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In The Area Of Songliao Basin In Gaotaizi Reservoirdiagenesis Research

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Abstract:- Qijia region is located in the northern Song Liao Basin in the central depression area, Gaotaizi reservoir is a typical tight reservoir, the study of the effects of diagenesis on reservoir properties are conducive to further exploration development. The rock types of Gaotaizi reservoir is mainly lithic arkose. The maturity of element is low, mainly fine-grained. Primary pores are less, secondary pores are mainly intragranular dissolution pores. The average porosity of Gaotaizi reservoir is about 13.34%, the average permeability is $27.41\times10^{-3}um^2$. On the basis of including vitrinite reflectance, the highest pyrolysis temperature, the transformation of clay minerals of Illite/montmorillonite mixing layer, rock features, authigenic mineral assemblage of sandstone, Gaotaizi reservoir is belong to middle diagenesis. The types of diagenesis which affect development of reservoir are including: compaction, dissolution, cementation, metasomatism and Pressolution. According to the objective study of diagenesis types and the judgement of diagenetic stage, the area is divided into four kinds of diagenetic facies: forced compaction diagenetic facies, illite cement diagenetic facies, carbonate cementation diagenetic facies, feldspar dissolution diagenetic facies. The influences of diagenesis acting upon reservoir physical property are three ways: mechanical compaction, the deposit of calcite cementation, authigenic quartz and filaments illite and the inject of oil and gas destory the reservoir porosity; The chlorite cladding protects the reservoir; dissolution due to oragnic acid improving reservoir properties by the formation of secondary porosity to increase reservoir space.

Key words*:-Songliao Basin; Qijia region;Gaotaizi reservoir;Diagenesis;Reservoir*

I. INTRODUCTION

Diagenesis refers to the various physical, chemical and biological processes after the deposition of sediments, and the interaction between the original sediment and the pore water of the medium can be balanced by diagenesis. In recent years, a lot of achievements have been made in the study of diagenesis.Diagenesis mainly through petrology, mechanical compaction, authigenic mineral precipitation and dissolution of reservoir. Rock composition is mainly soluble minerals such as feldspar and soluble rock, reservoir is easily dissolved in the fluid and sorting is poor reservoir physical property is poor; mechanical compaction is damage to reservoir is one of the main reasons, with the buried depth increases reservoir primary pores and reduce; calcite, secondary increase effect of quartz, illite, chlorite and other secondary mineral precipitation of reservoir physical properties of major, each mineral because of its content, forming time and occurrence and on the physical property of reservoir has a different mechanism. The study shows that the porosity of sandstone decreases with the increase of buried depth, and the compaction and cementation are the main reasons for the decrease of porosity when the depth of the 2500m is reached. Extension of Yanchang Formation of the upper Triassic Oil 2 stratigraphic river facies, delta facies sandstone caused by cementation of porosity loss of 1.8%～30%, an average of 7.1% and cementation of carbonate cements and quartz authigenic increase is caused by the physical properties of sandstone has become the main cements and sandstone in carbonate cement content and porosity and permeability of sandstone was significantly negative correlation. The cementation of the Tarim Basin in the north area of the Tarim Basin is reduced from 40% to 26.6%, and carbonate cementation plays a key role in the evolution of sandstone porosity. Yan Jianping of Ordos Basin in the southern ancient life circle of low porosity and low permeability sandstone reservoir layer into the diagenesis study found when the content of carbonate cements in less than 5%, the porosity can be big or small, usually 2%～15%, once the calcite content higher than 5%, the porosity is less than 6% in general; dissolution is the main formation mechanism of secondary pores in, its degree of development greatly affects reservoir. Secondary porosity of sandstone reservoir influence greatly by of secondary pore zones seriously study and found that the diagenesis, especially the dissolution of secondary pores formed a significant contribution, mainly is the dissolution of silicate minerals such as feldspars.

Qijia Gulong area is an important exploration area of the northern Songliao Basin, has about more than 50 years of exploration history and Gaotaizi oil layer is Qijia Gulong region, one of the main reservoirs in a tight reservoir is a typical representative. Longhupao area (including Qijia Gulong sag of the northern half) of Gaotaizi reservoir diagenesis causes reservoir porosity medium and low permeability, including mechanical compaction,

cementation and dissolution, etc.

