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A Sedimentary Analysis of the Cretaceous Delta Sandbodies in the Kuqa River-Kelasu River Area, Northern Tarim Basin, Xinjiang, Northwestern China

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***Abstract*—Cretaceous, in Kuqa River-Kelasu River region of the northern Tarim Basin, is composed of, in ascender order, Shushanhe Formation, Baxigai Formation and Bashijiqike Formation. Based on field observations in the respectives of sedimentology, an alluvial depositional system consisted of fan-delta, braided delta and lacustrine facies or subfaceis was recognized. Braided delta and lacustrine facies are mainly presented in Baxigai Formation while Bashijiqike Formation attributes to a fan-delta facies. By field measurement of sedimentary facies and detail descriptions of reservoir sandbodies in a scale of 1:50, the sedimentary evolution and distribution of sandbody of channel bars were discussed in this study.**

Keywords-Tarim basin; Kuqa River-Kelasu River; cretaceous; delta; sandbody; sedimentology

I. INTRODUCTION

Study area includes the areas from Kuqa River to Kelasu River of the northern Tarim Basin, which is adjacent to Tianshan mountain in the north and the uplift of the northern Tarim in the south, extending in a direction of NNE and covering an area of about 28.5 thousand km^2 (Figure.1). Tectonically it belongs to the foredeep depression which was initially formed in Late Permian and the superimposed foreland basin reformed in Meso-Cenozoic with a basement of the Paleozoic passive continental margin [1-3]. Six oil-gas fields have been explored in the area, of which the Kela-2 gas field, is the key resource base of oil-gas for the National Key Project of "West-to-East Gas Transmission"[2].

Mesozoic and Cenozoic stratigraphy are well developed in the study area [1-5]. The Cretaceous, in ascender order, is composed of, Shushanhe Formation, Baxigai Formation and Bashijiqike Formation, having the character of thicker in the northwest and thinner in the Southeast and with the hiatus of Baxigai Formation and Bashijiqike Formation in the east part and Shushanhe Formation is also poor developed. The Cretaceous, overlain by Cenozoic and underlain by Jurassic with unconformable contacts (Table1), is interpreted as alluvial deposition. Fine sedimentary successions as fluvial fan, fan delta and braided delta facies were well developed along the marginal area of the basin, while lacustrine delta-shallow lake depositions cover the other areas. The sandbodies from Baxigai Formation and Bashijiqike Formation are the major reservoirs of the Kela-2 Oilfield [6-9].

Cretaceous consists of gritstone bearing conglomeratic, coarse and fine grained sandstones, siltstones, silty mudstone and mudstone. Clastic composition of sandstones is dominated by rock clastics with the content of 10-60%, and the content of quartz ranges from 5% to 30%.

II. THE CHARACTERISTICS AND TYPES OF SEDIMENTARY FACIES

A. Baxigai Formation

This formation is mainly braided river delta--lacustrine sedimentary system. The braided river delta front subfacies are well developed in delta facies and so that of the shallow lake subfacies in lacustrine facies.

1) Composition of braided-delta front subfacies and microfacies

a) Subaqueous distributary channel microfacies: consisting chiefly of light maroon , fine grained sandstone interbedded with medium sandstones. Compositions of sandstones is majorly arkose with low compositional maturity and moderate sorting; the grains are mainly subrounded-subangular and then are round-subrounded, with the average medium grain size of 0.084mm, and matrix contents is 3-7%. Scouring surfaces and the lag deposits of clay breccias are common at the bottom of this microfacies, and upward there are trough cross bedding, parallel bedding and wave bedding; scour and infill structures occur occasionally. A typical vertical progradational–aggradational succession consisting of subaqueous distributary channels microfacies of braided delta front was chiefly presented in the middle-upper part of Baxigai Formation in Kuqa River (Figure. 2-5).

b) Distributary mouth bar microfacies: generally consisting of brown and light maroon fine grained arkose sandstone, with high compositional and the textural maturities, and the grains are round-subrounded, with 2% matrix; the deposit structures are mainly laminated and parallel beddings. Probability curves of grain size displays three fine grained intervals, with few rolling components and 50-80% jumpping components. This microfacies is characterized by a vertical coarsening-upward succession, having the thickness of 0.5-4.4m, with flat bottom surface and top

