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Study of characteristic of petrology and diagenesis in Jin 31-Jin 146 well area, Liaohe depression, Bohai Bay Basin

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Abstract: Jin 31-Jin 146 well area, Liaohe depression, Bohai Bay has a complicated structure, from the conditions in recent years, some of the oil and gas well production was not consistent with the performance of adjacent Wells, because of never done fine geologic research in Jin 24 pieces and Jin 33 wellblock,there was unconfirmed structure and low degree of awareness of the main purpose and main research layer section, conventional cognition is difficult. To fully tap the work area of oil and gas potential, it was necessary to carry out the work area related geological research. This paper applied data logging interpretation results, chip information, grading analysis and physical properties such as test data to srudied the petrology characteristics and discussed the diagenesis. The results showed that there was poor physical properties of the work area, compaction is relatively weak, with the increase of buried depth the diagenesis enhancement and physical property becomes poor.

Key words: *Liaohe depression; petrology characteristics; diagenesis*

I. GEOLOGY

Liaohe depression in Bohai Bay is a Cenozoic continental rift that are rich in oil and gas, total area of the depression is $1.24\times10^4 km^2$. According to its structural characteristics can be further divided into seven tectonic units:eastern sag, western sag,Damintun Sag,Shenbei Sag, central uplift, eastern uplift,western uplift[1].

Jin 31 - jin 146 wellblock was located in the huan south west oil of the western depression,next to huan 5 wellblock in the north, connected to Jin 127 wellblock in the south, connected to Jin 25-11 wellbolck in the east,there was blank area in the south of Jin 38 block in the west, area of about $40.0km^2$. Paleogene system are main exploration target zone in the liaohe oilfield at present, distribution area is $0.67\times10^4 km^2$. Palaeogene from bottom to top in turn developed Kongdian Formation,Shahejie Formation,Dongying Formation,Guantao Formation,Minghuazhen Formation. Main purpose of this project was the upper middle of Member 3 of Shahejie Formation.

II. STUDY ON RESERVOIR CHARACTERISTICS

2.1 Petrologic feature

2.1.1 Thickness

Reservoir petrology characteristics including colors, construction, structure, composition, etc. from macrocosm to microcosmic. The Rehetai reservoir and Dalinghe reservoir was formed by gravity flow mechanism, which was mainly composed of sandy conglomerate, sandstone sublacustrine fan clastic rock. In the study of reservoir geology, the reservoir thickness can be divided into sharp layer, thin layer, medium-thick layer, thick and extra-thick layer according to the oil and gas industry standard "the oil and gas reservoir evaluation method"[2].

Log interpretation results of the reservoir thickness statistical results showed that reservoir of the reservoir in Rehetai and Dalinghe was given priority to with thin layer and thick layer(Fig.1,Fig.2). Other blocks of the Rehetai reservoir average thickness was larger than the Dalinghe reservoir besided Jin 136 block. Jin 2-6-9 block and Jin 29 reservoir thickness of single layer was larger than Jin 24 the block and Jin 136 block reservoir thickness in the same horizon. That was to say, provenance from the northeast to the southwest, the single layer thickness of the reservoir has a tendency to gradually reduce.

