

# Fine Study of Sedimentary Micro Facies: A Case Study of a Research Area in Daqing Oilfield

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**Abstract - Aiming at the major reservoirs in Sanan seven East test area reservoir fine anatomy, division and correlation of the high resolution sequence, single channel level time unit microfacies precise characterizations. Results will each wells subdivision to nine depositional time unit, again according to different sedimentary microfacies characteristics established delta distributary plain, delta front phase 1, 3 sub phase, 26 kinds of microfacies of logging facies models, identified nine depositional time unit of plane microfacies characteristics.**

**Keywords** - fine description; deposition time; sedimentary microfacies; Sanan Oilfield

In the late oil development, the remaining oil distribution of various causes more complex, both inter layer, plane, there are layers and pores in [1-2], including the river delta sedimentary diversity, serious heterogeneity, residual oil study has become a complex problem, the author applied high resolution sequence stratigraphy and sedimentology theory, fine thin layer division and contrast of Daqing Sanan Sanan Oilfield test area seven East Main Reservoir, established the sequence stratigraphic framework of 390 wells of 9 time units, according to the different characteristics of sedimentary microfacies establish delta distributary plain, delta front, 1 phase 3 2T subfacies, microfacies logging facies model, established 9 time unit plane sedimentary microfacies and single sand body distribution, lay the foundation for the study of the geological characteristics of reservoir.

## I. REGIONAL GEOLOGICAL SURVEY

Research area is located in Changyuan of Daqing Sanan Oilfield (zone) seventh district of the South Eastern [3-4], including Southern 6, South 7, south of eight kinds of a total of 5 batches of 390 mouth well, were well foundation, a

tertiary infill wells, infill wells and the third infilling and polymer flooding wells. One of the basic wells, an encryption well and polymer flooding wells near 90%. The total area is about 9.42km<sup>2</sup>. The purpose of the study is BI1-4 reservoir. Burial depth of about 1100 ~ 1200m.

## II. HIGH ACCURACY SEQUENCE STRATIGRAPHY AND SEDIMENTARY MICROFACIES CHARACTERISTICS

### 2.1 Time division and comparison

The author makes an well layer by layer contrast analysis, so as to achieve the single sand body sedimentation unit level, which will X6-a-L44 as hierarchical key wells, and the original four layer segment to nine depositional time unit, which BI1 subdivision and BI1b BI1a two of the sedimentary time units; Bi2 points for BI2a, BI2b, BI2c of three deposition of unit of time; B13 and Bi4 layer divided to two depositional time unit of 390 wells in the target region.

Due to the major reservoirs in the target layer of fluvial delta depositional system, target layer of sand body development, vertical slice overlap seriously, through layer by layer well comparative analysis found well X6-a-L44 vertical to separability is obvious, sandstone and moderate thickness, cycle is obvious, channel sand body, so the X6-a-L44 as hierarchical key wells.

### 2.1.1 Fine division of sedimentary time units

Corresponding to the target layer of the main reservoir is river delta sedimentary system, ultra short term base level cycle stratigraphy and river single sedimentary, reservoir sand body were by the channel sand body cutting and stacking and formation, the river cutting and side cutting action is severe, single genetic sand body poor separability, it is difficult to determine the boundaries, resulting in depositional time unit of the comparative difficulty bigger, so the recognition and

distinction between vertical single channel sand body is the key and difficult point in the stratigraphic division. I follow the principle of contrast [5-9], of different facies classification, different regions of research focus, this with the high resolution sequence stratigraphy [10-12], fluvial sedimentology [13] and other theories as a guide to using "step by step standard control surface approximation datum spin back to the interface contrast [14]" the comparative method, the establishment of a high-resolution stratigraphic framework in the region.

Target layer in grape flower Bi layers of reservoir group, and BII formation in the bottom is a very obvious level marker beds, gray ostracod calcareous siltstone and in logging curve performance for the stability of the two conical spikes, the target BII-4 bottom in Bi on 10-15m at. Bi4 bottom for stable calcium single apex and 1.2m thick mudstone, logging curve characteristics of low resistivity and the conical single spikes combination. By the analysis of the well, the top of the BI can be judged according to the level of BI1, which is about 18m. The lithology of the BI1 standard layer is the upper part of the development of the medium calcareous sandstone, and the lower part is the purple red and the gray green mudstone with the lens of the lens. The corresponding electrical characteristics are characterized by a cone like spike, and the bottom is marked with a high gamma low resistance. The characteristics of these markers are well developed in the region more than 90% of the well, and it can control the target accurately. In the logo layer strictly under the control, the author from the hierarchical key wells X6-a-L44 of selected nearly vertical and provenance 6 5 transverse longitudinal 11 section facing the target area to make the fine small layer contrast, for subsequent plane sedimentary micro facies and single sand body space distribution of geological basis.