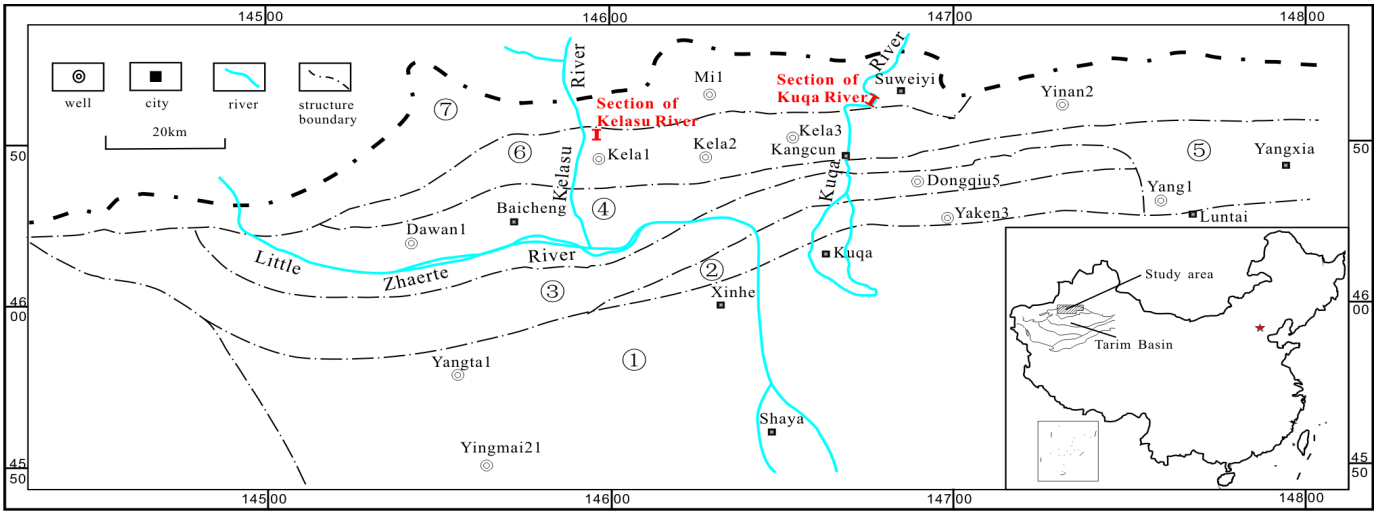


FIGURE I. THE LOCATION, TECTONIC AND RESEDUAL STRATIGRAPHIC THICKNESS OF THE CRETACEOUS IN STUDY AREA

TABLE I. STRATIGRAPHY AND LITHOLOGY CHARATERISTICS OF CRETACEOUS IN THE STUDY AREA

Systems	Series	Formations	Lithology	Contact relations
Eogene	***Kumugeliemu***			unconformity
Cretaceous	Lower	Bashijiqike	Sandstone, mudstone, siltstone and silty mudstone interbedded with sandstone and conglomerate, and composed of three upward-coarsening lithological sections vertically.	conformity
		Baxigai	Siltstone,silty mudstone interbedded with thin beded sandstone in the lower part, and coarse-middle or fine-grained sandstone, and conglomeratic sandstone interbedded with laminated siltite and silty mudstone in the upper part .	
		Shushanhe	amaranth mudstone with graylish green siltstone	conformity

surface cut by subaqueous distributary channel sandbodies (Figure 2-6).

2) Shore and shallow lake subfacies:

It consists of mainly brown calcareous fine grained arkose sandstone and some feldspathic lithic sandstone, with moderate compositional and textural maturity, and high stabled components in heavy minerals (Figure.2-7, 2-8).

B. Bashijiqike Formation

3 subfacies and 9 microfacies were identified in fan delta facies of Bashijiqike Formation, and delta plain subfacies is mainly in the 3rd member of this formation and subaqueous braided distributary channel microfacies presented in the 2nd and 1st member.

1) Fan-delta plain subfacies:

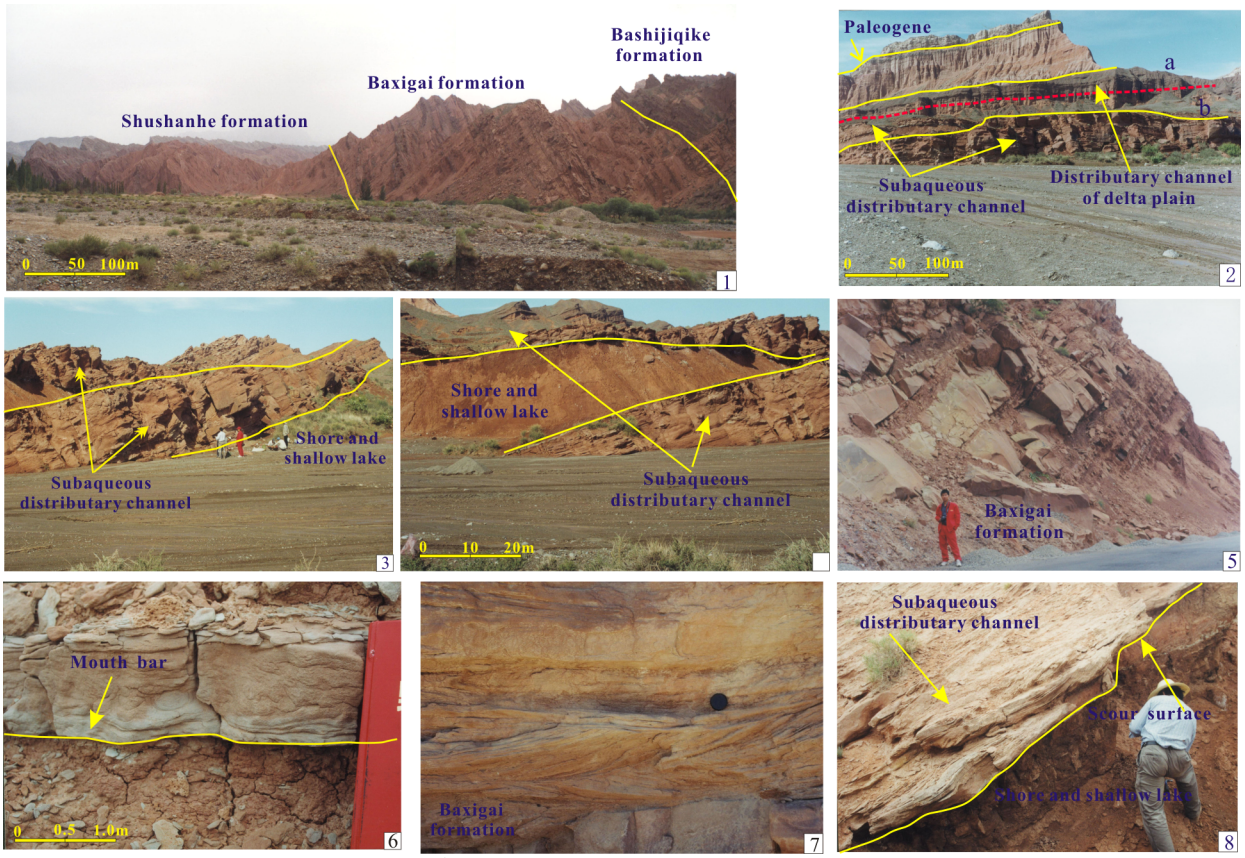
a) Debris flow: it is mainly composed of block conglomerate, cobble conglomerate and graded bedded conglomerate lithofacies. The sorting of conglomerate is moderate-low, having complex componment and great difference in grain size, and floating giant cobble can be seen in it. Conglomerate is supported by matrix (or grain) which is mainly sandy with rare mud, and obvious parallel or imbricate arranged structure in the layers can be found in partial section. Conglomeratic debris flow deposit bearing graded bedding is the main deposit in Kuqa River region, while massive conglomerate facies in Kelasu River region.

b) (Pebbly-sandy) Distributary (braided) channel: here the sorting of conglomerate is moderate-low, with matrix-grain supported and moderate psephicity, massive beddingss or large scale cross beddings are developed and parallel bedding and graded bedding as well. Braided channel deposition sequence of fan-delta plain mainly consist of conglomerate lithofacies with trough cross bedding, graded bedding and imbricated structure.