II. PETROLOGICAL CHARACTERISTICS

Reservoir sandstone petrologic characteristics of the reservoir set properties of large size in different chemical composition and structural characteristics is not the same, will affect primary porosity for the sandstones of the development, and the sandstone diagenetic changes also have great influence. In the rock into the specific conditions, the petrologic characteristics of sandstone diagenesis decided to further control the type, pore evolution. Storage layer petrological characteristics of reservoir of diagenesis, pore structure and reservoir layer of huge. Therefore, the research is conducive to diagenesis and reservoir properties.

1.Skeleton clastic composition

Clastic minerals by detrital components and interstitial material composition and detrital composition is composition of the rock and the main part, which determines the rock basic type and name. Quartz is mainly composed of single crystal quartz, containing a small amount of polycrystalline quartz. The surface is clean, no cleavage, a gray level interference color, low. In cathodoluminescence system, the vast majority of quartz hair dark blue light. The feldspar plagioclase, followed by alkali feldspar. Plagioclases polysynthetic twin, visible portion of the sheet perthite, characterized by the development of twin stripe. In the cathode luminescence system, the main yellow green light, followed by light blue light. Cuttings are mainly tuff debris, followed by the rock cuttings. Tuff debris consists of feldspar, quartz and individual grains have dark mineral composition, containing only feldspar and quartz. In the part of iron precipitation in rock cuttings. The distribution of the black mica is less, and the content is less, mainly develops in the fine-grained sandstone, mostly is the leaf shape, the compression bending.

2. Compositional maturity

Sandstone is composed of clastic particles and fillings, clastic particles mainly quartz, feldspar and lithic and contain varying amounts of flaky minerals and heavy minerals. In the process of sediment transport, the unstable components have been eliminated, and the stable components are gradually enriched. If the appropriate conditions, the debris group will be fully transformed into an intermediate state, that is, the unstable components eliminated, and finally only the most stable of the quartz debris. Compositional maturity degree will affect the properties of the reservoir, with the higher maturity of the sandstone composition and unstable group reduced, and stable component relative increase in compressive ability strong, not easy to deformation, generally, compositional maturity and high degree of sandstone mechanical compaction effect is weak, primary pores and relatively developed, and compositional maturity and low degree of sandstone into rock interaction is strong, with high content of feldspar is dissolution strongly, secondary porosity, high debris content, compaction machinery strong, due to the compaction of microporous development. The parameter of the close degree between the rock composition and the ideal state is the composition maturity:

3. Structure characteristics

The structure of clastic particles is mainly described by the quantitative or qualitative indexes, such as the particle size and the sorting, the contact relationship between the particles and the particles. Sorting debris particles have a direct impact on reservoir, in general, sorting better reservoir, reservoir physical property is better, poor sorting of reservoir due to small mineral particles blocked larger mineral particles formed pores caused poor reservoir physical properties. Local zone Gaotaizi oil sandstone dominated by fine-grained, separation medium to good, less mixed base, grain supported, inter particle contact relationship to bump and line contact. Particle size, called particle size, usually refers to the maximum apparent diameter, in order to facilitate research to be divided into several levels of granularity, this level of granularity is called particle size. The current commonly used particle division scheme is the sandstone is divided into very fine sandstone (0.063mm～0.125mm), fine sandstone (0.125mm～0.25 mm) and sandstone (0.25～0.5mm) and coarse sandstone (0.5～1.0mm).

According to the analysis of the microscopic particle size data, sandstone grain size histogram (Figure 2-1), local in Gaotaizi reservoir sandstone is mainly fine sandstone content (30%). Secondly, sandstone content (21%), very fine sand content (19%), clay content (17%), grit content (9%), fine conglomerate content (3%), conglomerate content(1%).

