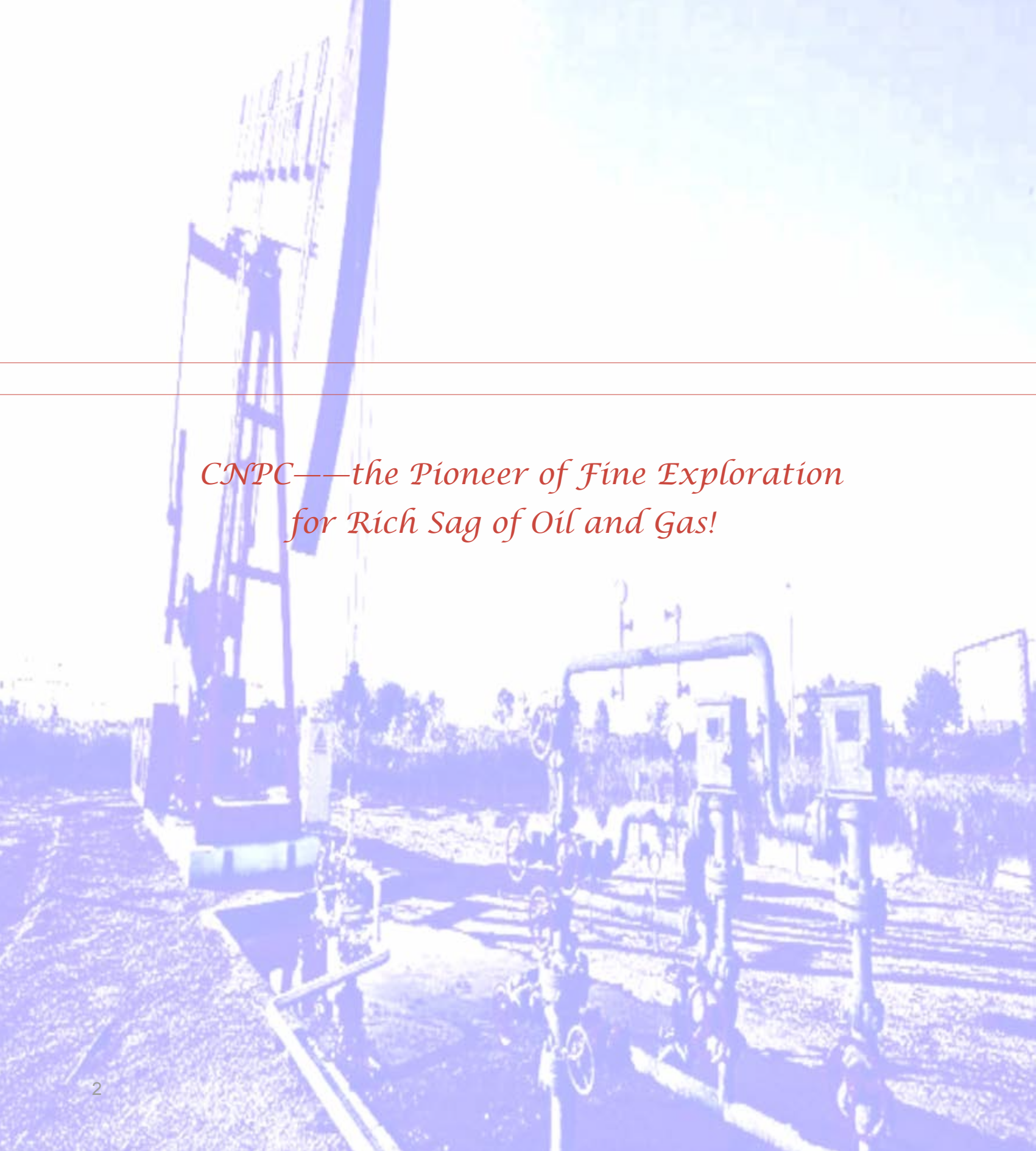
Fine Exploration Theories and Technologies for Rich Sag of Oil and Gas

Science & Technology Management Department, CNPC

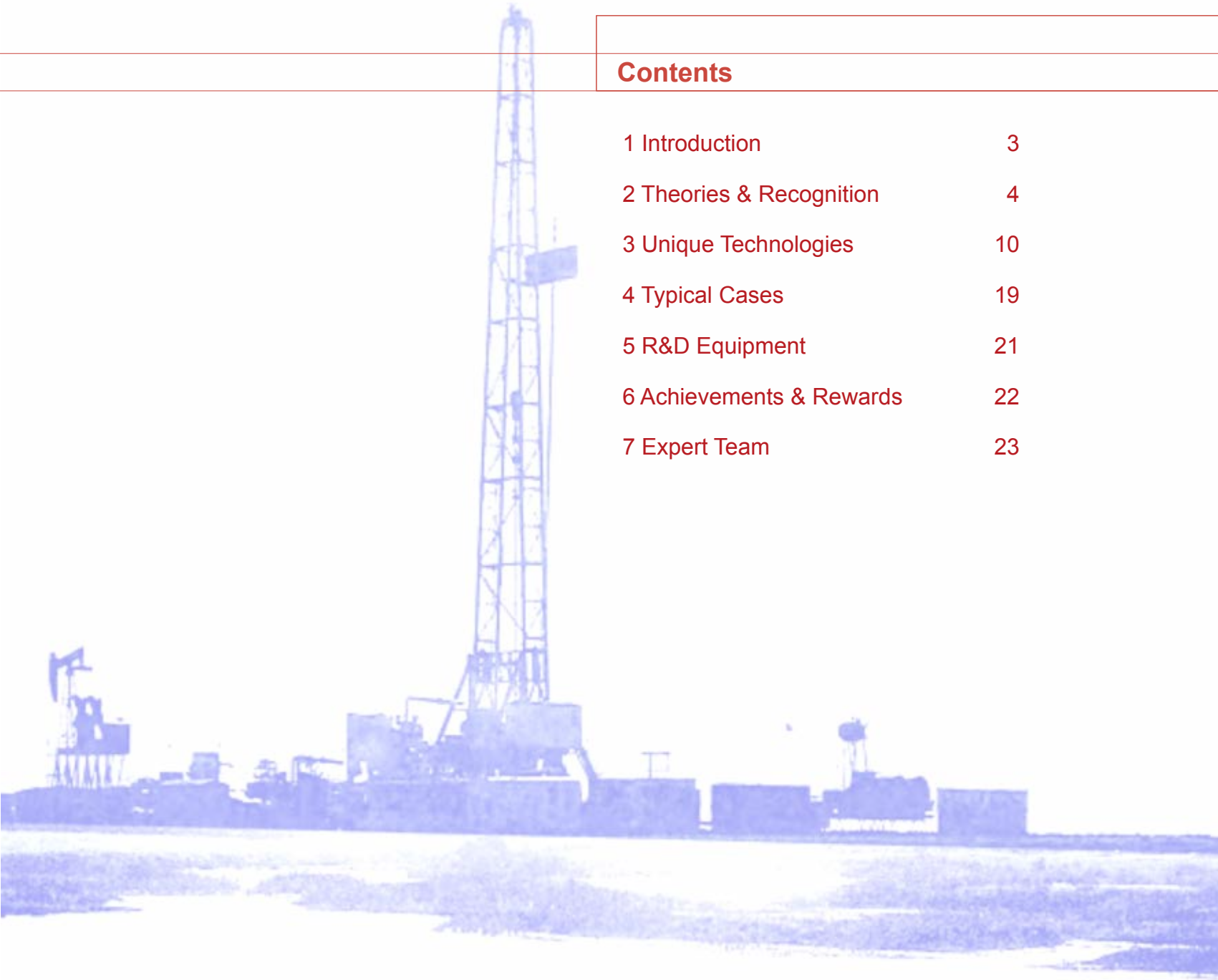
2015

CHINA NATIONAL PETROLEUM CORPORATION



CNPC——the Pioneer of Fine Exploration for Rich Sag of Oil and Gas!

Contents



China National Petroleum Corporation (CNPC) is a state-authorized investment agency and a state holding company. On July 1998, with the implementation of the Institutional reform of the State Council, CNPC was reorgnized to become an integrated oil company of cross-regions, cross-industries and cross-countries, it adopts modern enterprise system to realize the integrations of upstream and downstream operations, internal and external trade, production and marketing. CNPC's business covers six main sectors: oil and gas operations, petroleum engineering service, petroleum engineering construction, petroleum equipment manufacturing, financial services and new energy development. In 2014 CNPC produced 113.67 million tons of crude oil and 95.46 billion cubic meters of natural gas, while crude processing volume reached 150.2 million tons. The total revenue of RMB 2,730 billion with a profit of RMB173.4 billion had been achieved the same year.