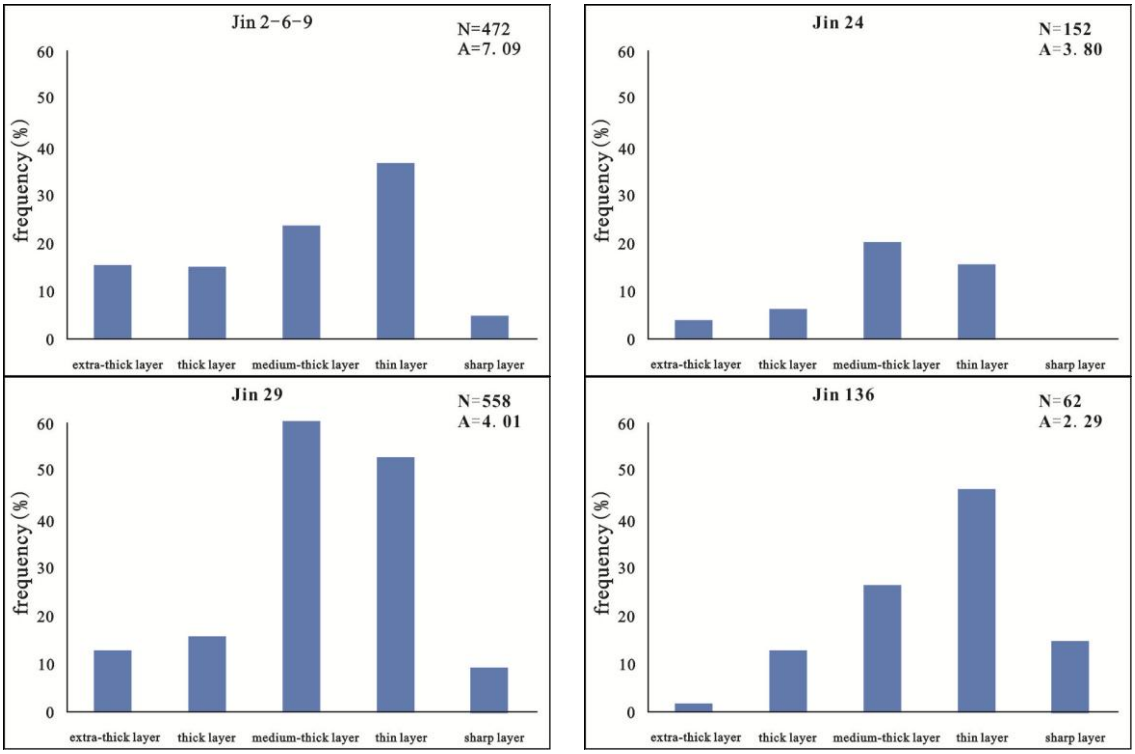


Fig.1 The histogram of each block single sand body thickness in Rehetai reservoir

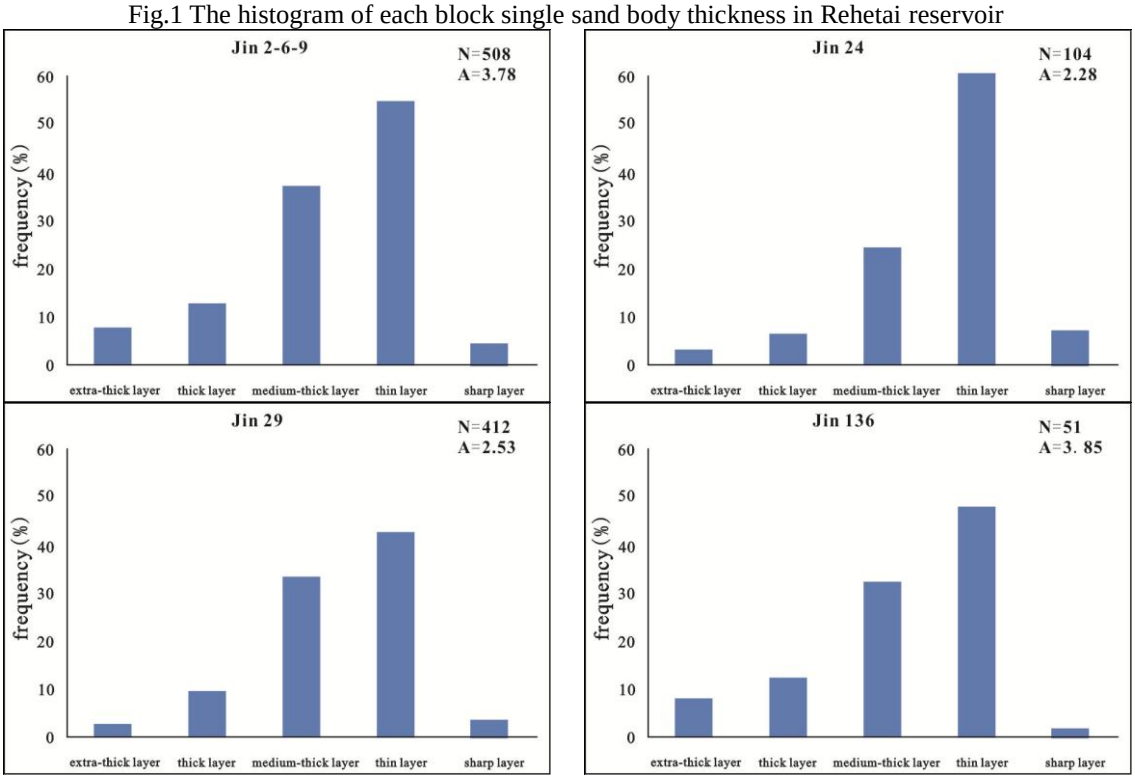


Fig.2 The histogram of each block single sand body thickness in Dalinghe reservoir

2.1.2 Texture

2.1.2.1 Granularity

The structure of the reservoir including clastic particles size, sorting and rounded, but granularity has larger effect on reservoir properties,therefore, in "the oil and gas industry standard of the People's Republic of China - rock thin section identification"[3], according to the particle size of coarse clastic ,the rocks can be divided into breccia, coarse sandstone and sandstone, fine sandstone, very fine sandstone and siltstone. Statistics of grain size analysis data(Fig.3,Fig.4) showed that the Rehetai reservoir and Dalinghe reservoir is given priority to with sandstone and fine sandstone.

