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The identification of lithologic traps in Nanpu Sag D3 Member of Gaonan Region

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Abstract: Gaonan Region has been in development and production since 1986. In recent years, there are more pre-researches in Gaonan Region, the shallow layer in Gaonan Region is major oil-bearing horizon, which has great potential to build and extend production.The geological target is from looking for the large structure develop to searching for the subtle structural and non structural subtle reservoir. The identification of lithologic trap is a favorable method in looking for non-structural concealed reservoir. Based on the analysis of regional geological background conditions, combined with acoustic curve reconstruct wave impedance inversion; seismic attribute analysis; Seismic facies andsedimentary microfacies analysis to complete the identification of lithologic traps.

Keyword: *seismic attribution, sedimentary microfacies, lithologic traps*

I. INTRODUCTION

The whole performance of Gaonan Region is a large nose structure which is attached to the north west direction of the Gaoliu fault and is complicated by Gaoliu, there are step-fault zone of the "Y"-type combination in the profile.The fracture development in the block, the southern development of the fault is large and less; these faults are mainly embodied in the north east. With the increase of degree of exploration and development, lithologic reservoir was found on both sides of tectonic wings of oil source fault .

In recent years,there are more pre-researches in Gaonan Region, finishing the top of the reservoir structuredetailedly and describing effective reservoir sand body distribution, looking for favorable lithology goals, and drilling a batch of reservoir appraisal wells（such as G194X1, G140X1, G160X3, G140X6, G129X1 and G129X2）, drilling results are good, so the basic idea of the lithologic reservoir exploration in this region has been determined, it provides a specific target for exploration of lithologic oil and gas reservoirs in this area.

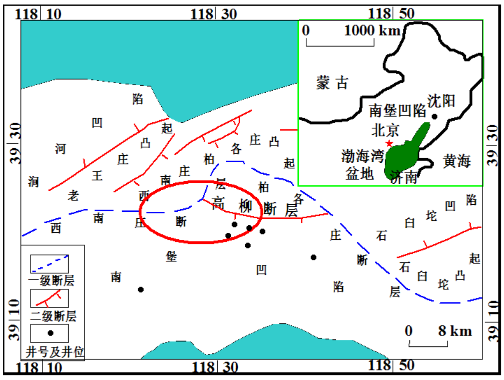

Fig 1 project overview

II. THE IDENTIFICATION OF LITHOLOGIC TRAPS

2.1 Research approach

The identification of lithologic traps mainly need to do following detailed work: First of all, analyzing of drilling and logging data; Secondly, use synthetic seismogram to calibrate seismic geologic stratum and each oil layer interface; Thirdly, compile the main structural layer of detail structure diagram, as well as the research of palaeostructure interface, to determine the tectonic background formed by subtle traps; Fourthly, study Single well sedimentary facies to determine the sand bodyunit type, study change of sedimentary facies to determine the spatial distribution of sedimentary units so as to predict spatial distribution of sand body; Fifth, Seismic attribute analysis and coherence analysis; Sixth, seismic inversion of reservoir groups; Finally, tracking of single sand bodies and the determination of single sand body plane form**.**

The author identify lithologic traps mainly by seismic attribution, inversion section and sedimentary microfacies.

2.2 Identification method

On the basis of sequence stratigraphy, combined with well logging, mud logging, seismic, lithofaciesand so on in many aspects to judge and search for lithologic traps[1].

2.2.1 Research techniques of sequence stratigraphy

Sequence stratigraphy is the most effective theory and method system in studying of hydrocarbon reservoirs[2]. Through identifying the sequence interface at all levels carefully（fig 3）, establishing isochronous stratigraphic framework and depositional systems tracts to determine the development of lithologic trap horizon, type, analyze Seismic facies and sedimentary facies of three-stage sequence unit, study source direction, predicts favorable region of lithologic trap development, so as to guide the identification of lithologic traps effectively.

The tigraphic deposition in this region has such characters cyclicity deposition, and has a more stablemultiple classes of depositional cycle character in the longitudinal, it can clearly reflect the change of every level of small cycle or rhythm by checking electric logging curve. Therefore, the oil group is divided into a layer which has an obvious feature of rock electricity. Based on the research of predecessors' achievements, it was divided into a secondary sequence, three ertiary sequence ultimately.

2.2.2 Fine structure interpretation

The fine calibration of seismic reflection horizons of the target layer is made by using the synthetic record of the system; application of automatic, semi-automatic and manual interpretation of the function is used to track the target layer seismic reflection layer; Application of coherent data volume, graph analysis and 3D visualization technique is used to complete the plane combination of target layer(fig 2).