CNPC was ranked 3th among the world's largest 50 oil companies and 4th in Fortune Global 500 in 2014.

CNPC strictly follows by the combined strategies of increasing resource capacity, expanding market shares and consolidating the international role, and persists in regarding technical innovation as a key framework to advance technological progress. To develop its core businesses, focuses will be placed on the solutions of key bottleneck technologies and key proprietary technologies. Thanks to continuously improving of the technical innovation system, optimizing the configuration of technological resources and strengthening the construction of strong talent teams, CNPC's technological creativity has been considerably upgraded. Consequently, a large number of technologies have been developed independently, with its own intellectual property.

Fine Exploration Theories and Technologies for Rich Sag of Oil and Gas is one of representatives for major innovations of CNPC.

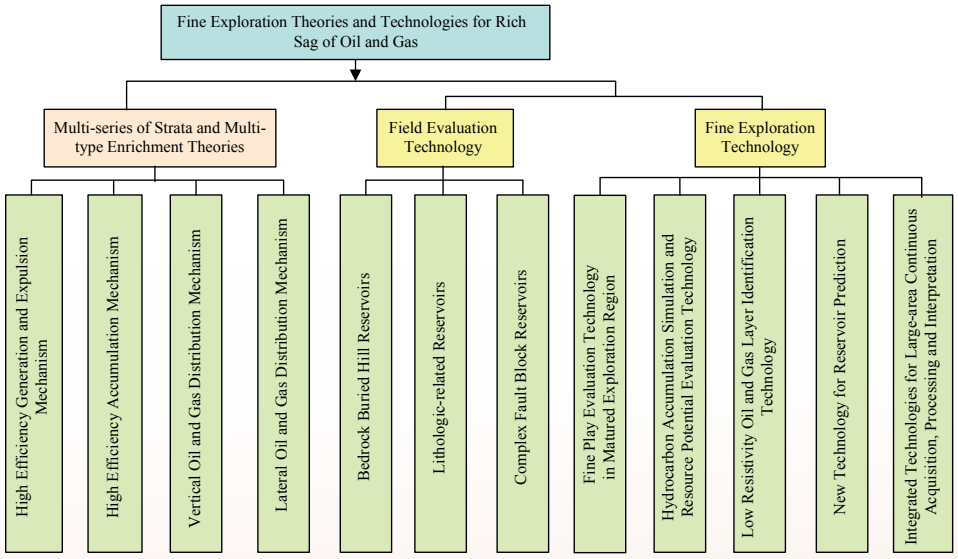
OFFERING ENERGY SOURCES, CREATING HARMONY

1 INTRODUCTION

With the development and perfecting of fine exploration theories and technologies, great breakthroughs and discoveries have been continuously obtained in exploration practice of the Bohai Bay Basin that has been explored and developed for over 50 years.

The rich sag of oil gas refers to the sag where the proven oil and gas reserves of over 100 million tons have been discovered, the resource abundance exceeds 10×10^4t/km^2 and the exploration potential is large. The area of such sags accounts for only 30% that of the whole basin, but the discovered proven reserves of the sags accounted for 90% of those of the whole basin and their residual resources were still over 80% those of the whole basin at the end of 2010. Multiple series of strata rich oil and continuous oil bearing have become the typical features of oil and gas enrichment in rich sag of oil and gas.

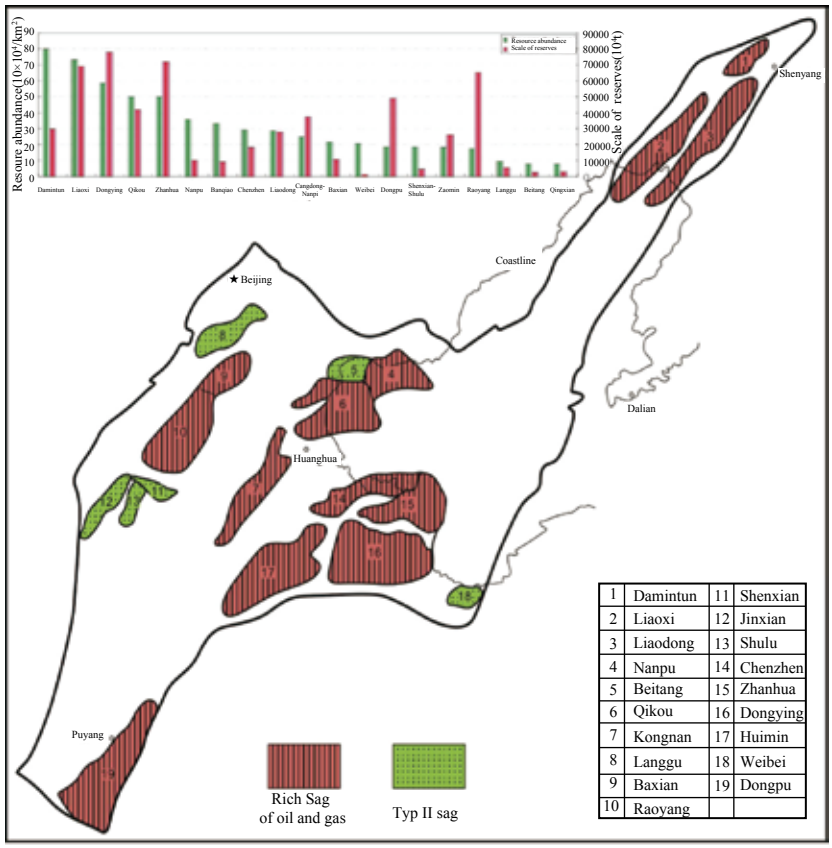
Since the early 1990s, CNPC has been committing to the recognition of geologic features and hydrocarbon enrichment ruces of rich sag of oil and gas, carried out studies and practice of fine exploration of sag rich in oil and gas and formed two major fields of theories and technologies, including 5 geologic theories and recognitions and 8 reservoir evaluation technologies. CNPC has remarkable technical advantages and wide service fields and its part technologies reach the international advanced level. In recent years, the oilfields such as Jidong, Dagang, Liaohe, Huabei, etc. have successively obtained great discoveries and breakthroughs using the fine exploration theories and technologies for rich sag of oil and gas according to their geologic features.



2 THEORIES & RECOGNITION

2.1 Definition of rich sag of oil and gas

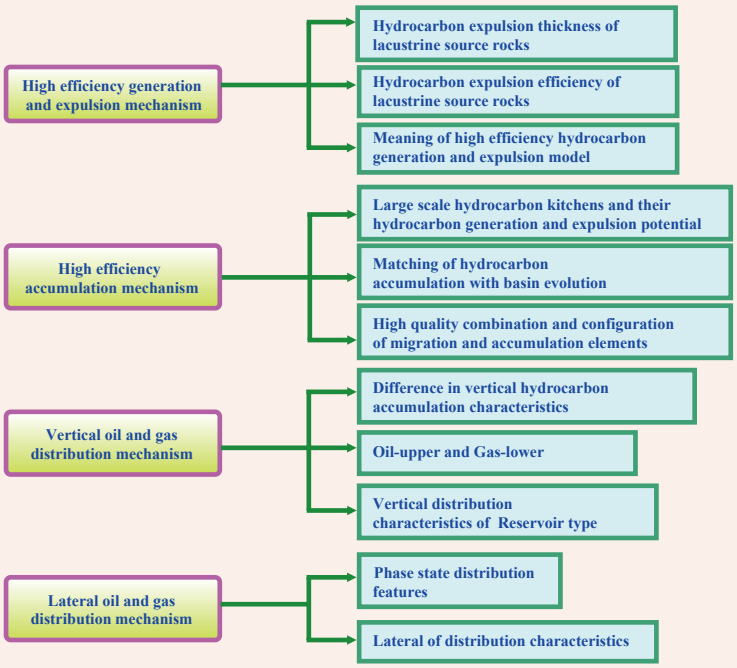
- Elements: the proven oil and gas reserves of over 100 million tons have been discovered; the resource abundance is high (larger than 10×10^4t/km^2); the exploration potential is large.
- Definition: the sag's area is large; continuous subsidence once occurred and thick dark colored mudstones were deposited and preserved; the sag has good geochemical indexes; large scale oil and gas generation, migration and accumulation already occurred; the exploration degree is high, many oil and gas reserves have been proven and there is still a large exploration potential.
- Main geologic features: multiple sets of source beds controlled by structures and sedimentation are developed; multiple types of reservoirs and traps are developed; multiple types of hydrocarbon reservoirs are superposed and connected surrounding main hydrocarbon generation sags; the distribution of hydrocarbon reservoirs is complex and concealed, so the exploration became more and more difficult.