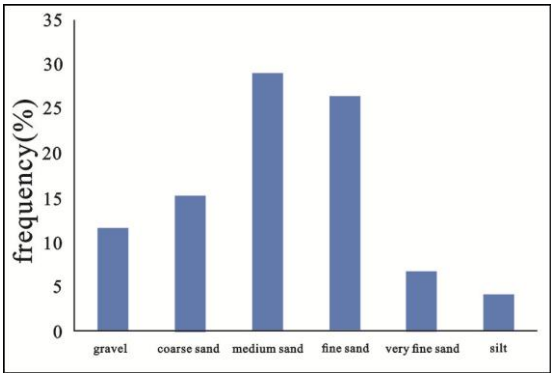


Fig.3 The Rehetai reservoir sandstone grain size analysis histogram

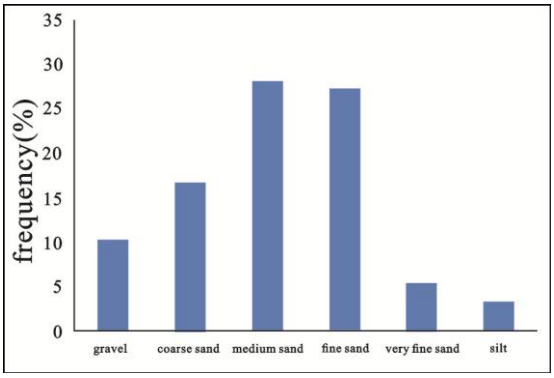


Fig.4 Dalinghe reservoir sandstone grain size analysis histogram

2.1.2.2 Sorting, rounded

Clastic reservoir with good sex of particle separation has large pore space and equally distributed, pore type was single, the pore throat ratio was small, less interstitial substance in the pore, between the porosity and the pore connectivity was good, porosity and permeability were high. statistical results of the 208 pieces sample showed that the degree of separation in Rehetai reservoir and Dalinghe reservoir in Jin 31 - Jin 136 wellblock reservoir was medium - bad, clastic particles was mainly subrounded – subangular, poor sorting and rounded, has a negative influence on reservoir property. The Rehetai reservoir and Dalinghe reservoir development in sublacustrine fan of the gravity flow mechanism and with grade of mixed clastic accumulation, less sorting and rounded were the main reason for Jin 31 - Jin 136 wellblock clastic structural differences.

2.1.3 Component

2.1.3.1 Clastic particles mineral composition

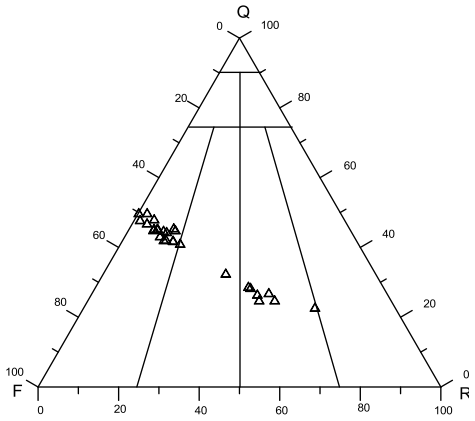
According to our country oil and gas industry standard specification sheet identification[3], the statistical results of the chip data of 10 typical Wells showed that Jin 31 - Jin 136 wellblock reservoir is mainly feldspar sandstone, feldspathic lithic sandstone and lithic feldspar sandstone(Fig.5). Detrital composition is mainly composed of quartz, feldspar and cuttings and trace heavy mineral composition, there was high content of soluble component such as feldspar and cuttings in sandstone detrital component, provided a rich material foundation for the formation of secondary porosity. The content of quartz is commonly 20% ~ 41%, average value was about 38%; and feldspar content occupied primacy in clastic composition, average value was 23% ~ 50%, average was about 42%, cuttings content was between 2% ~ 42%, average value was about 20%, the cutting was given priority to with acidic extrusive rock, the rest was composed of granite, quartzite, shallow metamorphic rock and sedimentary rock.