### *2.2 Log microfacies model*

Through the scanning data of cores and core data analysis, with well layer corresponding to the selected well logging curve, analysis the microfacies log phase factor characteristic and through the multi well with a micro phase logging features, summarize the microfacies were some logging phase factor characteristic, according to target different depositional environment, selection and natural gamma, natural potential, microelectrode (including micro gradient and micro potential) curve of the combination of comprehensive analysis

judgment, establish different energy of logging facies model. Eventually in the target area to establish the distributary plain subfacies including 15 kinds of well logging facies model, delta front subfacies a total of 7 kinds of well logging facies model, delta front subfacies is four logging microfacies model.

### *2.2.1 Micro facies model of the sub facies of the diversion plain*

#### *Micro facies of the diversion channel*

The research will be divided into 4 energy units, a class of river, two kinds of channels, three channels, four channels. Most of the rhythm of the diversion channel is marked by the positive rhythm, and there is a complex rhythm. The logging curves are serious, low to medium amplitude, amplitude and amplitude, and the shape of the resistivity curve is mainly in the form of bell type, the effective thickness is 1m~4m, and the total thickness of the two types of sandstone is 1m~5m, which is good.

#### *Heart beach micro facies*

By the characteristics of the micro facies of the heart, the characteristics of the logging curves, the development of sand bodies, the micro facies is subdivided into a kind of heart, two kinds of beach. Micro electric potential, micro gradient curve of high - to - high amplitude, high amplitude, and natural gamma, natural potential curve together with the bell, box, but mainly to box based, micro - tooth. The thickness of a kind of core bank is more than 5m, and the total thickness of the two types of sandstone is more than 6m, and the physical property is excellent, and the bottom of the reservoir is obvious. The thickness of the two kinds of core bank is between 4m and 5m, the total thickness of the two types of sandstone is more than 5m, and the physical property is good, and the curve has many returns, and the development of thin layer.

#### *Overflow sand*

According to the overbank sand micro phase characteristics of logging curves, sandstone and effective sandstone development degree, and riverway, unified for five types: the main spill shore sand, a class of overflow shore sand, second class overflow shore sand, overbank sand, four types of overbank sand overflow shore sand, logging curve is multi

fingering and multi-tooth type, sand thickness ranging from general 0~2m. Sex is poor. Heart flat micro phase characteristics of logging curves for micro potential and micro gradient curve high to high amplitude, high amplitude difference, and natural gamma ray, natural potential curve is presented together with the clock, box type, but based mainly on box type, micro gear.

#### *Channel edge*

The whole channel is located at the top of the sedimentary time units, the resistivity curve is generally high, and the height difference is high. At the bottom, there are obvious abrupt changes, the lower part is the mudstone or muddy silt.

#### *Abandoned River*

Abandoned channel [15] in general and the characteristics of the edge of the river opposite, abandoned channel sandstones are generally in the depositional time unit at the bottom, two microelectrode curves in high amplitude, effective thickness of sandstone is about 2m, the physical property is good. The upper curve is flat or slightly dentate, gradient oriented. This is due to the cause of its formation.

#### *Mud flow*

There is no sand interpretation of the main flow of the mud in the mud. The log curve is flat and has no fluctuation.

#### *2.2.2 delta front sub facies log facies model*

The delta front sub facies is the delta front sub facies and delta front sub facies. In the general delta front, the river terminal is developed, and the main channel of the delta front is not developed.

##### (1) Delta front sub facies - identify 7 subtypes

A class of river: the bottom of the well logging curves, with a positive rhythm, the clock, box is more obvious. The effective thickness of sandstone is generally greater than 3m, and the thickness of the total sandstone is more than 4m, and the physical property is better.

Two types of river: micro and micro gradient potential two curves in the high amplitude, amplitude difference, integral curve shape by bell type, effective thickness of sandstone is

generally greater than 2m, there are a few well effective sandstone thicknesses of less than 2m. Good sex.

A type of mat sand: the effective thickness is greater than or equal to 0.5m, with short finger shape. Good sex.

Two types of mat sand: the effective thickness is greater than 0m, the physical property of the general. Curve to the dentate.

Three kinds of mat sand: there is no effective sandstone, the overall sandstone is also thin, about 0.5m.

Four kinds of mat sand: there is no effective sandstone, the surface of the sand around the general 0.2m.

Dinner: pure mud, the logging curve is flat.

(2) Outside the delta front subfacies are identified 4 sub facies types: sheet sand body, a sheet sand, second-class mat shape sand, at dinner, logging facies pattern are as follows.

#### *2.3 Sedimentary microfacies and spatial distribution of single sand bodies*

Through setting up the logging facies model, analysis of the sedimentary characteristics of different depositional time units, layer by layer by identification and judgment of the well, and the combination of sedimentary microfacies and get the target area of each depositional time unit of plane sedimentary micro facies, combined with the depositional background of the target area. The characteristics of several key sedimentary time units are described below:

##### (1) BI2a deposition time unit planar sedimentary microfacies

BI2a belongs to the coastal sediments of the Delta, and is controlled by the interaction between the rivers and lakes and the river diversion. There are 41% channels in the region of the whole region, the other four kinds of overflow sand are developed, the main body is over the river, and the other is very little. The main river is near North South, identified 5 rivers, contains 160 wells. The main development of micro facies in the study area is the left side of the study area. The main channel is the two or three main channel, and the whole non channel sand body is dominated by the four types of sand bodies. The main body of the sand body is scattered.