Distribution location map of sags rich in oil and gas in the Bohai Bay Basin

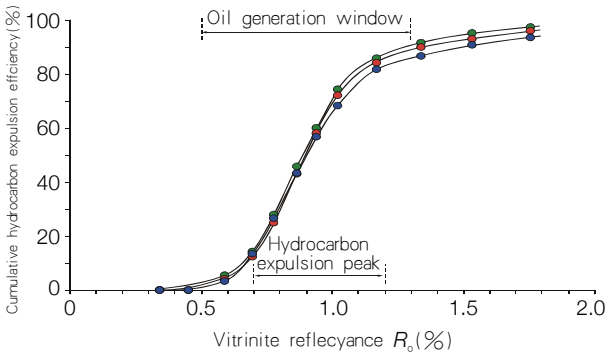
2.2 Multi-series of strata and multi-type enrichment theories

- The rich sag of oil and gas has multiple series of strata, multiple reservoirs and multiple trap types, so that hydrocarbon reservoirs are superimposed vertically and interlinked laterally; multiple types of hydrocarbon reservoirs are distributed surrounding the main oil generation sag; when the whole sag contains oil, a large oil and gas field can be formed. Multiple series of strata rich oil, multiple types coexisting and continuous oil bearing have become the typical features of oil and gas enrichment in rich sag of oil and gas. The multi-series of strata and multi-type enrichment theories include high efficiency generation and expulsion mechanism, high efficiency accumulation mechanism, vertical oil and gas distribution mechanism and lateral oil and gas distribution mechanism.

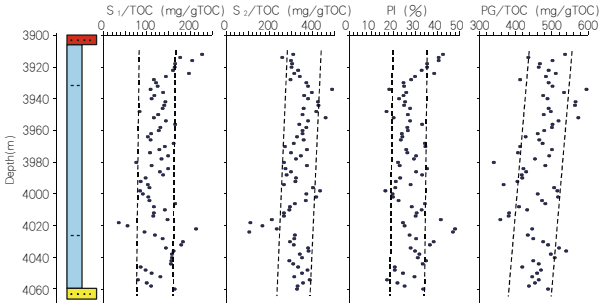


2.2.1 High efficiency generation and expulsion mechanism

- Background: the hydrocarbon expulsion is 30%. It is also only 40% in the high- and post-mature stage. The expulsion and accumulation coefficient is generally less than 8%.The effective hydrocarbon expulsion thickness is generally less than 30m.



Cumulative hydrocarbon expulsion efficiency mode chart of Paleogene-Neogene lacustrine source rocks in the Bohai Bay Basin



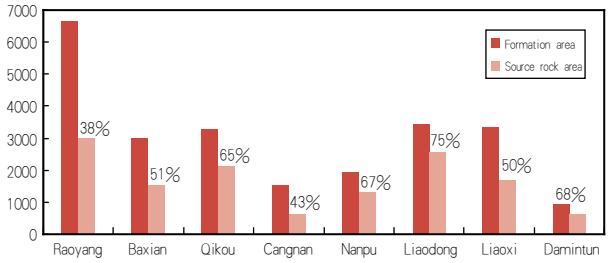
Thick bedded mudstone TOC and pyrolysis hydrocarbon generation potential profile

- Hydrocarbon expulsion thickness: hydrocarbon expulsion action has no direct relation to hydrocarbon expulsion thickness; i.e. the effective hydrocarbon expulsion thickness of lacustrine source rocks has no upper limit, and thick bedded source rocks can also fully expel hydrocarbons.

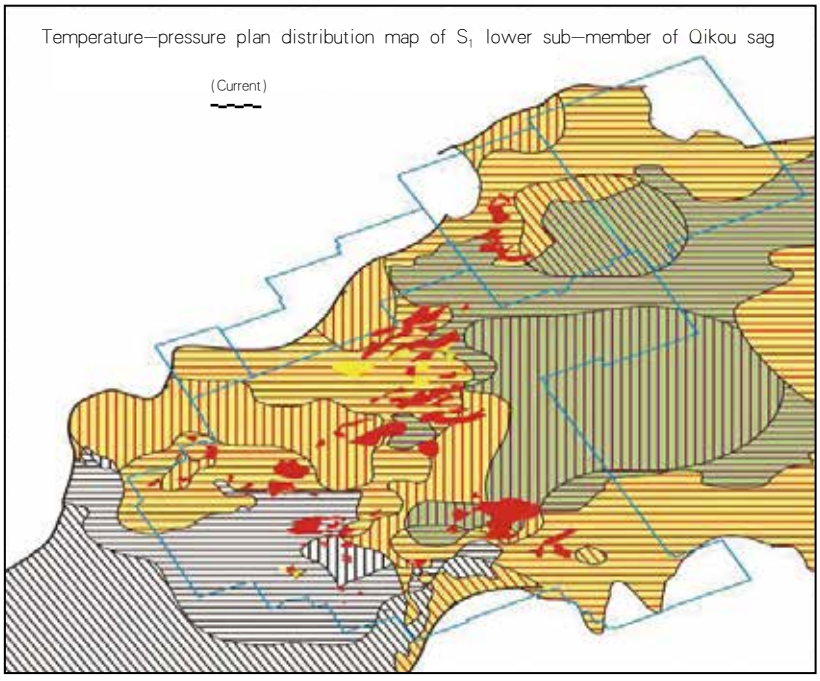
- Hydrocarbon expulsion efficiency: when the evolution of organic matters reaches the ending of the oil generation window, the cumulative hydrocarbon expulsion efficiency of various source rocks also reaches 85%~90%; that is, 85%~90% hydrocarbons are expelled out of source rocks in the oil generation window stage.
- Significance: according to new recognition, the re-evaluated oil and gas resource potential of the Bohai Bay Basin is around 50% higher than the third resource evaluation result.

2.2.2 High efficiency accumulation mechanism

- Large scale hydrocarbon kitchens and their hydrocarbon generation and expulsion potential: according to the ratio of effective source rock area/ sag area (%) value, except that the ratio in Raoyang and Cangnan is small (37.6% and 43.4%), the ratio of all other sags rich in oil and gas is larger than 50% and that of Liaodong sag reaches 74.7%.

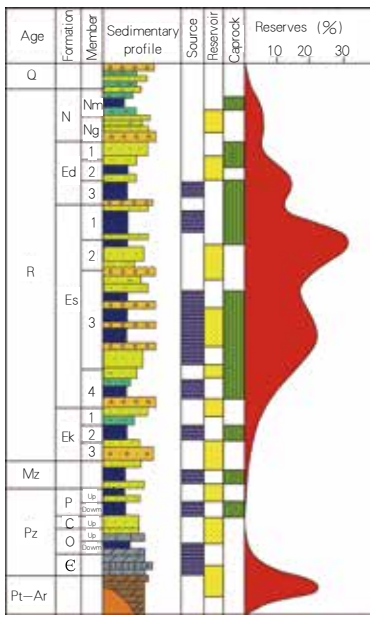


- Matching of hydrocarbon accumulation with basin evolution: Cenozoic structural evolution in Bohai Bay Basin can be divided into two structural evolution periods such as Paleogene rifting period and Neogene post-rifting period. The thermal evolution of source rocks and hydrocarbon migration and charging in sags rich in oil and gas are controlled mainly by the two-phase tectonic activities and form the main hydrocarbon accumulation period of sags.
- High quality combination and configuration of migration and accumulation elements: the oil and gas migration and accumulation superiority effect is remarkable and relates to mainly dominant channels and faults; sand bodies and slopes form favorable facies belts—trap configurations; structural belts developed successively are reasonably configured with hydrocarbon kitchens; the development of normal temperature—high temperature, high pressure and high energy systems in medium to deep strata is favorable for hydrocarbon accumulation.