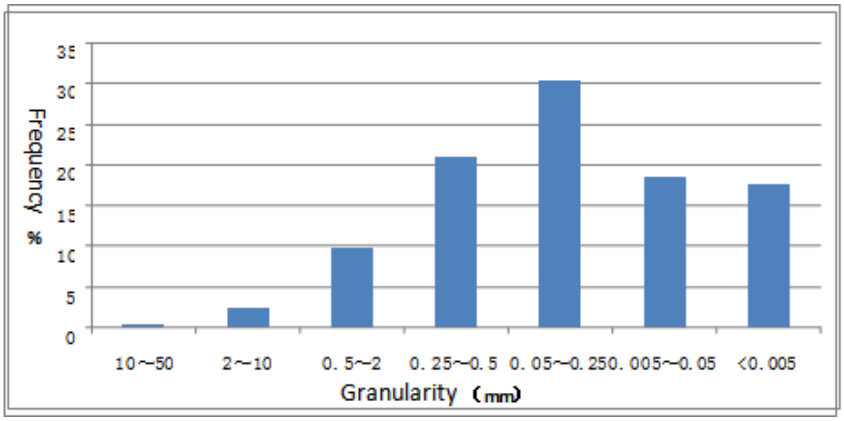

Figure 2-1

III. RESERVOIR CHARACTERISTICS

1.Primary porosity

Primary pore system refers to in clastic rocks in sedimentary process formed in the crystal, or clastic particles between natural growth between the single pore forming, has not undergone the transformation of cementation, infilling of minerals or dissolution. The primary pore type of Gaotaizi reservoir in the study area are as follows:

a.Primary intergranular space

①Primary intergranular space

Intergranular space is the pore between the clastic particles. Not by caulking, authigenic mineral filling, cannot withstand pore fluid dissolution intergranular space is primary intergranular space. The primary challenge in Gaotaizi reservoir pore of this area has a variety of forms: such as triangular, quadrilateral or irregular shape etc.

②Residual primary intergranular space

The remaining part of the remaining primary intergranular space is the cemented material (such as calcite, etc.) or in situ minerals (such as in situ quartz). Primary intergranular space is mechanical percolation clay, calcite, secondary increase quartz filling and the formation of the research zone Gaotaizi oil residual primary intergranular spaces.

b.Primary intergranular pore

The inner hole of the grain is the pore of the interior of the mineral particles. The grain size is smaller than the intergranular pore.

The primary intergranular pores in this area are mainly clastic mineral grains, intergranular pores and intergranular pores.

①Intergranular pore of clastic minerals

Development between the clastic mineral particles inside the crystal pore is detrital minerals intergranular pore, study area of Gaotaizi reservoir only developed biotite grains of detrital minerals intergranular pores.

②In situ mineral crystal pore

The pore of the internal crystal of the self - in - in - situ mineral particles is the self - in - situ mineral crystal pore. This type of pore is very small, not observed under polarizing microscope. The study area of Gaotaizi reservoir of authigenic mineral intercrystal pores mainly developed in microcrystalline quartz in

2. Secondary porosity

The secondary porosity is due to the dissolution of the particles, the matrix, and even the early formation of the dissolution of the cement.

a.Intergranular dissolution pore.

As the name suggests, intergranular dissolution porosity is the pore formed by the transformation of the dissolution of various dissolution. The dissolution pores in the study area include dissolution intergranular pore, residual dissolution intergranular pore and dissolution pore.

①Dissolution intergranular pore

Dissolution intergranular pore often because of detrital mineral properties and different corrosion occurrence, such as the edge of the dissolution of detrital quartz present embayment, particles on the cutting edge is arc shaped, such pore in Gaotaizi oil layer in Qijia Gulong region is relatively common.

②Residual intergranular pore

Residual dissolution intergranular pore, which is formed by the dissolution of the cemented material or in the self formed mineral deposits, is the residual dissolution intergranular pore. Calcite is the main study area filling

corrosion intergranular pore cements, authigenic minerals including percolating clay and authigenic quartz, as shown, edge of the particles was embayment indicates that the pore had suffered denudation, such pore in Qijia Gulong area of Gaotaizi reservoir is also more common.

③Super large pore

Multiple dissolution intergranular pores are connected into a larger pore, which is a solution of super large pores.

b. Grain dissolution porosity

The pores formed by dissolution and dissolution of minerals in the interior of clastic particles are called as dissolution pores. Gaotaizi reservoir in the study area the intragranular dissolution pore including feldspar lithic intragranular dissolved pore, intragranular dissolved pore and moldic pore. Such porosity is more common in the study area.

①Feldspar dissolution pore

The pores formed by dissolution in the interior of the clastic feldspar particles are feldspar grains. The dissolution of feldspar grains of feldspar dissolution is often along the cleavage plane window edge shape.