2) Fan-delta front subfacies

Based on sediment types and sedimentary characteristics, it can be divided into subaqueous distributary channel, subaqueous gravity current, interdistributary, sand sheet microfaces and etc. Fan-delta front made up the main part of fan-delta depositional system in this area, which mainly develops in 2 and 1 member of the Baxigai Formation.

a) Subaqueous (braided) distributary channel: it is composed of microconglomerate and conglomeratic medium fine-coarse sandstone with the thickness of 2-5m. The base is a scour surface, above which shows mud-boulder or argillaceous sandstone with large scale cross bedding and trough cross-stratification, and on the top, parallel bedding is developed bearing several scour surfaces. The subaqueous braided channel sandbody is getting thinner and smaller in grain size toward fan-delta front distal end, which is mainly mid-fine grained sandstone.



1: Cretaceous stratigraphy in Kuqa; 2: Delta deposition of Bashijiqike Formation and Baxigai Formationa and Paleogene, Yaha; 3—4: stacked sandbodies of subaqueous distributary channel and beach lacustrine deposits of Baxigai Formation,Yaha； 5: Succession of lacustrine -delta front deposits of Bashijiqike Formation in Kuqa; 6: bar of delta front subfacies of Baxigai Formation, Yaha; 7-8: Stacked sandbodies of subaqueous distributary channel and beach lacustrine deposits and large trough cross-beddings on the bottom of Baxigai formation, Yaha

FIGURE II. CRETACEOUS STRATIGRAPHY, MICROFACIES AND SEDIMENTARY STRUCTURES IN KUQA AND BAICHENG

b) Subterminal front sand (mouth bar): it is mainly composed of pebbled sandstone and sandstone with the thickness of 0.5m –2.0m, which is interbedded with distal-front sand and aleurite, and it lies in a transition location between subterminal front sandbody and distal-front sandbody in the lateral. Its scour surface is faint at the bottom of the sandbody, and has an obvious boundary with the underlying bedding with the development of a series of large-scale graded bedding, trough cross bedding, tabular and parallel bedding, this microfacies extensively developed in fan-delta of the study area.

c) Distal-front sandbody (distal bar or sheet sandbody): it is composed of medium-fine grained sandstone with medium-scale and large-scale cross bedding and wavy bedding, which has the thickness of 0.1m to 0.5m, interbedded with argillaceous fine-grained deposition, and extension is stable in the lateral.

III. SEDIMENTARY CHARACTERISTICS OF DELTA FRONT SANDBODY

A crucial target during oil-gas exploration is to predict the reservoir as exact as possible; therefore, detail reservoir description has become an important part of modern reservoir research. Since mid-1980s, geological modeling of reservoir is increasingly emphasized and applied, which has been the major content of reservoir characterization techniques and has been intensively researched from different aspects. That continental reservoir is characteristic of severe heterogeneity and that geophysical data has certain limitations both always influence the precision of reservoir description, as a result many petroleum geologists return to outcrop again. Recently, to establish reservoir geological model by combining outcrop investigation data with well-drilling and geophysical data has become the most basic job of modern reservoir description, and is a kind of expanded, fire-new and practical idea and method in reservoir evaluation.

Chinese petroleum geologists and sedimentologists have devoted themselves to the research of reservoir geological modeling, which is mainly used in large-scale section measurement in the field , and testing data analysis and comprehensive research, combining with sedimentology, seismic and logging technology to establish and simulate the formation, development, evolution and distribution, genetic types and geological and mathematical models of reservoir sandbodies, and have attained a series of achievements in the field of geological modeling and reservoir research[10-18].

TABLE II. DATA STATISTICS OF GENETIC SANDBODIES IN CRETACEOUS BASHIJIQIKE FORMATION, KUQA RIVER

No. of sandbody	Width （m）	Thickness （m）	Width / thickness	Genetic types	No. of sandbody	Width （m）	Thickness （m）	Width / thickness	Genetic types
2-1	>152	1.4	>108.50	Distributary channel	4-1	>168	2.5	>67.20	Distributary channel
2-2	>276	3	>92.00		4-2	>440	4.6	>95.65	
2-3	>162	2.7	>60.00		4-3	260	2.5	104.00	
2-4	59	1.95	30.26		4-4	>256	4	>64.00	
2-5	>280	2.55	>109.80		4-5	>280	2.3	>121.74	
2-6	>420	4	>105.00		4-6	>240	3.9	>61.50	
2-7	180	2.7	66.67		4-7	>440	2.8	>157.14	
2-8	>280	3.5	>80.00		4-8	100	1.2	83.33	
2-9	>480	4	>120.00		4-9	196	2.8	70.00	
2-10	70	0.7	100.00		4-10	81	0.7	115.71	
2-11	86	1.4	61.43		4-11	>300	4.5	>66.67	
2-12	250	2.4	104.17		5-1	>480	4	>120.00	Distributary channel
2-13	>480	4.4	>109.90		5-2	>350	2.2	>159.09	
2-14	>240	1.15	>208.70		5-3	414	1.9	217.89	
2-15	124	0.9	137.78		5-4	>288	3.05	>94.43	
2-16	>300	5	>60.00		5-5	>78	1.5	>52.00	
2-17	>204	4	>51.00		5-6	>400	1.4	>285.71	Mouth bar
2-18	114	0.6	190.00		5-7	>300	1.4	>214.29	Distributary channel
2-19	146	1.5	97.33		6-1	>340	4.6	>73.91	Distributary channel of fan-delta plain
2-20	>220	4.1	>53.66		6-2	>130	2.7	>48.51	
3-1	>480	8	>60.00	Distributary channel	6-3	>40	1.5	>26.67	
3-2	>174	1.5	>116.00		6-4	>380	4	>95.00	
3-3	179	2.2	81.36		6-5	70	0.9	77.78	
3-4	>310	2.1	>147.62	Mouth bar	6-6	340	1.3	261.54	
3-5	>36	0.8	>45.00	Distributary channel	6-7	>34	0.4	>85.00	