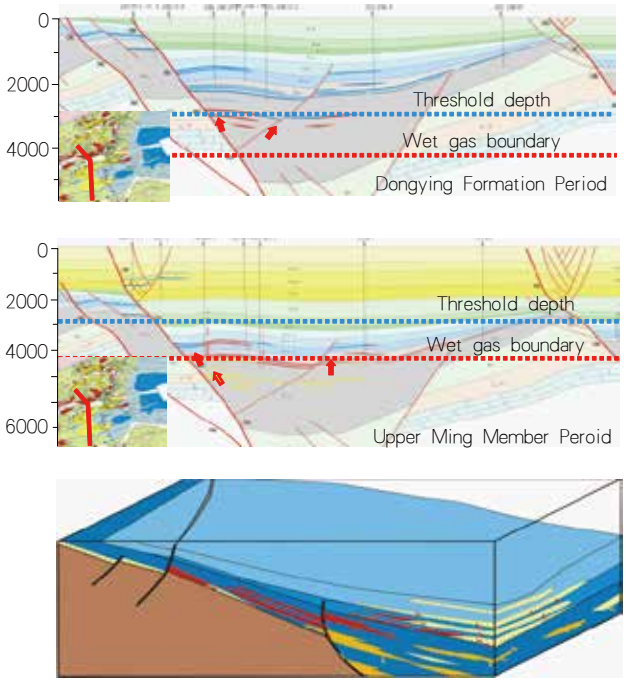


2.2.3 Vertical oil and gas distribution mechanism

- Difference in vertical hydrocarbon accumulation characteristics: late hydrocarbon accumulation in the upper assemblage, source rocks in the lower part and reservoirs in the upper part; early and medium-term oil and gas charging in the middle assemblage, self-source and self-reservoir; the oil sources in the lower assemblage mainly from Paleogene, new source rocks and ancient reservoirs.

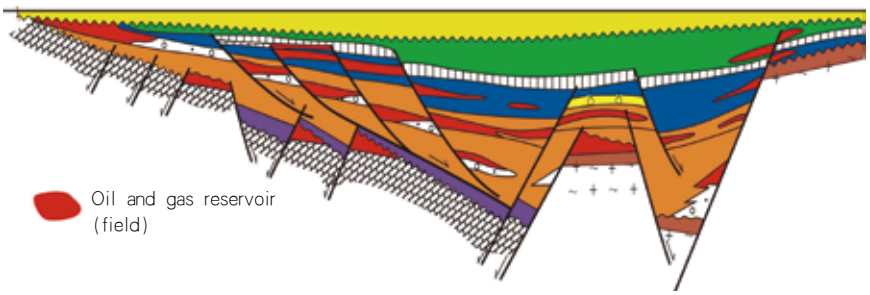


Comprehensive historgram of source-reservoir-caprock assemblages



Hydrocarbon accumulation evolution profile of BS22-BS1-BS6 wells

- Reservoir type distribution characteristics: lower assemblage: buried hills, fault benches (low buried hills), formation unconformity reservoirs; middle assemblage: rolling anticlines, fault blocks, lithology, tratigraphic overlap or compound reservoirs; upper assemblage: drape anticline reservoirs or structural—lithologic reservoirs.

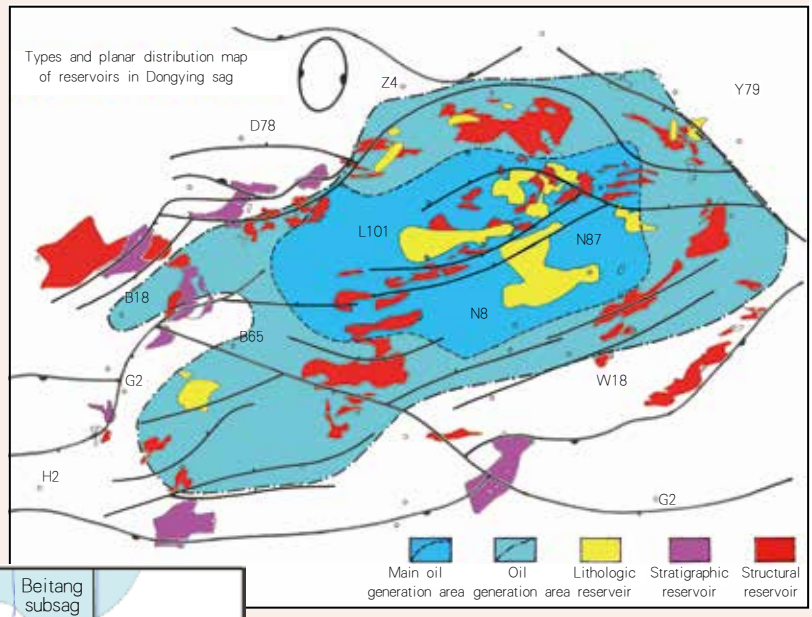


- Oil-upper and Gas-Lower: “multi-phase charging, firstly oil and then gas, differential accumulation” are the radical mechanism for forming “oil - upper and gas lower” and “ oil-hight and gas-low ”.

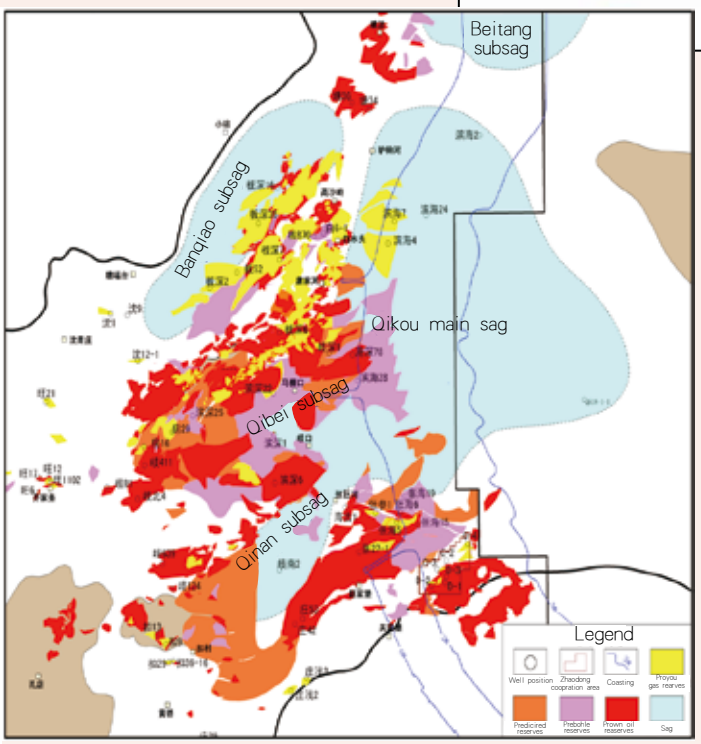
Reservoir profile mode chart of sags rich in oil and gas

2.2.4 Lateral oil and gas distribution mechanism

- The oil and gas distribution in the rich sag of oil and gas is generally characterized by “gas accumulation mainly in the central part and oil accumulation around the sag”.



Types and planar distribution map of reservoirs in Dongying sag



Types and Lateral distribution map of reservoirs in Qikou sag

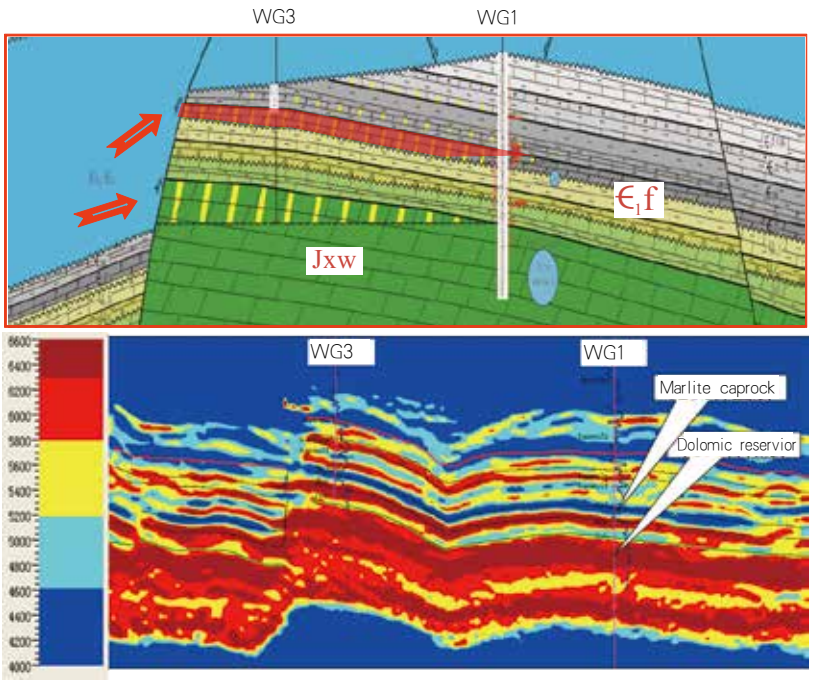
- The difference in the parent material type of source rocks can also lead to the regularity of oil and gas distribution pattern; e.g. the oil and gas distribution in Qikou sag rich in oil and gas has circular characteristics and also “south oil and north gas” characteristics.