②Debris dissolution pore

The pores formed by dissolution in the interior of the debris particles are the dissolution pores of the cuttings. Due to the different lithology, different degree of dissolution of different cuttings, lithic tuff and medium of volcanic rock dissolution is obvious.

③Molding pore

When the particle dissolution reaches a certain degree, detrital grains was completely dissolved, leaving edge residue of contour, namely moldic pore, on behalf of the strong local dissolution. Moldic pore Gaotaizi oil layer in Qijia Gulong area is generally caused by the dissolution of feldspar grains strongly corrosion.

IV. DIAGENESIS OF RESERVOIR

Rock action will change the composition and structure of the rock, physical characteristics of rock types of pore structure and permeability, not only affects the primary pore also of secondary pore formation and development have a decisive impact, thus affecting the reservoir physical properties, so analysis and Research on the diagenesis and its to the influence degree of the reservoir pore, secondary pore distribution of predicting area and of later reservoir for further exploration and development has certain significance. By means of data processing and thin section observation, the identification of the self forming minerals, the diagenetic sequence and the diagenetic stage were identified.

1. Compaction effect

Compaction refers to down after the sediment deposition and in the overlying water and sediment under hydrostatic pressure or by the tectonic deformation stress, the sediment volume reduction, internal water discharge, low porosity effects. Their main functions are: to make the rigid particles between the micro cracks or the re arrangement of the particles. For the soft particles, it will make it because of compression deformation and the performance of the form of false, or is extended and the performance of the direction of the. In addition, the shape and other minerals also bend deformation, in particular, the outstanding performance is mica. The compaction effect is mainly controlled by the maturity of the rock structure, the component maturity (plastic debris content), the thickness of the coal seam, the thickness of the sand body, and the depth of burial. In the same burial depth, the finer the sediment particles, the worse sorting, the higher the plasticity, the higher the content of the impurity, the greater the effect of compaction on the reservoir properties

Compaction makes the sediment close to the rock, with the depth increasing, the contact relationship of the clastic particles is changed into the line contact by the point contact. Gaotaizi oil reservoir rock quartz, feldspar and lithic clasts particles into line and asperity contact, point contact and suture contact was observed, the narrowing of the original intergranular pore is very obvious; mica and ostracode clastic plastic deformation are also common. Reservoir buried depth is moderate, but due to the fine sediment particles and poor sorting, and coupled with a certain amount of impurity and plasticity strong carbonate particles. Therefore, the effects of compaction of sediments has reached - deep degree (Figure 4-1).

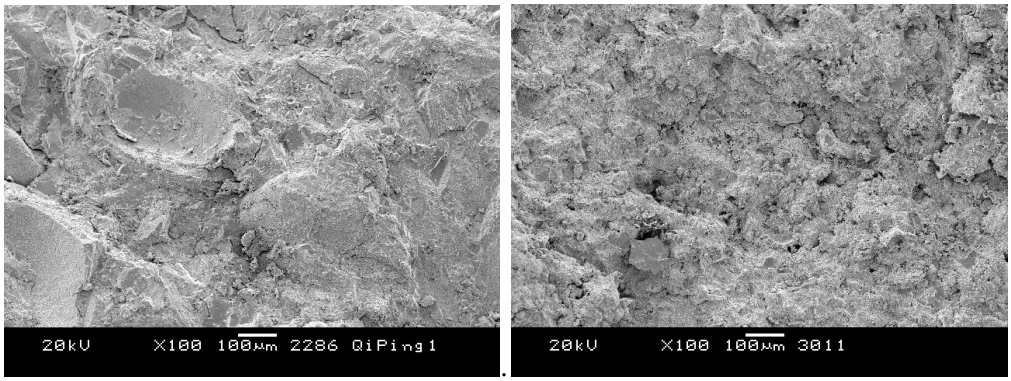

Figure 4-1

2. Dissolution and dissolution

The dissolution is defined as: the solid component in the rock is uniformly dissolved, and the fresh surface composition of the solid phase is always constant. In low porosity and low permeability reservoir area, dissolution and dissolution is the important diagenesis to change the properties of sandstone reservoir. Skeleton clastic particles and cement dissolution of secondary pores to find a Ligao pore zone has an important guiding significance.