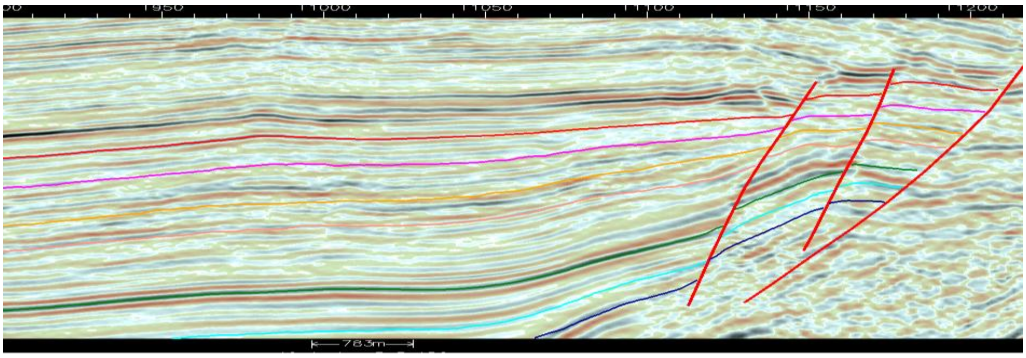

Fig 2 seismic interpretation section

2.2.3 Impedance inversion technique of acoustic wave curve reconstruction

In order to quantificat the thickness of reservoir sand body eventually, he wave impedance and reconstruction of the reservoir in the Dongying formation of the Gaonan area are carried out. The value of reconstruction inversion of wave impedance could reflect the variation of lithology basically. The plane velocity gradient is big, longitudinal depth change is big, big value distribution range of Impedance profile could represent the distribution characteristics of reservoir basically[3]. Refactoring curveis more sensitive to formation of sand and mud, it can reflect the change of thickness of stratum medium sandstone and mudstone accurately （fig 3）.

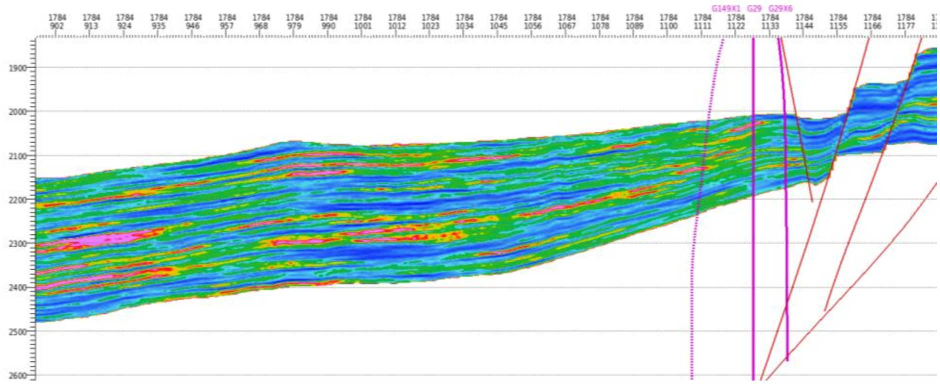

Fig 3 refactoring acoustic impedance inversion section

2.2.4 Seismic attribution analysis technology

Seismic attribute refers to those by pre-stack and post-stack seismic data, derived through mathematical transformation then export the the geometry, kinematics and statistical characteristics. Some seismic attributes can reveal abnormalities whichis not easy to be detected. Some seismic attributes can be directly applied to oil and gas detection. Seismic attribute analysis technique is based on optimization of properties, and it greatly help interpreters understanding geological phenomenon correctly, especially for the understanding of the reservoir characteristics, so it increase the application value of seismic data[4].

Aiming at the sedimentary characteristics of major objective interval Ed_3, after continuous experiments, it founds that properties of the amplitude are very sensitive to identification of sandstone and mudstone boundary, especially root-mean-square amplitude attribution performed more effective. Therefore, according to the characteristics of this region, the RMS amplitude and the maximum absolute value of the amplitude of the amplitude and the maximum absolute value are used for the exploration of lithologic oil and gas reservoirs(fig 4 and fig 5).