3 UNIQUE TECHNOLOGIES

3.1 Field evaluation technology

3.1.1 Evaluation technology for bedrock buried hill reservoirs

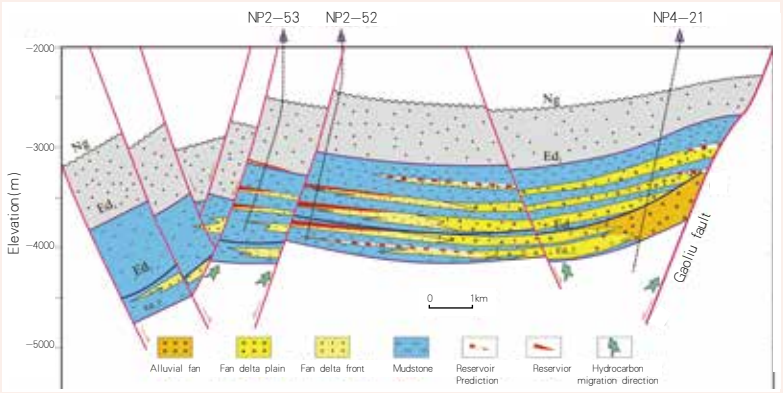
- Definition: study and evaluate a series of key geologic elements and finally predict favorable bedrock buried hill targets using relevant technologies and processes.
- Using seismic acquisition and processing technologies, determine fault combination and formation distribution, analyze reservoir-caprock assemblage and oil supply mode, predict favorable reservoirs, re-analyze fine oil source conditions, establish reservoir geology models, and finally carry out fine target evaluation.
- Procedure: fine 3D seismic acquisition and processing, fine structural study, fine effectiveness analysis of caprocks and sealing layers, fine reservoir evaluation and prediction, fine re-analysis of oil source conditions, fine target evaluation, fine reservoir geology modeling, etc.

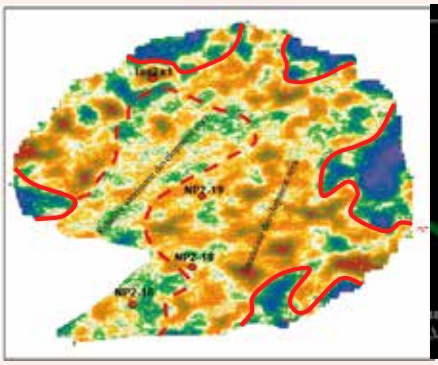


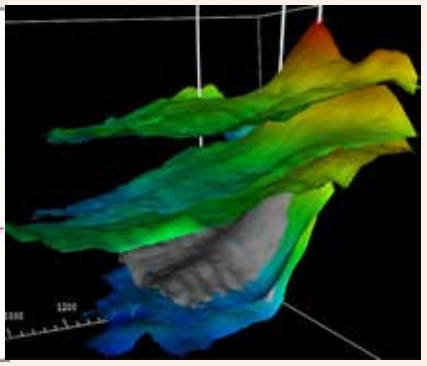
WG3-WG1 hydrocarbon accumulation and velocity inversion profile

3.1.2 Evaluation technology for lithologic-related reservoirs

- Definition: identify and describe lithologic traps, determine favorable targets and finely depict reservoir features on the basis of establishing the fine sequence stratigraphy framework.
- Establish Paleogene high-precision sequence stratigraphy framework, determine the distribution of sedimentary facies and favorable reservoirs of different sequence stratigraphy contacts, identify, track and depict compound lithology targets, and point out favorable belts and targets in lithologic reservoirs in sags rich in oil and gas.
- Procedure: sequence stratigraphy framework establishment, sedimentary system analysis, reservoir feature analysis, identification and depiction of lithologic traps, etc. Identification and depiction of lithologic traps involve multiple technologies such as seismic attribute analysis etc.







Lithosome spectrum decomposition energy map

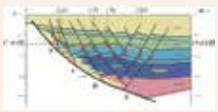
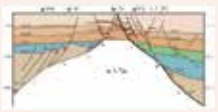
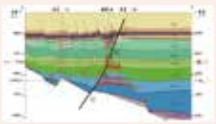
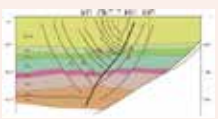
Lithologic trap visual display map

3.1.3 Evaluation technology for reservoirs in complex fault blocks

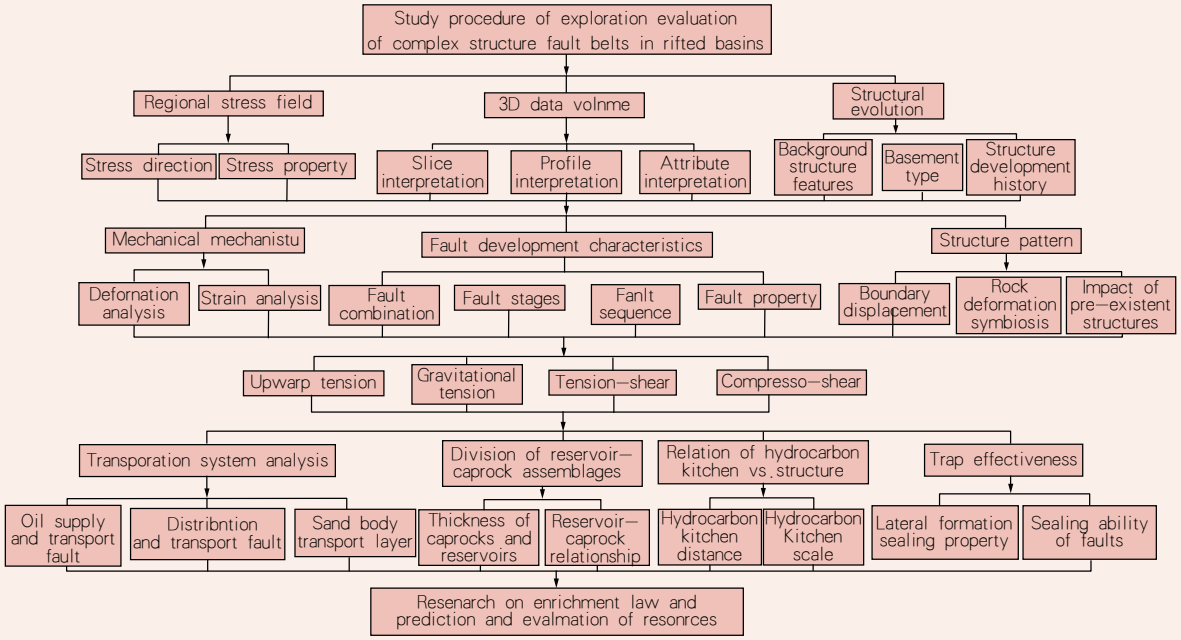
- Definition: classify fault belts, analyze stress mechanism, pattern, etc., study oil and gas distribution law and determine favorable targets with a view to studying reservoirs in complex fault blocks.

Make certain the forming mechanism, enrichment law and main control factors of reservoirs in complex fault blocks in different periods, different regions and different series of strata, predict the oil and gas distribution in reservoirs in complex fault blocks, and integrally evaluate complex faulted structure belts.

Petroleum geology features and models of different types of complex structure belts

Gravitational tension type	Stress mechanism	Regional tensile force action of contemporaneous faults	Upwarp tension type	Stress mechanism	Depending upon bedrock tilted fault blocks and Pre–Paleogene bedrock uplifting and development
	Distribution location	Bottom wall of the shovel–type normal fault steep upward and gentle downward on the steep side of the sag		Distribution location	There are bedrock–uplifted structural parts in the margin of oil generation sags or on low uplifts.
	Geologic features	Firstly fault activities and then structure forming; main action including sliding caused by gravity		Geologic features	Mainly upwarp action, limited distributed distribution, relatively simple structure, large fault block area, small buried depth
	Oil and gas distribution	The fault developed in the flank easily forms an oil source fault; Oil and gas are distributed mainly along it and in strap shape on plane.		Oil and gas distribution	Main oil source faults are developed in the core of the anticline; Oil and gas are the richest in the core of the structure; oil and gas are mainly in shallow Paleogene–Neogene.
	Reservoir profile			Reservoir profile	
Tension–shear type	Stress mechanism	Generated under the joint action of tension and torsional stress	Compresso -shear type	Stress mechanism	Generated in a local extrusion environment caused by a strike-slip fault
	Distribution location	Open sag middle		Distribution location	Distribution of filtering parts along the sag and slope
	Geologic features	The main fault supplies oil and secondary faults control oil; Oil and gas accumulate in the fault block controlled by secondary faults.		Geologic features	Caprock folds are in a closed state and are distributed in reverse S–shape; There are positive flower structures typically.
	Oil and gas distribution			Oil and gas distribution	Oil and gas are distributed mainly near the fault block in the structural high part of the main fault; The enrichment degree of oil and gas along the top of the anticline is high.
	Reservoir profile			Reservoir profile	

- Procedure: study of structural belt foundation and macroscopic background, study of fault and structure features, study of structure belt classification, and hydrocarbon accumulation study according to complex faulted structure belt types.



