



Research Article

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Seismic Sedimentologic Study in Qingshankou-Formation in Late Cretaceous

Songliao Basin of Northeast China

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ABSTRACT

A seismic sedimentologic study is made in the theQingshankou-Formation in the northern Songliao Basin, based on 3D seismic operation area, the principles of seismic sedimentology and sequence stratigraphy in North Songliao Basin Qingshankou-Formation is ochronal strata frameworks are established, and then Seismic data is processed with t echnologies of phasing and stratal slicing and then the amplitude on slice is interpreted to obtain the planar distribution of reservoir. The sedimentary packing and evolving histories are restored in Qingshankou-Formation various types of gravity flow reservoirs are on the basis of gravity flow sedimentary structure identification of sliding rock, sandy debris flow, turbidite rock.

Key words: Songliao Basin; Late Cretaceous; Qingshankou-Formation; Seismic Sedimentology; Gravity flow sedimentation

INTRODUCTION

At present, the seismic sedimentology and seismic geomorphology of marine faces, especially the researches of the fluvial system and fossil submarine channels have got a wide range of success [1]. According to the seismic and well curve data calibration, 3D seismic stratigraphic sections reveal the relative geological time high-frequency(10m) system tract and its depositional model[2]. Seismic sedimentology is based on high-precision 3D seismic data, sedimentary environment, outcrop and drilled core information , the combined feedback of a new method system established sedimentary environment patterns, and becomes to identify the 3-D geometric shapes of sedimentary unit, internal structures and depositional process[3].

Songliao Basin is located in northeast China (119°40'-128°24'E, 42°25'-49°23'N), approximately 750km in length, 330~370 km wide, with a total area of 260,000km². It shows a large diamond shape, NNE to SSW trending

Meso-Cenozoic sedimentary basin formed on a folded basement (Fig.1).

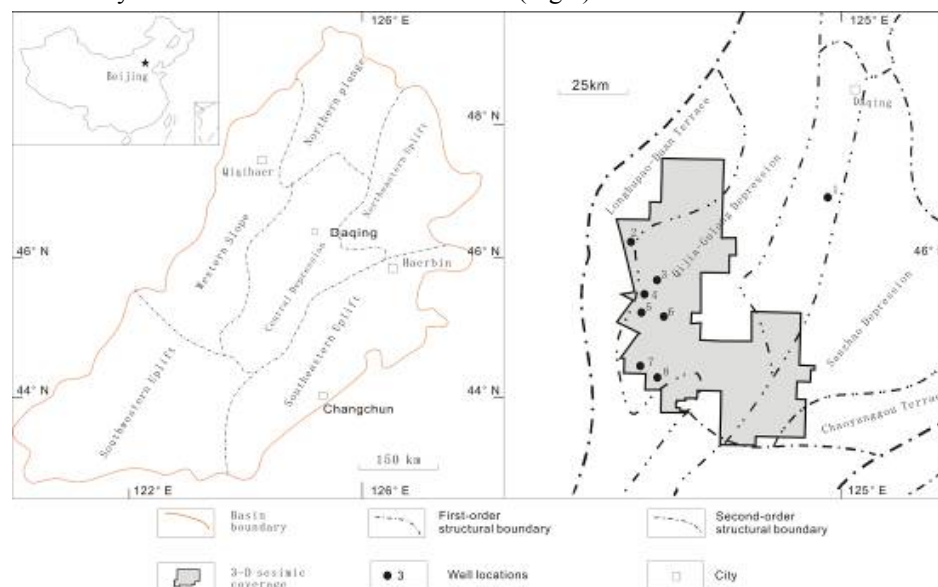


Fig. 1: Left: tectonic division of Songliao Basin; Right: location of 3D seismic coverage area

The study suggests that Qingshankou-Formation deposition in the depression phase medium has a datum plane lifting process in the formation of the water inlet and water return cycle characteristics, the formation thickness is 142m~675 m [4]. Qingshankou-Formation lake basin sedimentary evolution is mainly divided into 2 stages: the first member of Qingshankou Formation is formed in lacustrine expanding stage and the second and third are in lake retreat. While the first and second member of Qingshankou Formation of the lake is expanded, a large area of the gravity flow deposition is developed; the third member of Qingshankou-Formation is also the part of gravity flow deposits.

