam in shore-shallow lake. The sand bodies have a large distribution range because of small slope, so large lithologic and stratigraphic reservoirs can be formed. There are sublacustrine fan and deep water turbidite fan deposits in trough area. These sand bodies contact with source rock, so it is advantageous to form self generating and self storing lens reservoir.

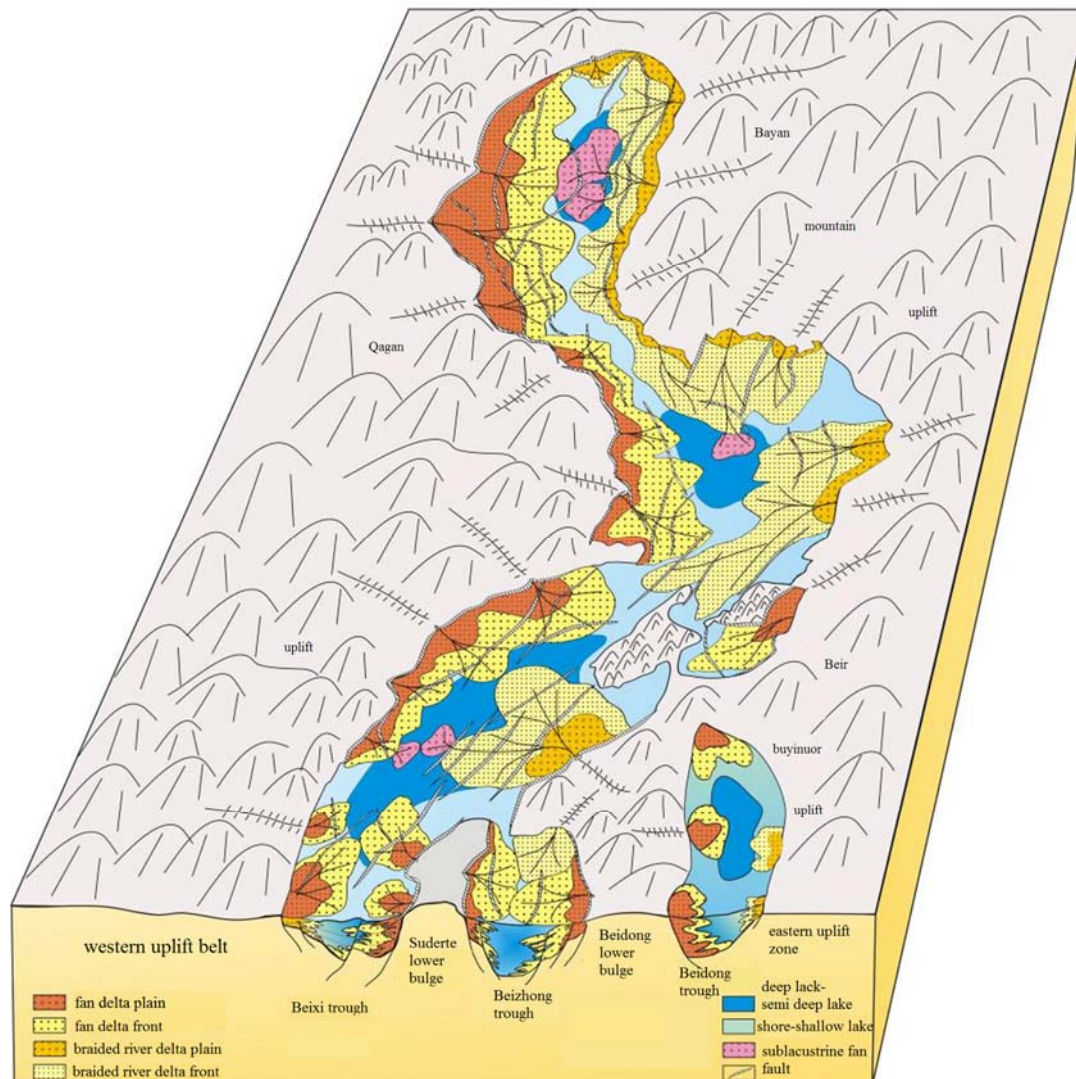


Figure 2. Depositional systems distributing of the first member of Nantun formation in Wuxun-Beir Sag

3. There are Four Types of Reservoir and Multiple Anomalous High Porosity Zones

The reservoir in Wuxun-Beir sag distribute in Tongbomiaio stratum and Nantun stratum. The reservoirs rock include multiple types, which include pyroclastic rocks (fused tuff and tuff), volcano sedimentary rock (sedimentary tuff and tuffaceous sandstone), dawsonite-bearing sandstone, and common sandstone.

The reservoirs of Tongbomiaio-Nantun stratum in Beir sag include pyroclastic rocks, volcano sedimentary rock and common sandstone. The type of reservoirs of Tongbomiaio stratum is pyroclastic rocks, volcano sedimentary rock and sandstone (Fig. 3a). The type of reservoirs of lower Nantun stratum is volcano sedimentary rock, sandstone and pyroclastic rocks (Fig. 3b). The type of reservoirs of upper Nantun stratum is sandstone, volcano sedimentary rock and pyroclastic rocks (Fig. 3c). The content of volcanic clastic material longitudinally decrease gradually from the bottom to the top, and transition to sandstone last. The reservoirs in Wuxun sag include sandstone, volcano sedimentary rock and dawsonite-bearing sandstone. The pyroclastic rock has less content. The type of reservoirs of Tongbomiaio stratum is sandstone, volcano sedimentary rock and dawsonite-bearing sandstone (Fig. 4a). The type of reservoirs of lower Nantun stratum is mainly sandstone (Fig. 4b). The type of reservoirs of upper Nantun stratum is sandstone, dawsonite-bearing sandstone, and volcano sedimentary rock (Fig. 4c).