3.2 Fine exploration technologies

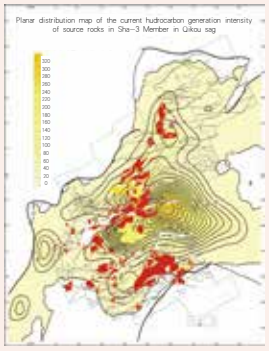
3.2.1 Fine play evaluation technology for matured exploration Region

- Definition: carry out fine stratigraphic division and correlation of reservoir-caprock assemblages on the basis of geologic evaluation; taking this as the evaluation unit, carry out division and evaluation of areas and belts and optimization of targets.

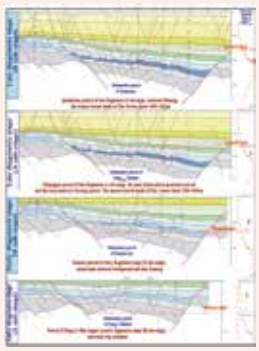
Determine the division and distribution features of reservoir-caprock assemblages and then divide and evaluate series of strata. Analyze hydrocarbon accumulation geology features and summarize the oil and gas distribution law and the total resource potential of oil and gas using the means such as analysis, physical simulation, mathematical simulation, etc. Divide and evaluate favorable belts and finally optimize targets.

- Procedure: composed of three major evaluation links such as geologic evaluation, resources estimation and comprehensive evaluation and optimization successively.

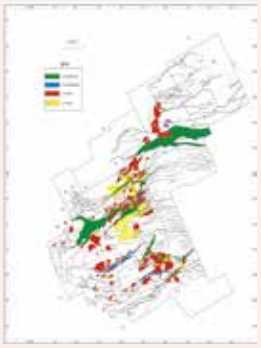
- Features: Take sand sets or reservoir groups as correlation units in reservoir-caprock assemblages; the advanced technical means such as mathematical and physical simulation, VR, reservoir prediction, etc. are combined; the evaluation standard and scheme are proposed.
- Technical indexes: Geologic evaluation indexes: reservoir-caprock assemblage division scheme, lateral distribution of different grades of reservoir-caprock assemblages, distribution of hydrocarbon generation centers of source rocks in different series of strata, types and distribution features of transport systems, and statistics of potential oil and gas resources by series of strata and belts; comprehensive evaluation indexes of belts——belt evaluation standard and scheme, distribution of different grades of belts, description of favorable geologic conditions of belts, and number of favorable targets.
- Scope of application: mainly applicable to the sag with a relatively high exploration degree. The data including drilling data, well logging data, seismic data, etc. can meet the demands of division and correlation of regional reservoir-caprock assemblages.



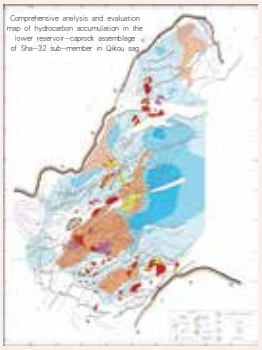
Plan view of hydrocarbon generation intensity



Hydrocarbon accumulation evolution map



Distribution map of dominant passages and faults



Comprehensive geologic evaluation map

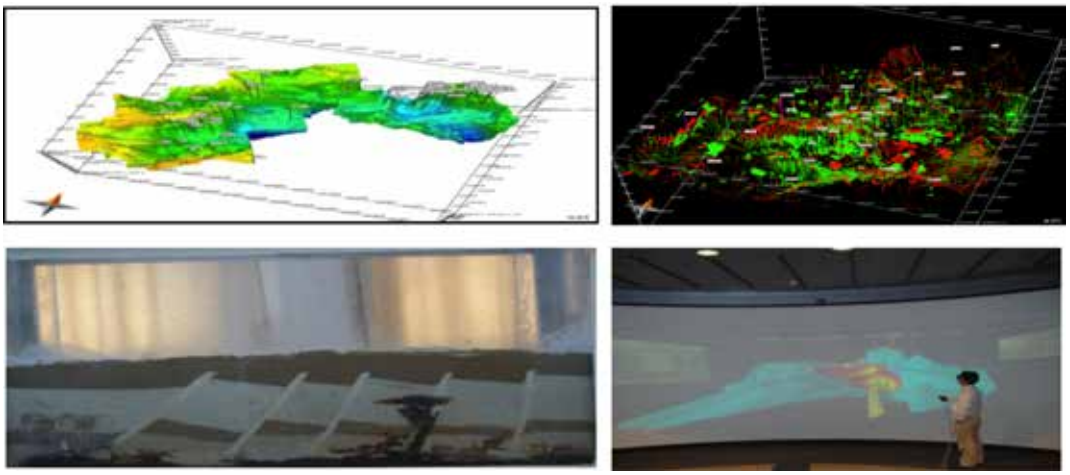
Key geologic evaluation drawings

3.2.2 Hydrocarbon accumulation simulation and resource potential evaluation technology

- Definition: reproduce the hydrocarbon reservoir forming process with the 3D visualization technology, effectively find the current distribution location of reservoirs, and evaluate the resource potential of hydrocarbon bearing systems.

Propose relevant parameters and establish the 3D skeleton model, geologic model and migration and accumulation model respectively; carry out numerical simulation using the relevant numerical simulation software; meanwhile, carry out 2D numerical simulation and physical simulation to obtain other parameters or law recognition; according to the simulation result, extract relevant information, summarize the geologic features of hydrocarbon accumulation and oil and gas distribution law, and finally determine the oil and gas resource potential.

- Procedure: the key is to establish the three models such as 3D skeleton model, geologic model and migration and accumulation model and thus to finally predict the oil and gas resource potential and the distribution of oil and gas.
- Features: the three main links are related at a high degree; it is needed to combine the technical means such as analysis, physical simulation and VR; the oil and gas resource potential is calculated according to the established whole process of oil and gas generation—migration and accumulation—preservation, loss and balance.
- Technical indexes: 3D visualization of geologic parameters of the mathematical model, 3D visualization of dynamic evolution of geologic parameters, 3D visualization of the oil and gas migration and accumulation process, profile and plan view (integrated map) of one or multiple



Key evaluation drawings

geologic parameters, and relevant statistical tables and drawings of total oil and gas resources and residual one by series of strata and by belts.

- Scope of application: mainly applicable to hydrocarbon accumulation process recovery and resource potential prediction of rift basins or depression basins.

3.2.3 Reservoir prediction technology

- Definition: if the longitudinal and transverse variation of lithology or reservoir information is uncertain in seismic inversion, it is required to try to carry out normalization or reconstruction of the curves of the used wells before inversion and to propose a new information extraction technology.
- When the regional difference longitudinally in the numerical value of curves of wave impedance or velocity in sandstone and mudstone strata is related to the variation of the lithology or reservoirs with non-reservoirs at the corresponding underground position, a self-adaptive analysis of the data is made by adjusting and controlling some parameters and then the reasonable relevant difference segments (low or high parts) on the wave impedance or velocity curves are extracted.
- Features: the regional difference longitudinally in the numerical value of hole curves is related to the variation of the lithology or reservoirs with non-reservoirs, In addition the curves obtained from post-stack and pre-stack inversion still keep such relevance and the same lithology or reservoir shall have a uniform positive difference or negative difference transversely.

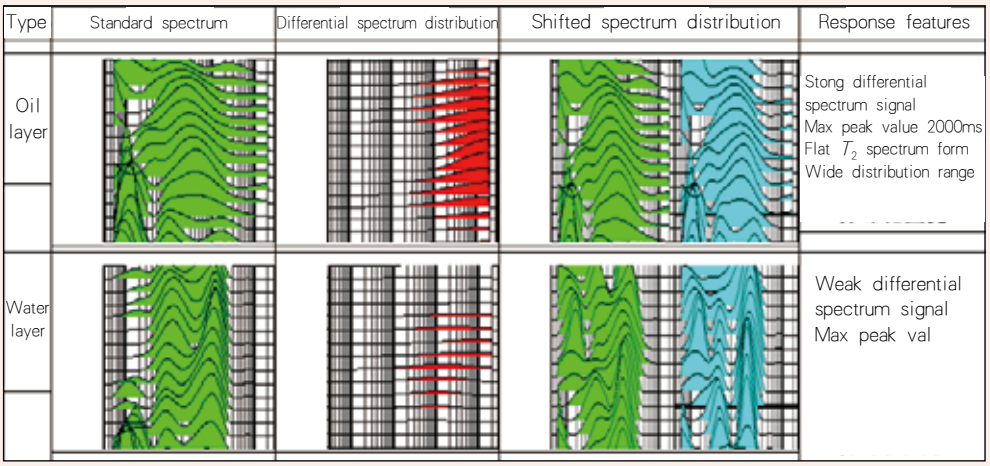
3.2.4 Low resistivity oil and gas layer identification technology

- Definition: in order to ensure no leakage and no wrong judgment of oil and gas layers, various data such as well logging data, geologic data and mud logging data are used to fully recognize low resistivity genesis,and make a analysis according to concrete genesis and adopt relevant identification methods.