Casting thin sections show, detrital feldspar and lithic suffered a relatively common dissolution, dissolution, on the edge of a very small amount of detrital quartz exhibit suffered by the signs of dissolution of feldspar dissolution, dissolution of the relatively strong, is the erosion and dissolution of part often accounts for detrital feldspar volume of more than 1 / 2, formed in the erosion and dissolution of secondary pores in generally retained damaged residue with louvered. In part of the secondary pores filling bitumen and particle pore filling coarse grained calcite, which indicated asphalt formed later than the feldspar dissolution, dissolution, and earlier than that of coarse grained calcite .

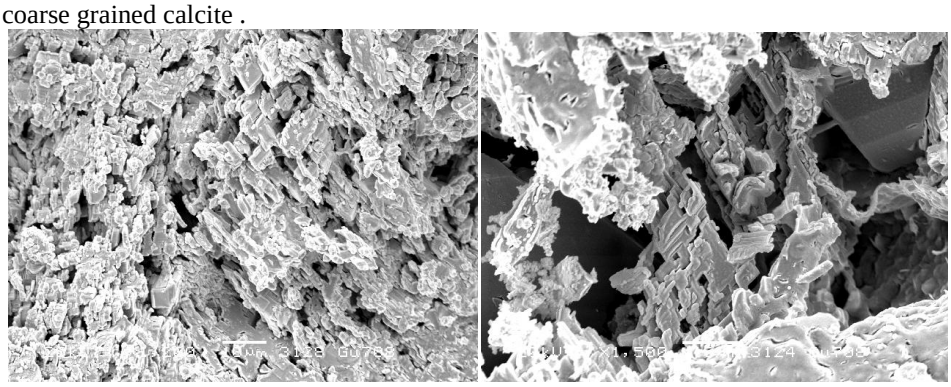

Figure 4-2

From dissolution, dissolution of cuttings is mainly tuff debris and Ayama Iiwa. Lithic tuff matrix is partly or completely dissolved, and feldspar and felsic part residual form diffuse shaped and annular secondary pores. Dissolution dissolution mainly occurred in clastic feldspar and debris, and its occurrence time was earlier than that of oil and gas(Figure 4-2).

V. DIAGENESIS ON RESERVOIR PHYSICAL PROPERTY CONTROL

Rock action will change the composition and structure of the rock, physical characteristics of rock types of pore structure and permeability, not only affects the primary pore also of secondary pore formation and development have a decisive impact, thus affecting the reservoir physical properties, so analysis and Research on the diagenesis and its to the influence degree of the reservoir pore, secondary pore distribution of predicting area and of later reservoir for further exploration and development has certain significance.

Among the various factors affecting the reservoir physical properties of the study area, the compaction effect plays an important role in the change of physical property. When the difference between the formation of the structure, even if the reservoir is in the same stage of sedimentary formation, but as diagenesis is relatively weak, the reservoir in the underground depth is relatively shallow, compaction effect is relatively weak, the contact relation between the clastic grains show for the point contact, so the pores of the reservoir permeability is better, however, when the reservoir in the depth of the underground is the deep, the contact relationship between particles by point contact change point - line contact or line contact, resulting in pore permeability variation, reservoir physical properties deteriorate. Different diagenetic stage, compaction influence on physical properties in different degree, generally speaking, when the diagenesis is at the early stage, just settling down of detrital material before

consolidation. In the overburden pressure, clastic particles will generate rotation, particle recombination occurs between, plastic components of distorted deformation, so in the early its influence on physical properties is far greater than the resulting in the late effects.