In the light of the lake faces mudstone area in the central depression in Songliao Basin developed gravity flow deposit, with the help of high-resolution 3D seismic amplitude attribute analyzing technology combined with drilled cores, well logging, mud logging, a large number of experimental analyzing data, Qingshankou Formation large-scale well-developed gravity flow deposits are elaborated, to study the spatial distribution features and geneses for thorough understanding of the extremely vital significance the large continental lacustrine deposition and tectonic evolution.

DATA AND METHOD

In this study, by using 3D seismic work area from Daqing Oilfield Exploration and Development Research Institute, at the same time, I analyze 6-well microfacies: Well YIN 36, YIN 661, YIN 142, YIN 47, YIN 205, YIN 78, sandy debris-flow grain-size probability cumulative curves are emphatically analyzed of YIN 51 and YIN 47 Well respectively, the first and second member of Qingshankou-Formation are carried out detailed descriptions of single Well of YIN 51, YIN 661. Based on the established isochronous stratigraphic framework the following techniques use: stratal slicing, frequency-shared interpretation, similar body attribute analysis and instantaneous amplitude technology.

Core observation and analysis. Shanmugam [5] think of turbidite reliable marker is normal grading stratification, this research also as a standard turbidity flow recognition. In the north of Songliao Basin, turbidity current deposits

are more common, turbidites and body thickness is less than 1m, even lower than 0.1m, but multiple phases, that role has frequent developmental characteristics of turbidite sedimentation. Turbidite lithology is mainly sandstone; fine sandstone and siltstone, can occasionally see gravel rock. In Well Ying661 as an example, from the well core description chart from top to bottom with a total development of the convolute bedding sliding rock, with massive bedding sandy debris flow, with a thin layer of siltstone turbidity current deposits, with the bottom die structure of sandy debris flow, retaining the original sedimentary structure sliding rock, with convolute bedding fluxite, has a festoon cross-bedding sandy debris flow and other (Fig.2).