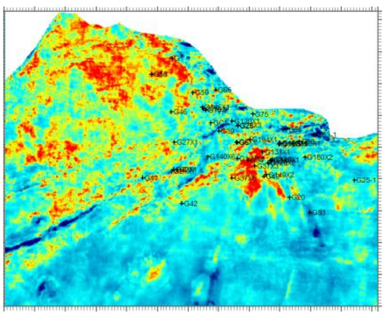

Fig 4 Ed3 ⅠRMS amplitude

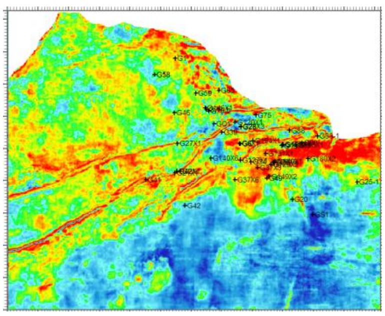

Fig 5 Ed3 Ⅰmaximum absolute amplitude

2.2.5 Seismic facies and Sedimentary microfacies analysis technology

According to the characters of seismic wave and its change, contrast the real seismic data of a certain reservoir, describe the lateral changes of seismic signal, combined with the single-well microfacies, geological statistics method is used to convert seismic facies into sedimentary microfacies(fig 6).

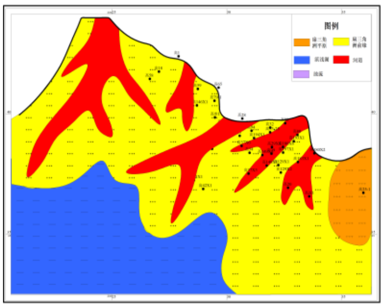

Fig 6 Ed3 Ⅰsedimentary microfacies

According to the data, such as, core, logging, well logging curve data, seismic attribute and so on, it reveals that Dongying group sedimentary facies types mainly include fan delta plain, fan delta front, fan delta front and lake facies deposition, and it was further subdivided into subsea distributary microfacies, sand sheet microfacies, sand bar microfacies, diffluent bay microfacies, sublacustrine fan facies and euprofundal microfacies and so on [5].

III. EFFECT OF LITHOLOGIC TRAPS IDENTIFICATION EVALUATION

Combined with stratigraphic evolution regulation and characteristics of the sedimentary facies plane distribution and prediction of thickness of seismic reservoir, it summarizes D3 of the Lithologic trap development area, because most layered sandstone of the target stratum are not continuous, therefore lithologic trap mainly based on structural-litho-trap, local area develop Lenticular sandstone pinchout trap.

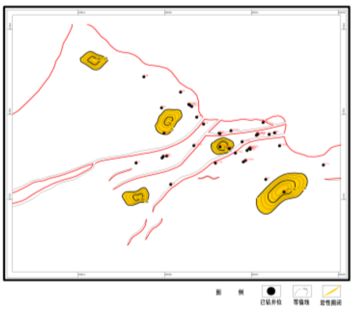

Fig 7 Ed3 Ⅰtrap plane distribution map

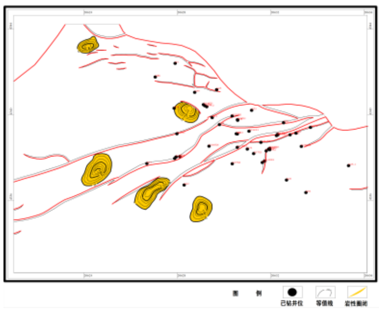

Fig 8 Ed3 Ⅱtrap plane distribution map

The lithologic traps are identified in Ⅰ oil group of D3 Member(fig 7), from the point of view of distribution, mainly distributed in the northwest and north of the study area. The lithologic trap is which is located in the G46 well-G146X1 well, is the largest of the lithology, and its area is about 2.35 km^2.

The lithologic traps are identified in Ⅱ oil group of D3 Member(fig 8), from the point of view of distribution, mainly distributed in the middle and northwest of the study area. The lithologic trap is which is located in the G42X1 well, is the largest of the lithology， and its area is about 0.8 km^2.

IV. CONCLUSION

1. Impedance inversion technique of acoustic wave curve reconstruction is a more direct and effective mean of identifying lithology for thin sand shale interbed area.
2. The use of 3D seismic data volume for three-grade sequence interface explanation,extraction of seismic attributes and Sedimentary microfacies of characterization techniques, etc candetermine the location and development of effective lithologic traps.

3.Through the identification of lithologic traps in D3 Member of Gaonan Region, the lithologic reservoirs exploration area can be determined, and the direction of oil and gas exploration in the regioni can be also pointed out.

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