The sandbodies of Bashijiqike Formation and Baxigai Formation in study area are principal reservoir of Kela-2 gas field for “West-to-East Gas Transmission” Project. The aim of this study is to dissect on the sedimentary systems in detail which is mainly made up of fan-delta and braided delta [19], and to study three-dimensional structure of Kela-2 gas field in Kuqa Depression, research genetic sandbodies scale and their physical properties in order to analyze reservoir sandbodies in a fine scale, establish accurate sedimentary geological model, contrast with similar reservoirs, and finally predict the distribution of reservoir.

A. Methods and Means

This paper reveals the results of sand groups of Bashijiqike Formation and the single and compound sandbodies of Baxigai Formation on the west bank of Kuqa River and Kelasu River. In the study, by applying precise engineering survey and high-density exploratory trench, several single and compound sandbodies were accurately measured in a big scale of 1:50, quantitative statistic was taken on the extend range and lateral distribution relationship of genetic sandbodies. 14 exploratory trenches with 500m in length, 0.7m in width and 0.7m in thickness were excavated; earth rocks were exposed about 800 m3. 28 stratigraphic sections with the length of 2500m (the scale ranges from 1:50 to 1:500) were measured, in which 18 sections are of the Bashijiqike Formation 10 sections are of Shushanhe Formation and Baxigai Formation has 10. From the shallow drilling, 675 physical parameters (porosity and permeability) samples of reservoir and 220 petrographic thin sections and grading analysis data were obtained. 7 natural gamma rays were actually measured with the length of 820m. The realistic control area of description is about, 1000×100=100000 m^2 on the west bank of Kuqa River; 350×100=35000 m^2 on the west bank of Kelasu River; 25×4=100 m^2 (single sandbodies) at Kezilenugou, 100×4=400 m^2 (compound sandbodies).

B. Distribution of the Main Genetic Sandstone Facies

A total of 108 sandbodies (Table2, Table3) were measured in a big scale in the outcrop by using one compound sandbody as a unit. Compound sandbodies of delta front in Cretaceous Shushanhe Formation (Table4) is scrutinized. Data statistics of genetic sandbodies are given in Table2 and Table3.The realistic section of Bashijiqike Formation of Kuqa River and Kelasu River shows that among all the sandbodies the subaqueous distributary channel sandbody is the largest one. Of which the

TABLE III. DATA STATISTICS OF GENETIC SANDBODIES IN CRETACEOUS BASHIJIQIKE FORMATION, KELASU RIVER

No. of sandbody	Width（m）	Thickness（m）	Width / thickness	Genetic types	No. of sandbody	Width（m）	Thickness（m）	Width / thickness	Genetic types
1-1	>400	2.0	>200.00	Mouth bar	3-2	>260	2.9	>89.66	
1-2	>400	5.9	>67.80		3-3	>260	4.1	>63.41	
1-3	>240	3.0	>80.00	Distributary channel	3-4	>260	1.6	>162.50	
1-4	130	2.0	65.00		3-5	>260	1.5	>173.33	
1-5	>112	1.9	>58.95		3-6	>260	2.6	>100.00	
1-6	>400	3.7	>108.11		4-1	>110	2.5	>44.00	
1-7	>400	5.9	>67.80		4-2	>260	8.0	>32.50	
2-1	>400	3.0	>133.33	Mouth bar	5-1	140	0.4	350.00	
2-2	>400	2.7	>148.15		5-2	>180	3.2	>56.25	Distributary channel
2-3	154	0.6	256.67	sheet-sand bar	5-3	>260	2.0	>130.00	
2-4	>400	2.4	>166.67		5-4	>260	1.4	>185.71	
2-5	>400	2.8	>142.86		5-5	>260	2.0	>130.00	
2-6	>400	3.1	>129.03		5-6	>50	0.6	>83.33	
2-7	>400	3.4	>117.65		5-7	196	1.5	130.67	
2-8	62	0.6	103.33		5-8	80	0.7	114.29	
2-9	66	0.5	132.00	Distributary channel	5-9	>60	0.4	>150.00	
2-10	>400	4.5	>88.89		5-10	60	0.4	150.00	
2-11	>400	2.8	>142.86		6-1	>100	2.1	>47.26	
2-12	>280	0.8	>350.00		6-2	>260	2.8	>92.86	Distributary channel of fan-delta plain
2-13	>260	5.0	>52.00		6-3	>260	3.5	>74.29	
2-14	100	0.5	200.00		6-4	100	2.7	37.04	
2-15	>120	1.0	>120.00		6-5	>70	2.6	>26.92	
3-1	>170	2.5	>68.00	Distributary channel					

maximum width is greater than 480m and the minimum width is 34m, with 320m on average. The maximum thickness of stratigraphy is 8m and the minimum is 0.4m, with 6.6m on average. The maximum width of proximal front sandbody (mouth bar) is greater than 400 meters, and the minimum width is 310m, with 216m and 203m on average respectively; the maximum thickness of stratigraphy is 5.9m and minimum thickness is 1.4m, with 3.5m and 0.2m on average separately.