Fully mining the logging information sensitive to low resistivity oil and gas layers from the existing conventional logging data new logging technologies and other integrated information are used. Firstly strengthen petrophysics research and collect many cores; establish various logging response models more approximate to actuality through core analysis.

For key exploration wells, fully use high and new technologies, reasonably combine multiple logging items, acquire data completely and accurately, realize integrated multidisciplinary fine interpretation (identification), and ensure no leakage of oil and gas layers and no wrong judgment of oil and gas layer grade in the exploration process.

- Features: there are very many factors for causing low resistivity of oil and gas layers and they need to be analyzed and judged comprehensively, In addition, it is needed to carry out integrated multidisciplinary fine interpretation (identification) to ensure no leakage and no wrong judgment of oil and gas layers (grade).



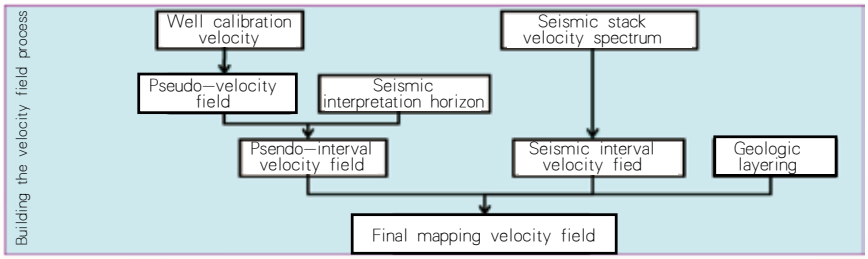
Typical response features of NMR interpretation mode of high porosity reservoirs

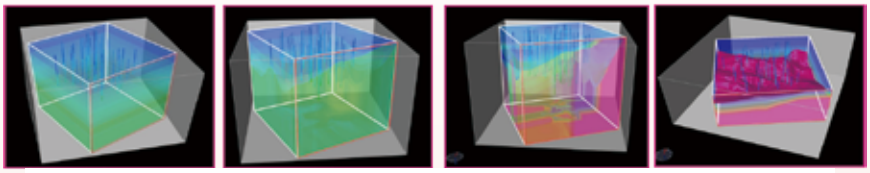
3.2.5 Integrated technologies for large-area continuous acquisition, processing and interpretation

- Definition: the rich sags of oil and gas in Bohai Bay Basin cross land, beach, sea, large urban areas, etc.; the surface conditions and structures are complex, faults are developed, there are many exploration target formation systems, the lithology is changed greatly, and underground geologic conditions are complex; three major technologies are formed including high-precision 3D seismic acquisition on large area complex surface, continuous processing and fine interpretation.

CNPC has proposed the “three-uniform” seismic acquisition and integral deployment scheme for all sags in terms of seismic acquisition. unique processing technology series are formed including data purification technology, consistency processing technology, ultra-large area 3D seismic data fine imaging technology, etc. in terms of seismic processing. In respect of seismic interpretation, the research on regional sequence stratigraphy framework and single-well and multi-well seismic and geologic analysis arel; the seismic horizons in the whole area are unified, and the relationship of geophysical interface vs. geologic interface;are determined the previous 2D profile interpretation mode for 3D data volumes is broken and the interaction mode involving planes, profiles and multiple data volumes are used; the interpretation of firstly key profiles and then survey lines as well as firstly faults and then horizons is carried out a 3D space velocity field is established and structure interpretation efficiency and mapping precision are geatly improved.

- Technical features: use the “three-uniform” integral 3D seismic acquisition and deployment concept and realize the innovation and application of three technologies such as integrated offshore, land and beach acquisition technology, two-way non-longitudinal observation technology and multi-node network spread connection technology; innovatively form three technology series and eight major characteristic technologies such as data purification processing, consistency processing and ultra-large area 3D seismic data fine imaging.
- Scope of application: applicable to surface conditions of land, beach, sea, large urban areas, etc. and underground geologic conditions involving complex structures, faults developed, multiple exploration target formations, large lithology variation, etc.





Velocity calibration pseudo—velocity filed establishment

Seismic stack velocity, interval velocity filed establishment

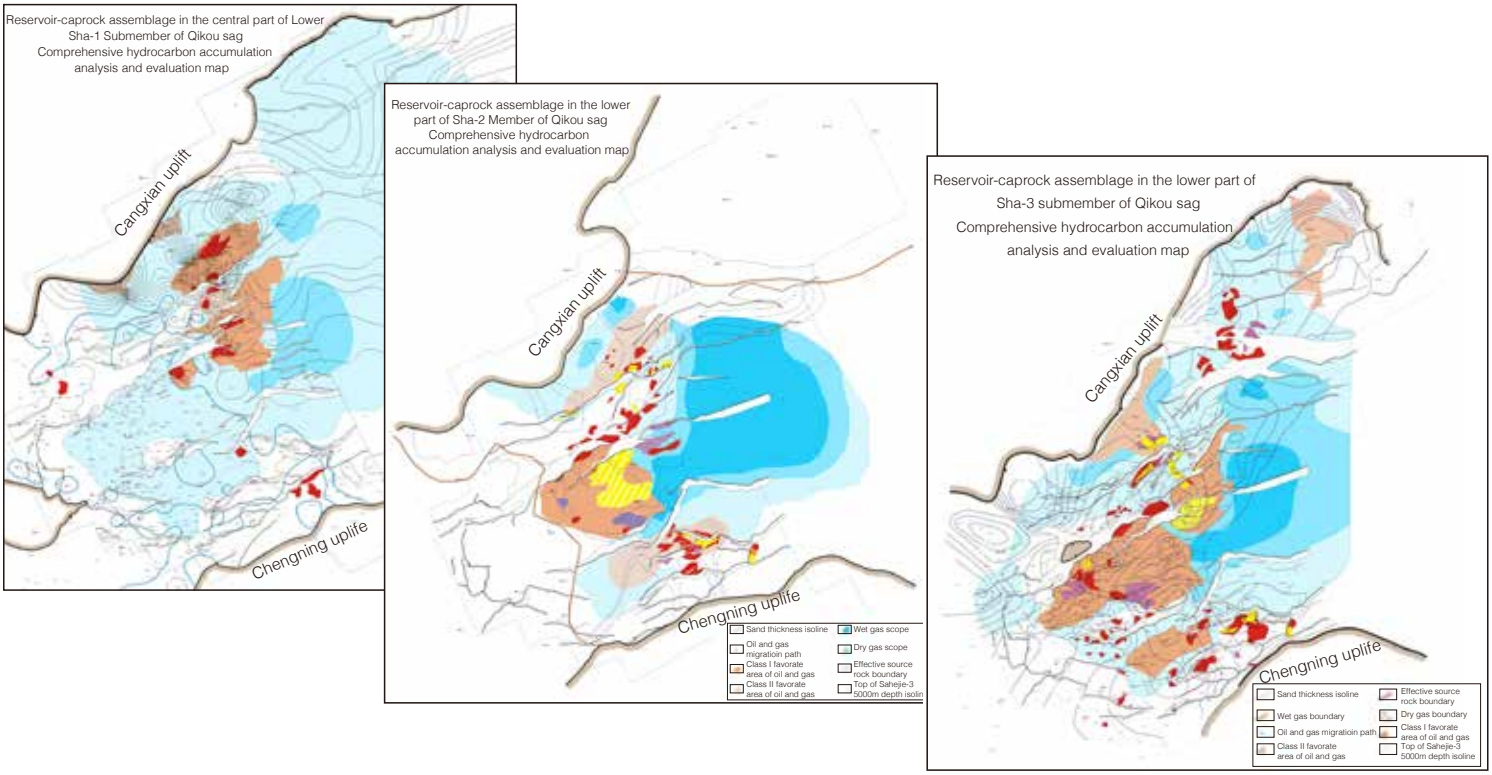
Geologic layering, interval velocity field correction