##### (2) BI1b deposition time unit planar sedimentary microfacies

BI1b belongs to delta front facies, affected by the relatively large impact of Lake waves, river crossing, bifurcation frequently, with a narrow channel, accordingly on both sides for a sheet sand, sand sheet, sheet sand and four kinds of sheet sand and dinner microfacies. The main channel is close to the north to the south, 7 small river were identified, six rivers in the upper left side of the study area development and cross slip. Another branch of the river development in the study area in the lower right, the region contains a total of 39 wells, drilled wells river about 132 mouth, drill encounter rate reached 33.9%.

(3) BI3a, 3b, 4a, and 4B deposition time units are deposited on the surface of the micro facies.

BI3a, 3b, 4a, 4b the four depositional time unit is delta front phase, without the river deposition microfacies, sand sheet deposits and dinner mud in deep lake and half deep lake, sediments far from the source and sand body is not well developed, physical property. It can be seen from the BI3a to the BI4b mat sand covered area gradually become larger, the average thickness of the sand table sand gradually thick, but the basic between 0.2~0.5m. BI3a time unit within the main body of the table sand and a type of table sand said a large proportion of the total, a total of 75.9%, of which the main body of the sand is 34.4%, a type of seat sand accounted for 31.5%. BI3b time unit is only 8 of the main body of the 7 wells, a type of sand is only 45 well development, only 11.5%. Second sheet sand and dinner microfacies a total of 87%, which accounted for 62% of second sheet sand, dinner, microfacies accounted for 25%, concentrated in the study area on the right side of the area and the middle offset position. BI4a time unit within the main body of sand only sporadic development of 11 wells, such as well Xt-40-t4t, X7-10-Ct51, etc.. One type of mat sand accounted for 11%, the development of sporadic, as well as X7-21-B52. Two types of mat sand development area is larger, accounting for 57.2%. At the micro phase accounted for 27%, mainly developed in the study area on the right and bottom right. Sheet sand BI4b time unit only sporadic development flaky, most are at the micro phase.

### III. STANDARD WELL ANALYSIS REVEALS THE VERTICAL SEQUENCE OF THE I1-4 LAYER

The sedimentary evolution of the I1-4 layer is influenced by many factors, including the supply of sediment, the change of

ancient climate, tectonic subsidence and so on. The evolution of the I1-4 layer is summarized by the combination of various factors, previous research results, and the time unit plane sedimentary characteristics:

From the front we have studied the time unit sedimentary microfacies can be seen, BI1-4 small layer from bottom to top, base level of deposition performance for a complete cycle decreases firstly and then increases slowly, in Pu I2 early base level dropped to the lowest, Pu I3, 4 layer in datum descend quickly period. At this time, the large lake, Lake deep, the sand is dominated by large area sheet sand, fluvial energy weak. To Portuguese I2C time unit, because around the basin was uplifted, the lake a sharp contraction in the, river energy becomes strong in many aspects factors, the sedimentary sand body in the unit of time are mainly distributary plain channel deposits, coupled with later, climate and gradient and sand body deposited BI2c time unit gradually changes into braided morphology of distributary plain deposition. Subsequently the lake gradually expanded, the river energy gradually become weak, the Portuguese I2b, Portuguese I2a two units of time sedimentary sand body are mainly distributary channel sand bodies, and the former in sand body size to a larger scale than the latter. Early Portuguese I1 to deposition and sand body mainly to narrow water diversion channel and sheet sand based, river energy was weak, with the lake of steady expansion to Portuguese I1 at the end of the deposition and sand body mainly to sheet sand.

### IV. CONCLUSION AND COGNITION

(1) In the research area of 390 wells 9 time units were about 10530 well level fine strata classification and correlation follow "conjugates source, hierarchical control, cycle comparison, consider the principle of fault", combined with delta fluvial facies sedimentary model to establish the main reservoir high-precision sequence stratigraphic framework.

(2) The major reservoirs in Sanan seven East test area for BI1-4 small layer BI1b, BI2a, BI2b, BI2c four time unit, which BI2c time unit delta shunt plain braided deposition; BI2a BI2b normal delta distributary plain deposition; BI1b for delta front deposition.

(3) Establish three sub phase 26 kinds of microfacies of logging facies model, draw a plane sedimentary microfacies, the whole of the Portuguese I1-4, bottom-up, base level of

deposition performance for a complete cycle decreases firstly and then increases slowly. BI2c time unit reference surface to a minimum. From BI2c to BI1a, the thickness of the sand gradually becomes smaller, the size of the sand body and the physical properties of the sand are gradually reduced.

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