C. Scrutiny on the Sedimentary Characteristics of Single Sandbodies and Compound Sandbodies of Delta Front

The single sandbodies of Baxigai Formation (Figure.3) and delta-front compound sandsbodies of Cretaceous Shushanhe Formation (Figure.4) in Kezilenuer Valley of the eastern Kuqa River are scrutinized in this paper. The main parameter of sandbodies is given by Table 4.

The Table 4 &Table 5 and Figure 4 &Figure 5 show that the compound sandbodies of delta front in Shushanhe Formation is 100 meters in width and 9 meters in thickness, and were sandwiched in between siltsyone and mudstone of shore-shallow lake sub-facies in vertical with a clear boundary, while the compound sandbodies bifurcate to both sides and pinch out in siltstone and mudstone of shore-shallow lake subfacies in lateral, which composed of 5 different single sandbodies and barrier bed (Table4). The length of delta front single sandbody of Baxigai Formation is 25m, and the maximum thickness is 2.5m

TABLE IV. DATA STATISTICS OF THE COMPOUND SANDBODIES OF CRETACEOUS SHUSHANHE FORMATION AT KEZILENUER, KUQA RIVER

Numbers of sandbody		Width（m）	Thickness（m）	Width/thickness	Sedimentary lithofacies and genetic types of sandbody
Compound sandbodies		100.0	6.5-6.0	0.0065-0.006	Medium fine feldspathic quartz sandstone; Trough cross bedding, tabular oblique bedding, parallel bedding, contemporaneous deformation bedding; single sandbodies of subaqueous distributary channel of delta front.
No. of single sandbody	KZ-Ⅴ	100.0	2.0-1.5	0.02-0.015	
	KZ-Ⅳ	100.0	1.5-3.5	0.015-0.035	
	KZ-Ⅲ	25.0	1.5-0	0.06	
	KZ-Ⅱ	65.0	2.0-0	0.03	
	KZ-Ⅰ	80.0	1.5-0.5	0.02	
Block layer	KZGD-3	10.0	0.5-1.0		Silty mudstone-siltstone; horizontal bedding and wavy cross bedding; subaqueous distributary channel and shore and shallow lake (lake flooding layer sediment), four-order interface.

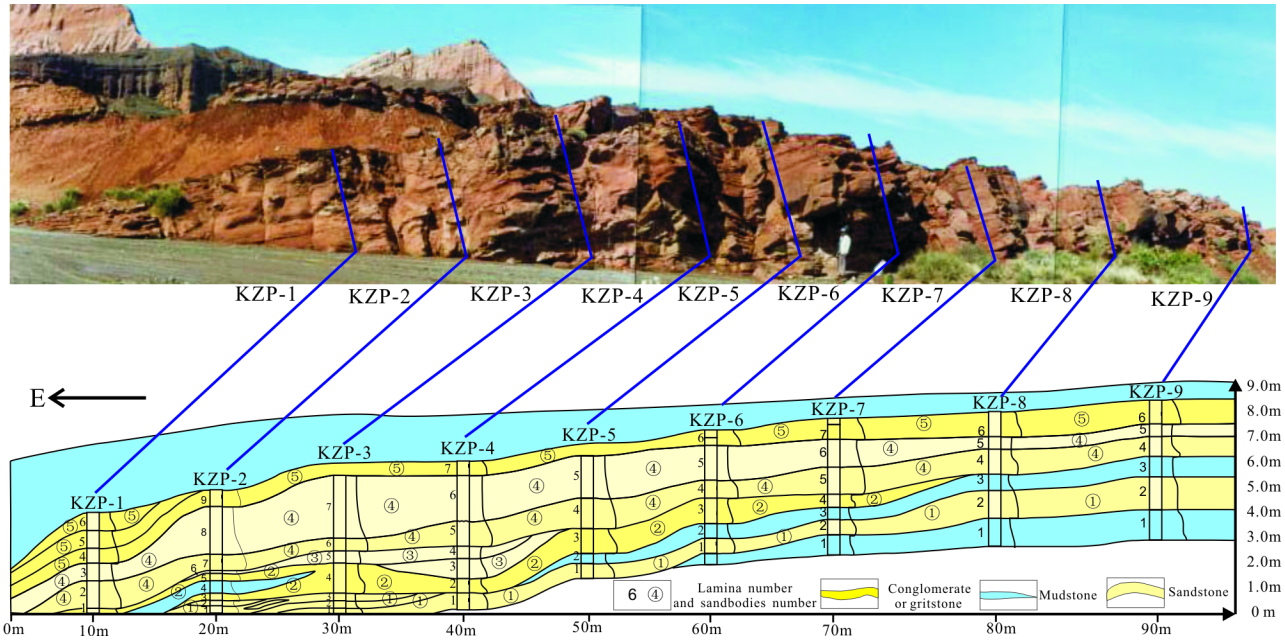
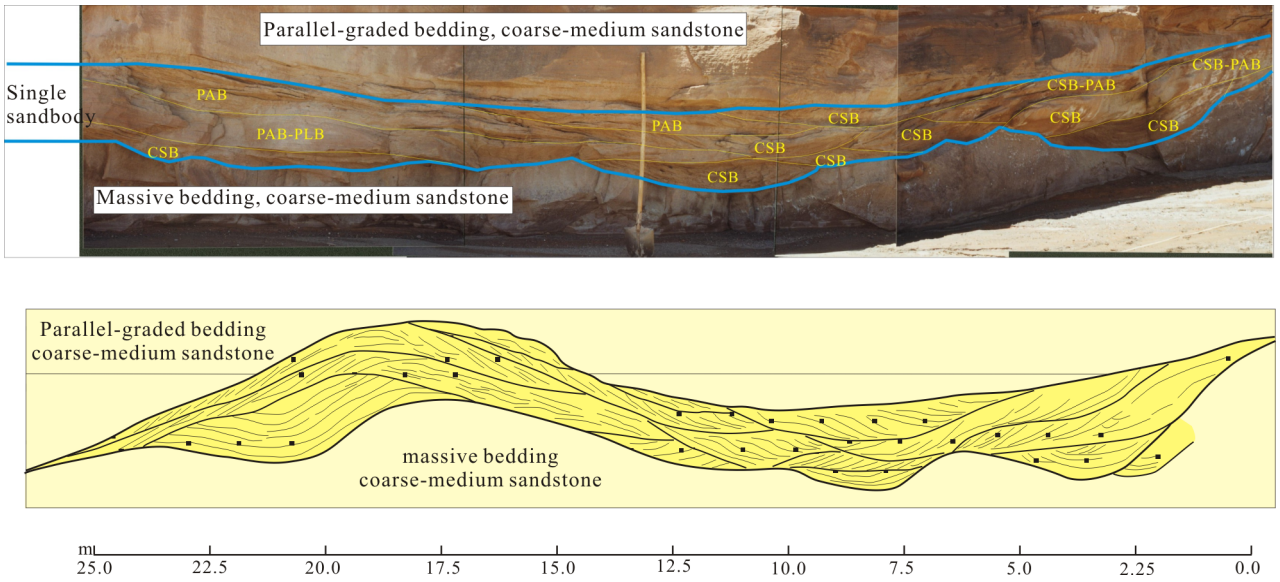