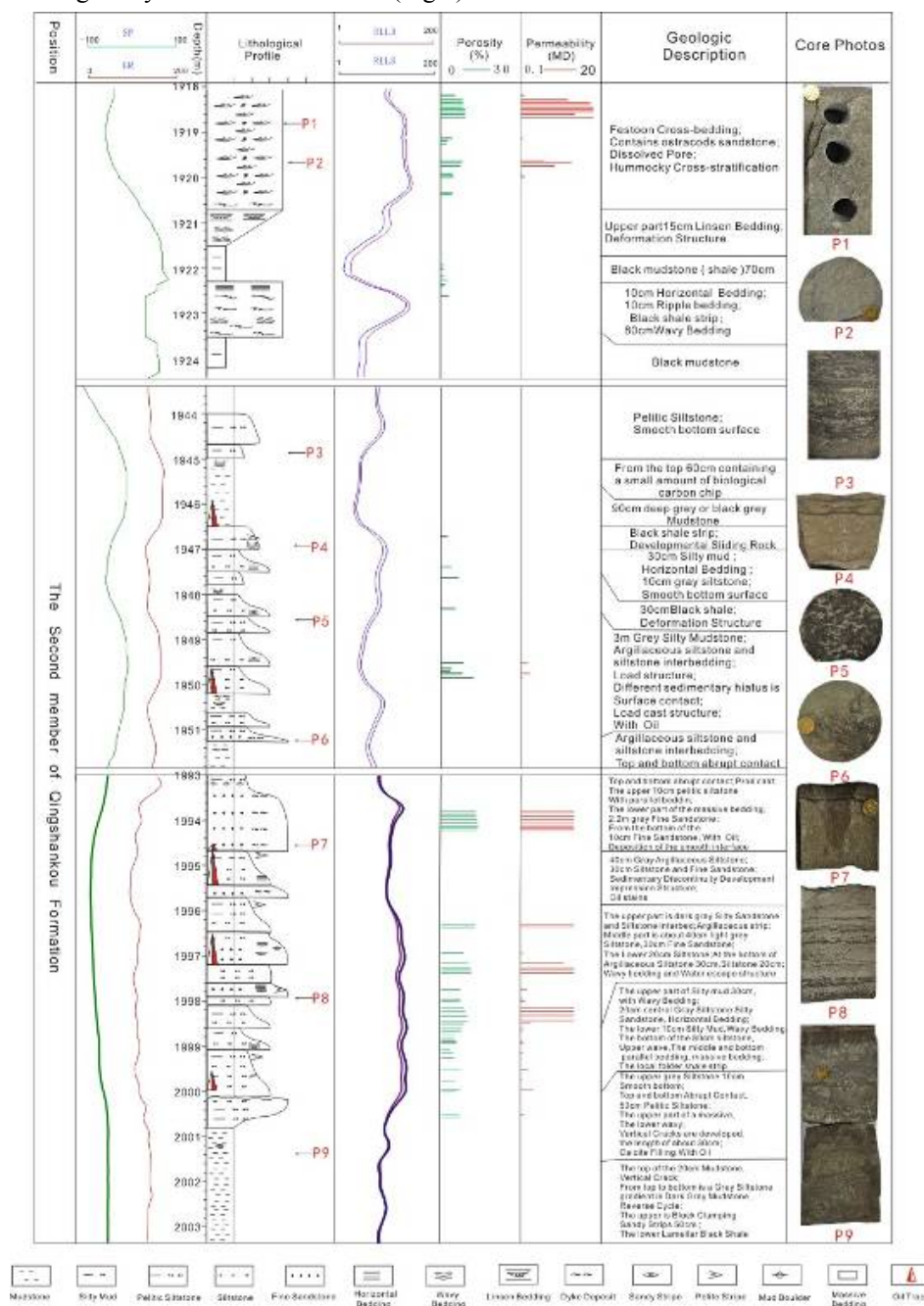


Fig. 2: Core descriptions of the second member of Qingshankou Formation in Well Ying 661

INTERPRETATION AND CONCLUSIONS

Sandy debris flow. According to the grain size probability curve distribution, sandy debris flow grain size probability cumulative curve can be divided into 3 types[6] (Fig.3).

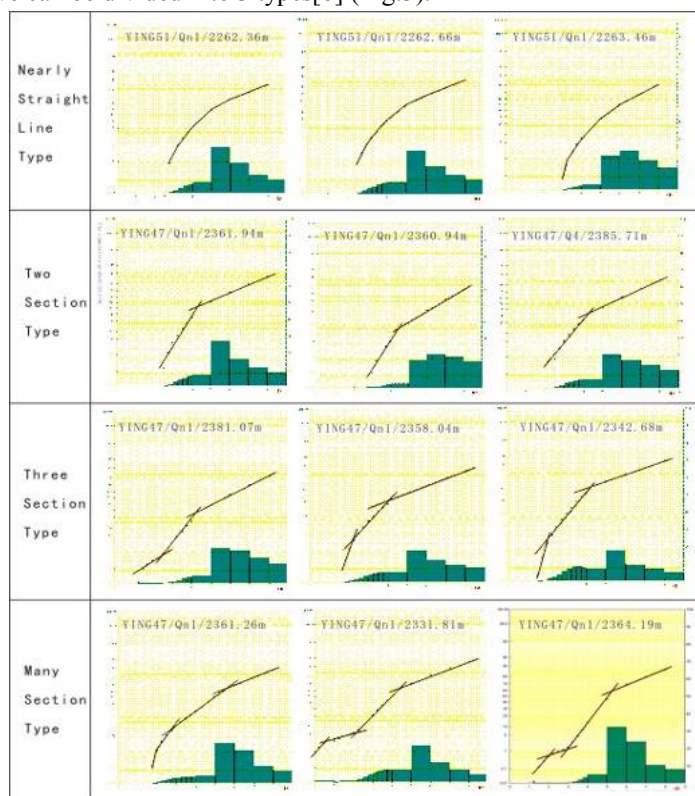


Fig. 3: Grain size probability cumulative curves of the sandy debris flow

Through the above analysis we can see that, though sandy debris flow also belongs to the category of gravity flow, but sandy debris flow grain size probability cumulative curve and C-M chart analysis show, sandy debris flow is not only the gravity flow of the grain size distribution characteristics, as well as traction flow characteristics of grain size distribution. The main reason may be sandy debris flow is laminar flow, in its "freeze-type" the deposition process greatly preserves delta shallow "parent rock" petrology characteristics, such as grain size, separation, sandstone structure, so sandy debris flow characteristics of grain size have duality characteristic[7].