Final mapping velocity field

4 TYPICAL CASES

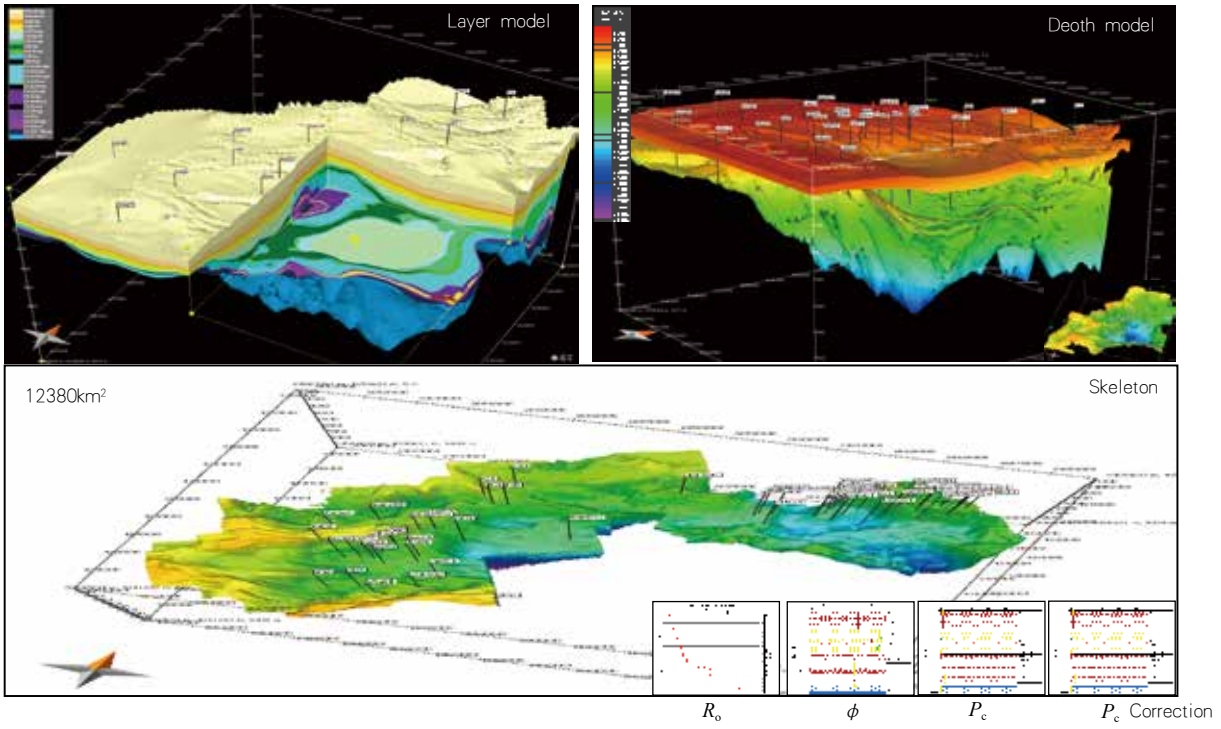
4.1 Fine play geologic evaluation of Qikou sag

Analyze the hydrocarbon generation features, reservoir distribution, caprock distribution, structure features, etc. of Qikou sag, determine the division and distribution features of reservoir-caprock assemblages, divide evaluation series of strata and establish the evaluation model. According to the valuation model, analyze the hydrocarbon accumulation geology features of “generation-reservoir-caprock-migration-trap-preservation”; summarize the oil and gas distribution law and the total resource potential of oil and gas using the means such as analysis, physical simulation, mathematical simulation, etc. Propose an evaluation scheme, divide and evaluate favorable belts and finally optimize targets. 7 type I favorable belts and 6 type II favorable belts in key series of strata are studied and determined, thus providing powerful technical support to achieving the objective of increasing 1.0 billion ton reserves.



4.2 Hydrocarbon accumulation simulation and oil and gas resource potential evaluation of Qikou sag area

Carry out scientific space discretization, time discretization and resource coupling relationship analysis of Qikou sag by means of characteristic layer surface, key time sequence and migration and accumulation simulation on the basis of knowledge about oil and gas bearing systems; rebuild the dynamic configuration relationship among oil and gas migration direction, flow rate and reservoir forming element combination in 3D space before and after different critical reservoir forming moments by means of numerical simulation; visually reproduce the hydrocarbon reservoir forming process with the 3D visualization technology and predict the oil and gas resources and oil and gas distribution of Qikou sag.



5 R&D EQUIPMENT

As a core research organization, CNPC Research Institute of Science and Technology has 2 national laboratories such as key national EOR laboratory and national shale gas R&D (experiment) center, 14 company grade key laboratories and many instrument units, over 400 sets of advanced integrated large scientific research and experiment equipment and advanced computer hardware, matching software resources and strong network systems such as IBM SPII (48CPU) large parallel computers, VR systems, etc.

CNPC Data Center and CNPC Exploration and Development Data Center, have a large quantity of exploration and development data and scientific and technical literature and are fitted with advanced computer software and hardware resources and powerful information network systems.

6 QUALIFICATIONS & STANDARDS

In recent years, CNPC complied series monographs for fine exploration theories and technologies for sags rich in oil and gas.

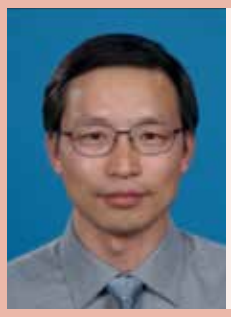
7 EXPERT TEAM

Hu Jianyi Academician of the Chinese Engineering Academy. He has established and improved China's continental reservoir theories and technologies and summarized China's reservoir type series. He took charge of, studied and completed the first General Evaluation Study Report on China's Oil and Gas Resources. His representative works include China's Continental Petroleum Geology Theory Basis, Non-structural Reservoirs, China's Petroleum Geological Theory and Exploration Progress, etc. He was awarded with special grade national science and technology advance prize in 1985 and grade I national science and technology advance prize in 1989.

Hu Jianyi Professor level senior engineer.He once served as the deputy director of Daqing Petroleum Administration, the director of China Oil and Gas Exploration Bureau and the director of the Land, Resources and Oil and Gas Reserves Review Office. Over 50 papers and 10 monographs published . He was awarded with 2 grade II national science and technology advance prizes and multiple grade I provincial and ministerial prizes.

Qiao Hansheng Professor level senior engineer. He once served as the chief geologist of Jidong Oilfield and the deputy chief geologist of RIPED. He enjoys the government special allowance.

Zou Caineng Professor level senior engineer, senior technical expert. He enjoys the “government special allowance from the State Council”. He is the vice-president, member of the Party Committee and chief geologist of RIPED. He was awarded with 1 grade I national science and technology advance prize and 9 grades I and II provincial and ministerial prizes. Over 60 papers and 7 monographs published.



Niu Jiayu Professor level senior engineer, senior technical expert. He is long engaged in oil and gas geology and exploration research work. He was awarded with 1 special grade provincial and ministerial prize, 2 grade I provincial and ministerial prizes, 1 grade II provincial and ministerial prize and 1 grade III provincial and ministerial prize. 3 monographs published.

Zhou Cancan Professor level senior engineer, senior technical expert. He serves as the leader of the special national oil and gas project “Theoretical Methods and Processing Technologies for Oil and Gas Logging Interpretation of Complex Reservoirs”. He was awarded with 1 grade II national science and technology advance prize and 5 provincial and ministerial science and technology advance prizes. Over 40 papers and 2 monographs published.

Yuan Xuanjun Professor level senior engineer, senior technical expert. He is a sedimentation expert and a comprehensive research expert in lithologic reservoirs. He was awarded with 1 grade I national science and technology advance prize, 2 grade I science and technology advance prizes of CNPC and 1 special grade science and technology advance prize of PetroChina. Over 20 papers and 5 monographs published.

Zhang Yan Professor level senior engineer. He is long engaged in comprehensive geologic data interpretation work, which covers the main petroliferous basins in the east and west of China, structural interpretation, reservoir prediction and integrated evaluation of areas, belts and targets. Zhang Yan now is the leader of the special national oil and gas project “Marine Subject—Geophysical Special Topic”. He was awarded with 1 grade II national science and technology advance prize, 3 grade I provincial and ministerial science and technology advance prizes and tens of bureau grade scientific research achievement prizes.

CNPC
中国石油

Contact of Science & Technology Management Department, CNPC :

Mr. Diao Shun
Tel: 86-10-59986059
Email: sdiao@cnpc.com.cn
diaoshun@sohu.com

中国石油科技管理部联系人：

刁　顺　先生
电　话：86-10-59986059
Email: sdiao@cnpc.com.cn
diaoshun@sohu.com