FIGURE III. DESCRIPTION OF THE COMPOUND SANDBODY OF CRETACEOUS SHUSHANHE FORMATION AT KEZILENUER, KUQA RIVER



(PAB—parallel bedding, CSB—cross bedding, CSB~PAB—cross bedding~parallel bedding, PAB~PLB—parallel bedding~ horizontal bedding)

FIGURE IV. DISCRIPTION OF SINGLE SANDBODY OF CRETACEOUS BAXIGAI FORMATION AT YAHA, KUQA

D. The Developing Frequency in Vertical and the Lateral Change Law of Sandbodies

1) The characteristics and types of developing frequency of sandbodies in vertical.

a) The developing frequency of sandbodies in vertical.

We make statistics and intimate dissected researches of the frequency of compound sandbodies vertical developed in the realistic section, which located at the Cretaceous Shushanhe Formation delta front in Kezilenuer Valley (Yaha) of the eastern Kuqa River and the subaqueous braided channel in Bashijiquke fan-delta front exist at Kura River and Kelasu River. Based on the realistic section (Figure 3) with a scale of 1:25 which shows the compound sandbodies of delta-front of Cretaceous Shushanhe Formation in Kazilenuer valley of the eastern Kuqa River, making the study and statistics about the data of developing frequency of single sandbodies in vertical (Table 4). The width of this compound sandbody is 100m and 9m in thickness, it is sandwiched in between siltone and mudstone of shore and shallow lake sub-facies in vertical with clear boundary line, and it bifurcate to both sides and disappear in siltite and mudstone of shore and shallow lake sub-facies in the lateral direction. On the control section line of different

TABLE V. STATISTICS OF SINGLE SANDBODY OF CRETACEOUS BAXIGAI FORMATION AT YAHA, KUQA

Type of sandbodies	**Width （m）**	**Thickness （m）**	**Width / thickness**	**Sedimentary lithofacies and genetic types**
Single sandbody	25.0	maximum：2.5	0.083	Medium fine feldspathic quartz sandstone; Trough cross bedding, tabular oblique bedding, parallel bedding; single sandbodies of delta front subaqueous distributary channel
Trough cross bedding series	2.5-5.0	2.0-0.3		Units of the bottom or lower part of distributary channel
Tabular oblique bedding series	2.5-10.0	0.2-0.5		Units of the lower or the upper middle part of distributary channel
Parallel bedding series	5.0	0.5		Units of the lower or the upper middle part of distributary channel
The upper part of single sandbody	Medium coarse feldspathic quartz sandstone with parallel and graded bedding, three-order interface			
The lower part of single sandbody	Medium coarse feldspathic quartz sandstone with blocky bedding, three-order interface			

parts of this compound sandbody (KZP-1—KZP-9), the developing frequencies of single sandbodies are inconsistent in vertical, because of the furcation between siltstone and mudstone interlayer of shore and shallow lake sub-facies and the sandbody, to both sides of the sandbody, the developing frequency of sandbody reduce in vertical. For example, on measuring line KZP-4 in the middle part of the compound sandbody, there are 5 complete single sandbodies upward, the developing frequency is 100%, but there are respectively 4 and 3 single sandbodies on the measuring line KZP-2 and KZP-8, and the developing frequency is respectively 80% and 60%. The realistic section of Bashijiqike Formation of Kuqa River and Kelasu River shows that Bashijiqike Formation is mainly composed of sandstone with few interlayers and isolated barrier beds, and develops respectively 70 and 38 great compound sandbodies which belong to subaqueous distributary channel sandbody of delta front (Figure.5&Figure.6). No matter on line KCP-1~KCP-9of the realistic section of Kuqa River or on line KLP-1~KLP-6 of Kelasu River, or in vertical of measured stem section, the frequency of compound sandbodies of Bashijiqike Formation is up to 95%, and the ratio of sand to earth is bigger than 95%. According to the control of outcrop, over 150 single sandbodies present only on principal section of Bashijiqike Formation (from the top of number3 to that of number 1) in Kuqa River in vertical, while over 100 single sandbodies in vertical develop in Bashijiqike Formation on line KLP1 of realistic section in Kelasu River. Vertical pattern of sandbodies