3.1 Sedimentary characteristics of the gravity-flow sedimentary rocks in Qingshankou Formation by different deposition plane shapes and relative positions

Sublacustrine fan type gravity-flow sedimentary rocks. The sublacustrine fan-type gravity flow sedimentary rocks are mainly distributed in Gulong region, strata are mainly distributed in the first and second member of Qingshankou Formation, sublacustrine fan can be divided into two types, one kind of development in sublacustrine channel at the end of the fan, the other is independent of the fan body, not development channel deposition [8]. The type is located in the lake bottom low-lying department, plane for the irregular sector, seismic profiles show weak reflection feature, a lenticular. Sandstone thickness larger, predict thickness is generally in the 4-28 m range, the types of reservoirs in mudstone intermediate development, oil and gas migration is conducive to the nearest (Fig.4).

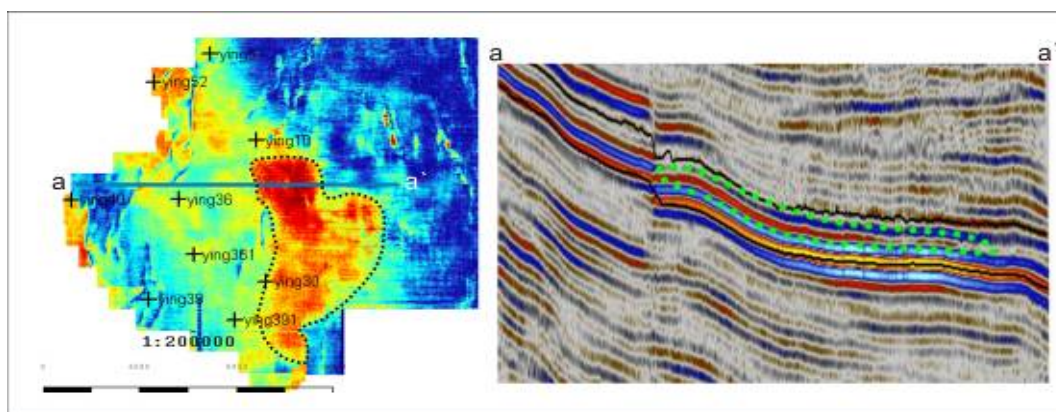


Fig. 4: Plane and profile distribution characteristics of the sublacustrine fan in the first member of Qingshankou Formation in the Western continuous 3D seismic area

Slope fan type gravity flow sedimentary rocks. Slope fan-type gravity flow sedimentary rocks are mainly distributed in the plane of Yingtai-Talaha area, position in space, developed in the slope position, length of zonal distribution, seismic performance for the continuous strong reflection characteristics. The whole Qingshankou Formation has distribution. From the origin, the main development of rock types is sliding rock, fluxite, sandy debris flow, tempestite [9].

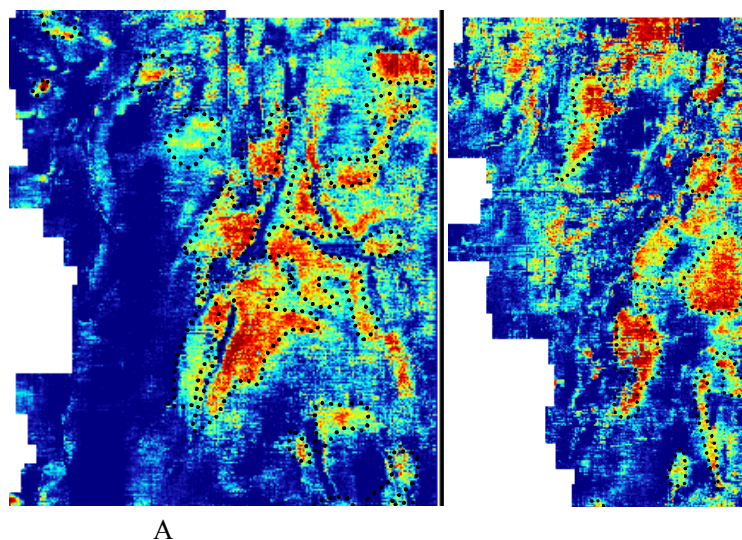


Fig. 5: Seismic amplitude attribute of the third member of Qingshankou Formation in the western continuous 3D seismic area