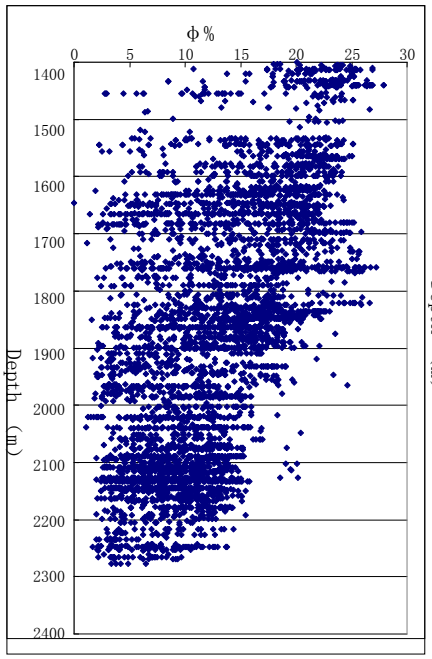

Figure 5-1

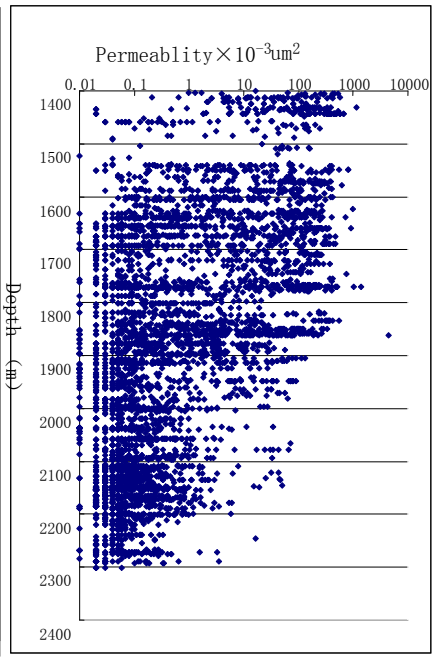

Figure 5-2

Study on compaction in the macro performance: depth of 2140～2220 meters, porosity development in 8%～14%; depth range 2220～2320 meters, porosity development in 3%～8%; buried depth is 2140～2220 meters, a penetration rate of 0.05～0.8md; buried depth is 2220～2310 meters, a penetration rate of 0.03～0.07md (Figure 5-1, Figure 5-2).

The main function of dissolution is to produce secondary pores, so that the physical property of the reservoir can be improved. The study area of Gaotaizi reservoir development mainly in a variety of pores, feldspar intergranular and intragranular dissolved pores. The dissolution of feldspar grains generally along the weak tectonic cleavage or bicrystal, pane inter granular pores, individual particles, leaving only a shell, which group points is eroded away. After strong dissolution and feldspar eventually present - shaped debris. If the degree of corrosion to further strengthen, moldic pores. Carbonate cements. After the formation of intergranular pore and intergranular pore. Primary pores in the dissolution of the larger, the dissolution of the development of the part of the reservoir, the physical properties are usually better. Feldspar content and feldspar dissolved pore content with a good positive correlation, the statistical content of feldspar and storage layer relationship, between the two has weak positive correlation between, from the side also shows feldspar content high, the more conducive to the dissolution of candle pore formation .In conclusion, dissolution and dissolution is one of the influencing factors of the development of secondary pores, and the dissolution and dissolution are related to organic acids, so the distribution of favorable reservoirs can be predicted according to the distribution of organic acids.

VI CONCLUSION

1. Reservoir sandstone rock type is mainly lithic arkose and lithic sandstone, granularity is mainly fine sandstone, middle good sorting, compositional maturity and low, less mixed base, grain supported, inter particle contact relationship to bump and line contact.
2. Based on vitrinite reflectance, the highest pyrolysis temperature, illite / smectite mixed layer clay minerals transformation, rocks, sandstone in authigenic mineral assemblages and can determine the Gaotaizi reservoir layer in the middle diagenetic stage.
3. The influence of reservoir development the main diagenesis including: compaction, dissolution, cementation of carbonate cementation, quartz cementation, clay mineral cementation, metasomatism and pressure dissolution.
4.Qijia area of Gaotaizi reservoir into rock phase types are classified to four kinds: compaction into rock facies, illite colloid formed facies, carbonate cementation into rock facies, feldspar dissolution diagenetic phase.
5.The influence of diagenesis on reservoir physical property as the main: mechanical compaction, filling

bitumen, calcite, secondary increase of quartz cementation reduce the reservoir pore space; illite and illite smectite mixed layer filling pore, throat blockage of bridge like illite, damage reservoir; caused by organic acid dissolution by forming secondary pores to increase reservoir space, from improving the reservoir physical properties.

6. Gaotaizi reservoirs in Qijia area, divided into three categories according to the reservoir layer pore structure and physical characteristic and mercury injection data index.

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