The formation and distribution of secondary pore in reservoir is the key to capacity and scale of lithologic and stratigraphic reservoirs. Research shows that there are longitudinally two anomalous high porosity zone in Tongbomiao-Nantun stratum in Beir sag. One of high porosity zone is in depth of 1300-1800m, the other one is in depth of 2400-2700m. There are longitudinally three anomalous high porosity zone in Wuxun sag. One of high porosity zone is in depth of 1200-2000m, another is in depth of 2200-2500m, the third is in depth of 2700-2740m. The porosity of reservoir is controlled by the rock type, clastic particle cladding, atmospheric water leaching, sedimentary facies and the injection of CO₂, etc.

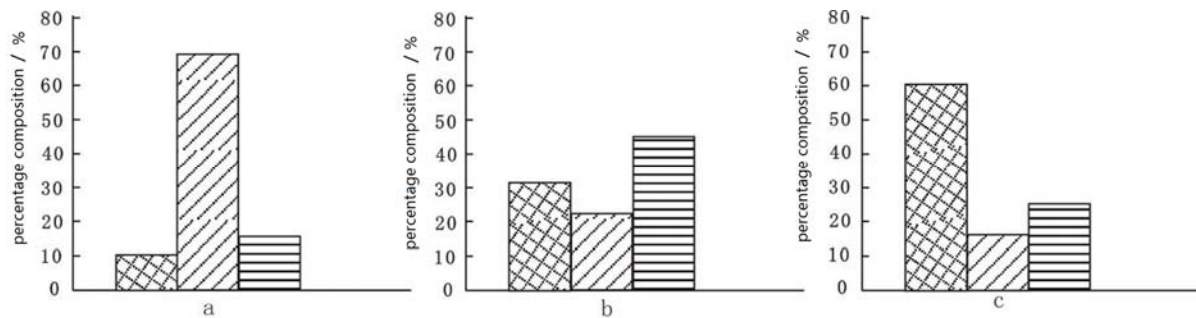


Figure 3. Histogram of rock types reservoir for Tongbomiao Formation(a), 1st Member of Nantun Formation(b),and 2nd Member of Nantun Formation(c) in Beir sag

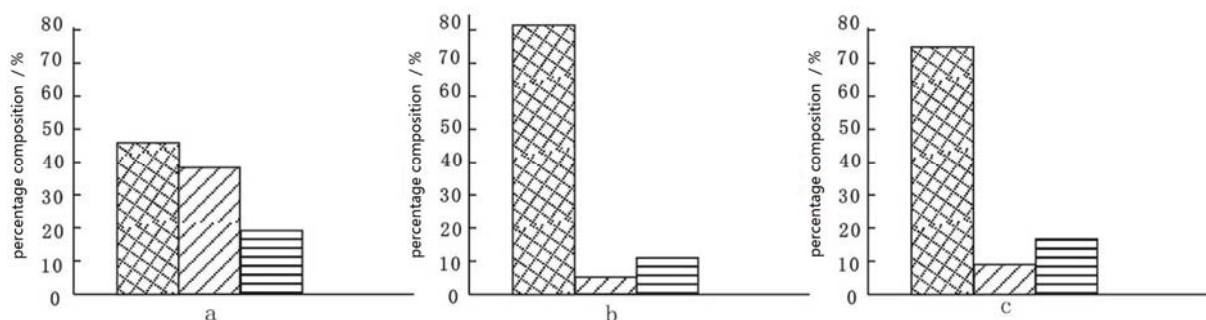


Figure 4. Histogram of rock types reservoir for Tongbomiao Formation(a), 1st Member of Nantun Formation(b),and 2nd Member of Nantun Formation(c) in Wuxun sag

4. Stratigraphic Reservoir

The reservoir can be divided into stratigraphic overlying reservoir, stratigraphic unconformity reservoir and buried-hills reservoir.

(1) Stratigraphic overlying reservoir

The reservoir distribution in the slope or bulge of basin edge, for example, well BeiD8, the oil generated in Beixi subsag and migrated along the unconformities, faults or sand body, and accumulated in the traps in Beixi slope.

(2) Stratigraphic unconformity reservoir

The reservoir distribution in the slope, palaeo uplift in basin, edge of palaeo protruding. The sand bodies underwent multistage tectonic movement, and were uplifted and denudated, and then were sealed by impermeable mudstone. So unconformity reservoir was easy to form under the unconformities, for examples, well Bei37, well Su33 and well Huo3 reservoirs.

(3) Buried-hills reservoir

The reservoirs distribute in Beir sag basically. There are two models which are bedrock weathering crust reservoir and bedrock fissure reservoir.

Well Bei34 is a typical example of bedrock weathering crust reservoir. The oil generated in Beixi subsag and migrated along the unconformities and faults, and accumulated in Suderte structural belt.

Bedrock fissure reservoir distribute in Suderte structural belt basically. Fracture and pore are rich in

the mudstone; they are reservoirs and migration channel, for examples, well Bei14, well Bei16 reservoirs.

5. Conclusion

There are three sets of source rock, six kinds of sedimentary systems, four types of reservoirs, multi high porosity bands, five times tectonic movement, six sedimentation ceases, three sets of source reservoir caprock assemblage. The geology condition is favorable to Lithologic and stratigraphic reservoirs. Lithologic and stratigraphic reservoirs distribute along unconformities and different level flood surface longitudinally, and distribute around the hydrocarbon source stove on the plane. There are different types of lithologic reservoir in different zone athwartships. The characteristics of lithologic reservoir are different evidently in different tectonic position.

6. References

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