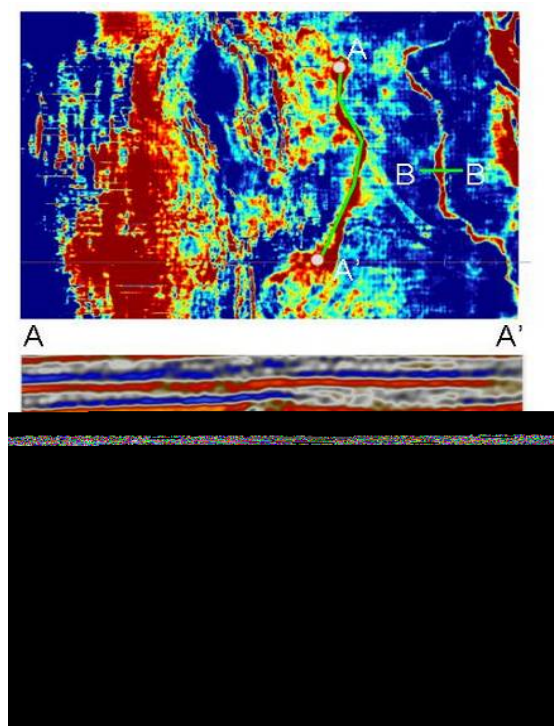


Fig. 6: Seismic amplitude attribute of Channel identification in the first member
Of Qingshankou Formation in the western continuous 3D seismic area

Gravity-low sedimentary rocks complicated by faults. Complicated by faults-type gravity flow sedimentary rocks are mainly distributed in the Talaha area, stratum are mainly distributed in the second and third member of Qingshankou Formation, the type is located in the low-lying department of basin bottom, the plane irregular shape, the seismic profile displays a strong reflection characteristics. The type to sandy debris flow deposition, monomer distribution area in the 0.7-11.86 km² range, the types of reservoirs because it is first sedimentary gravity flow sand, after fault segmentation, for oil and gas migration provides effective reservoir space (Fig.5-A).

Discrete gravity-flow sedimentary rocks. Discrete gravity flow sedimentary rocks are mainly distributed in North Talaha, the whole Qingshankou Formation are distributed, the type is located in the low-lying department of basin bottom, the plane shows irregular lump and rounded distribution, seismic profile performs independent strong reflection characteristics. Tempestites mainly developed. Sandstone thickness is larger, the predicted thickness of 4-16 m, the type of reservoirs developed, thus in favor in large-interval mudstone of oil and gas migrating to this type of reservoir (Fig.5-B).

Channel-type gravity-flow sedimentary rocks. Channel type gravity flow sedimentary rocks are mainly distributed in the Gulong region, which are mainly distributed in the first and second member of Qingshankou Formation, the type is located in the Low-lying department of the basin bottom, seismic profile performs the reflection characteristics pisolitic "Low-frequency bright spot"[10]. Seismic attribute chart performs the long-strip or band distribution. Generally, in the end of the channel, the sub lacustrine fan distributes, the main channel sandstones are sandy debris flow deposits, which the extended for channel type gravity flow length ranging from 12m to 15m (Fig.6).

CONCLUSION

Through the seismic sedimentology researches of Qingshankou Formation in Songliao Basin, Well-developed various types of gravity flow reservoirs, discovered in Qingshankou Formation are on the basis of gravity flow sedimentary structures, many sedimentary types, such as sliding rock, slumping rock, sandy debris flow, turbidite rock, tempesite and so forth are identified. Channel type gravity flow sedimentary rocks are mainly distributed in the Gulong region, which are mainly distributed in the first and second member of Qingshankou Formation.

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