b) The vertical patternof sandbodies

The vertical changes of sandbodies are dominated by the hydrodynamic condition at the time of deposition, Figure.7 shows 3 single sandbodies measured and their mutual variation characteristics in vertical, which represents the vertical pattern of most sandbodies in the study area. In this figure, the interior of sandbody 2 has different vertical variation, the mouth bar microfacies is in the upper part with inverted structure and distributary channel microfacies is in the lower part which has a gradual transition relationship with the mouth bar microfacies, and there are great differences between upper and lower part of distributary channel, i. e., suspension component is increasing upward while rolling component is increasing downward. The top and bottom surface of sandbody2 is a scour surface respectively between sandbody1 and 3, which form abrupt contact with each other in vertical. The top and bottom of single sandbodies of delta-front in Cretaceous Baxigai Formation at Kezilenuer Valley of the eastern Kuqa River are respectively cut by scour surface structure, and this single sandbody presents a typical channel-fill sequence, in which great trough cross-beddings develop in the lower part and tabular and wavy cross-beddings occur in the upper part. In vertical, the variety of the compound sandbodies is basically in accordance with aforesaid single sandbody, in addition to some differences between the sandbody scale and sedimentary microfacies. From the above, the compound sandbodies can clearly reflect the variation and the rule of sandbody in a better way than those single ones in vertical and lateral.

2) The Lateral pattern of sandbodies

Lateral pattern of sandbodies: The lateral change of sandbodies mainly means the internal change themselves, contact relations and pattern with non-sandbodies which presents in both compound and single sandbodies.

a) Lateral thinning or pinchout: Although the width-to-thickness ratio and extended range of single sandbodies are different from compound sandbodies, lateral thinning or pinchout occur without exception, which is a regular pattern and common law of sandbodies.

b) The lateral variations of composition, structure and texture: in the study area, no matter single sandbody or compound one, they are both the products of the distributary channel swing and stacking of fan-delta front and plain surroundings. Stacking indicates the vertical variation of single and compound sandbodies, but swing controls their lateral distribution and changes.

The sediments in main stream line are coarse and fining toward lateral and compositional maturity and texture maturity is the highest in the centre of channel sandbodies. Single and compound sandbodies characteristics of the delta-front obviously reflect the lateral variation of different sandbodies in the realistic sections. The single sandbody represents the migration of channels from right (west) to left (east), sedimentary bedding structures are giant trough- shaped cross-stratification, parallel bedding, tabular and wavy cross-bedding and horizontal bedding from right to left. For the same reason

to the latter, the shore-shallow lake mudstone and siltstone isolated barrier beds of sandbody migrated from

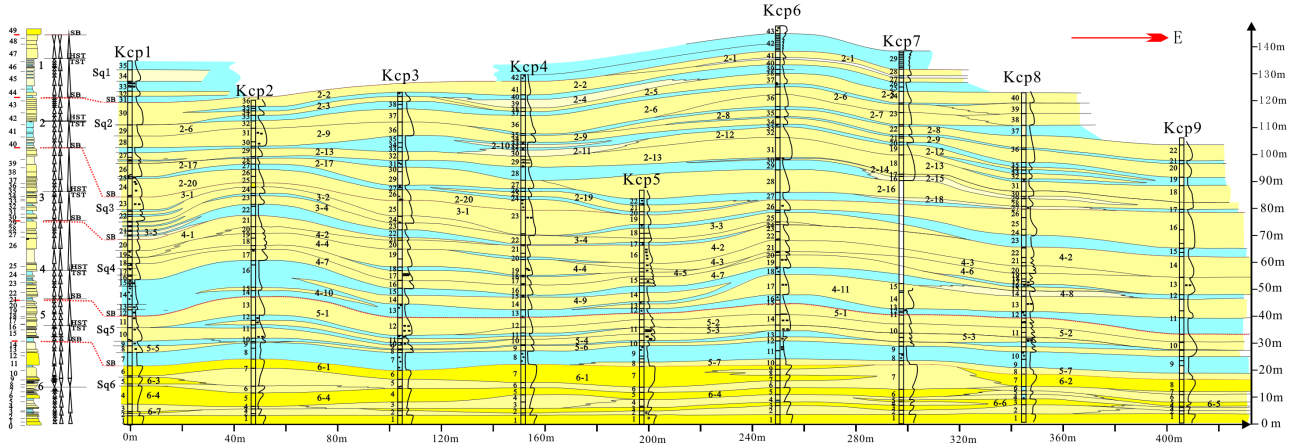


FIGURE V. DESCRIPTION OF CRETACEOUS BASHIJIQIKE SEDIMENTARY SECTION ON THE WEST BANK OF THE KUQA RIVER (1:50 IN VERTICAL)