2.1.3.2 Filler content composition and cementation

Filler content of purpose layer reservoir in the study area was given priority to with mudstone and carbonate cements, carbonate were mainly calcite. Filler content of the reservoirs were mainly distributed in between 10% ~ 20%, average value was 12%. Cementation type was given priority to with pore type, basal type.

2.2 Study of diagenesis

In petrochina "15" of science and technology research projects “research of reservoir evaluation method” projects[4], on the basis of fluid inclusion homogenization temperature, vitrinite reflectance R_o, sporopollen color *TAI*, chromatography - mass spectrometry, pyrolysis analysis, determination of organic acids, X-ray diffraction, the common thin section microscopic identification, scanning electron microscopy, electron probe, the casting thin sections identification, according to the oil industry standards (SY/T5477-2003) clastic diagenetic stage division of specification[5], divided clastic rock diagenesis of yuanyang gully region in the western sag of liaohe into two phases five (subage): precocious rock stage A and stage B, mesogenetic stage A_1 subage, A_2 subage and stage B, the depth of the floor were respectively 1600m,2900m,3800m,4500m and the deep that more than 4500m. Further research the main diagenesis types and its impact on reservoir pore evolution and physical properties in the work area.



I--quartz sandstone II--feldspathic quartz sandstone III--lithic quartz sandstone
IV--arkose V--lithic feldspar sandstone VI--feldspar lithic sandstone VII--Litharenite
Fig.5 Jin 31 - Jin 136 wellblock triangle reservoir rock types

2.2.1 Mechanical compaction

With the increase of the depth, the mechanical compaction effect was enhanced. In the overlying strata pressure, sandstone clastic particles occured displacement and sliding, clastic particles on the contact relationship between the dots - line - evolution suture contact order. Considering from the perspective of compaction, Jin 31 - Jin 136 wellblock experienced by the vast majority of sandstone diagenesis can't more than mesogenetic stage. In the early diagenesis, there was weaker cementation and easier ampaction. With the increase of buried depth, the contact relation between the clastic particles gradually changed from point contact into line contact, in the rapid loss of intergranular pore cause the rapid loss of intergranular pore. Usually think[6], the influence of compaction maximum depth at about 2500 m. And sandstone of most well of purpose layer in the study area buried depth of 1500 m deep, clastic particles main point - line contact. Due to the same horizon from northwest to southeast in depth gradually increase, so the mechanical pressure was gradually increased. In addition, the compaction under the influence of mixed base content discretion was more noticeable. The study area was gravity flow deposits, sand mixed mud, rapid accumulation, the high content of matrix, supporting role of particles was strong, compaction was relatively weak.

2.2.2 Cementation

Carbonate was the most common filler content in Jin 31 well – Jin 136 wellblock, followed by shale and quartz. Carbonate cement of sandstone reservoir in work area were mainly intergranular cement, content or secondary pore filling. When the carbonate cements in the sandstone was crystalline, clastic particles floating shaped, then this cement formed in shallow buried without compaction stage,and microcrystalline - grain shape of output of carbonate cement is often formed in the deep burial stage[7]. The area of argillaceous sandstone body mostly in the form of mixed base filling in pore.

2.2.3 Dissolution

Jin 31 - Jin 136 wellblock reservoir rock dissolution mainly happens on the precocious stage B period - A of middle diagenesis phase, at about 1600m to 4000m depth range. The dissolution mainly was acid unstable mineral dissolution mainly for aluminum silicate minerals feldspar, cuttings and carbonate cement dissolution in this area, be dissolved feldspar was plagioclase, orthoclase and albite, cuttings were mainly rich in feldspar lithic, carbonate minerals were mainly calcite. Feldspar and debris dissolution mainly formed intragranular dissolved pore or mold hole, dissolution of carbonate cement was often to intergranular dissolved pore. But the dissolution of minerals was mainly feldspar,less calcite and cuttings.

III. CONCLUSION

1) Rehetai and Dalinghe reservoir in the reservoirs was given priority to with thin layer and thick layer, mostly was medium-sandstone and fine sandstone.
2) The degree of separation of Rehetai reservoir and Dalinghe reservoir was medium – bad, poor sorting and rounded.
3) Filler content of purpose layer reservoir was given priority to with mudstone and carbonate cements.
4) Compaction was relatively weak, carbonate cement of sandstone reservoir in work area were mainly intergranular cement, content or the form of secondary pore filling, most of argillaceous filling in pore with the form of matrix. The dissolution mainly was acid unstable mineral dissolution mainly for aluminum silicate

minerals feldspar, cuttings and carbonate cement dissolution in this area. With the increase of buried depth in Jin 31 - Jin 136 wellblock, the diagenesis enhanced and hysical property became poor.

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