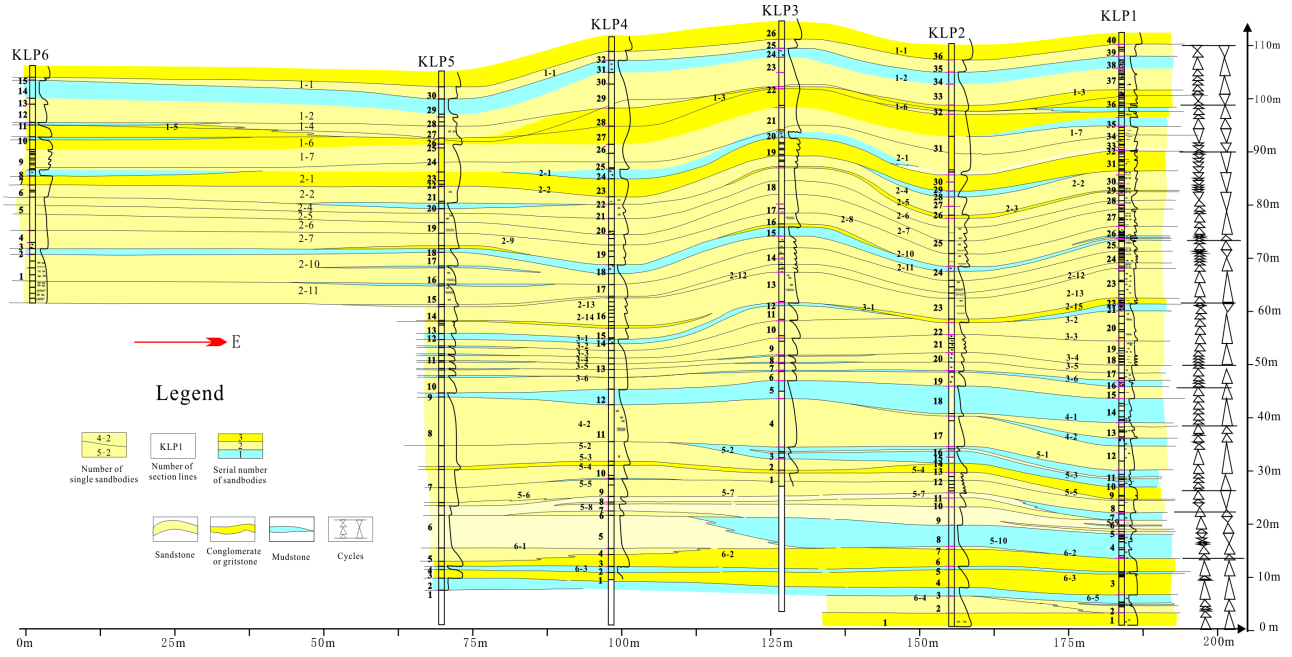
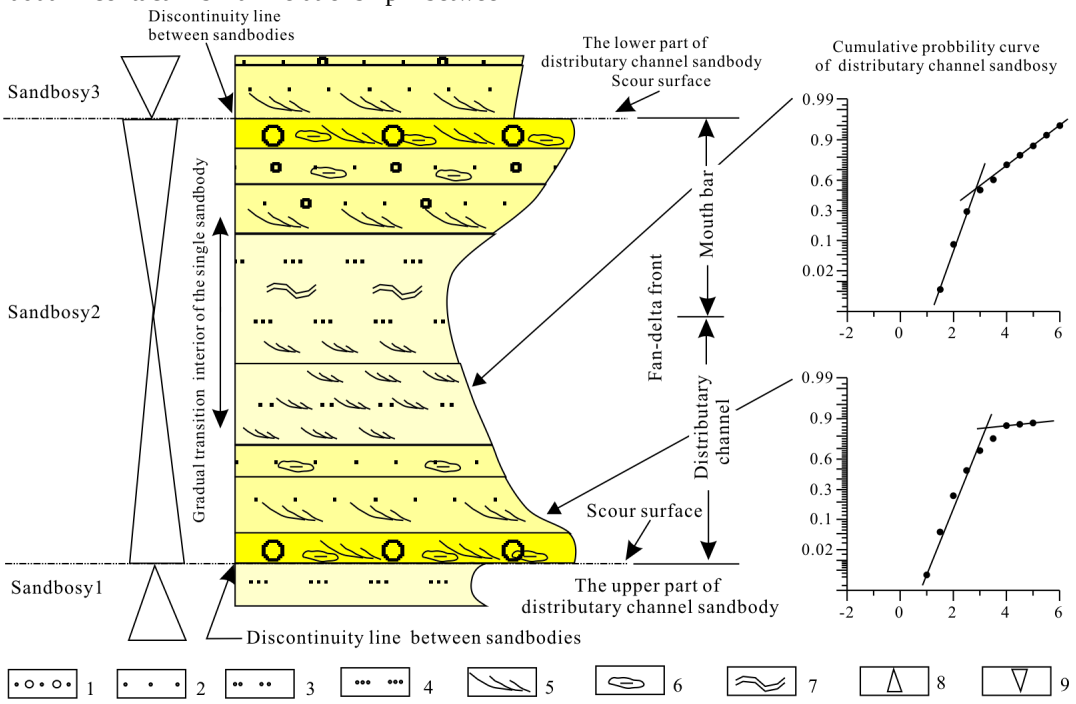


FIGURE VI. DESCRIPTION OF CRETACEOUS BASHIJIQIKE SEDIMENTARY SECTION OF THE *K*ELASU RIVER (1:50 IN VERTICAL)

right to left, as a result the thickness of the single sandbody was thicker accordingly. Another lateral variation of Cretaceous sandbodies is contact relationship and type between sandbodies and non-sandbodies. It can be classified into abrupt and gradual contact. The former is: ① a boundary

of sandbodies and non-sandbodies (shore shallow lake mudstone and siltstone) pinched out abruptly; ② the stacked pattern between sandbodies have the same subfacies and microfacies where there is an obvious erosion contact boundary. Gradual contact is a relationship between sedimentary lithofacies due to the gradual change of medium energy in sedimentary environment, for instance, the relationship of transitional facies change between subaqueous distributary channel sandbody and mouth bar sandbody in lateral.



1: Pebbly gritstone; 2: gritstone; 3: medium sandstone; 4: packsand; 5: trough cross bedding; 6: calcareous concretion；7: wavy cross bedding

FIGURE VII. VERTICAL PATTERN OF SANDBODIES IN STUDY AREA

IV. CONCLUSION

Cretaceous Bashijiqike Formation in study area is mainly subaqueous distributary channel of braided-delta. Baxigai Formation is a lake-delta sedimentary system, in which delta-front subaqueous distributary channel deposit is mainly in the lower part and delta front sandbar and shore-shallow lake deposit lies in the upper part. According to the detail dissection and research of subaqueous distributary channel single sandbodies of delta front and compound sandbodies composed of subaqueous distributary channel, front sandbar, and shallow lake sediments, 50 genetic sandbodies at Cretaceous Bashijiqike Formation on the west bank of Kuqa River, 45 genetic sandbodies on the west bank of Kelasu River and 16 genetic sandbodies at Cretaceous Baxigai Formation of Kezilenuer valley were identified and classified. The statistics of data and parameters of single sandbodies and compound sandbodies were systematically and quantitatively taken, and scales, distribution and stacked patterns of sandbodies in vertical and lateral were also researched.

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