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# Research on the Geological Features of Oil and Gas in Salt Related Basin and Its Exploration

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In this paper, the author researches the geological features of oil and gas in salt related basin and its exploration. The salt basin is rich in oil and gas resources. The structures in the basin are generally rather gentle. Most of the oil and gas pools already found are belong to the types of lithology, lithology-stratigraphic and pale-geomorphic with thin reservoirs. The geology of oil and gas and the generation and distribution of oil and gas resources in the salt basin is analysed in detail in the paper. It is also pointed out in the paper that what direction should be taken in oil and gas exploration in the basin, and that the important role of the seismic prospecting technologies in the discovery of large oil and gas fields in the basin could not be replaced.

## 1. Introduction

Oil Field itself is a system, in which the core businesses provide sufficient developing space, while the noncore businesses provide assistant services for the core business (Cai et al., 2008; Zhi, 2012). So all the businesses develop together like an undividable integer, supporting each other and going hand in hand. These businesses, continuously being affected by extra uncertain factors in changeable development environment, keep trying to reach a dynamic balance by internal mediation, which meets the characteristics of the theory of function coupling. However, core businesses should be given more focuses than noncore businesses to become competitive advantages of companies. So we treat the core businesses and noncore businesses as two subsystems interdependent and correlated in different hierarchies, which meets the hierarchical principle of system theory (Jean et al., 2005).

Based on the analysis above, the evaluation management theory, the sustainable development theory, and the system theory could be used as a guidance to study evaluation indexation system of evaluation development in oil fields. As is shown in Figure 1, oil fields could maintain a balance between core and noncore businesses under the guidance of the evaluation management theory; the core and noncore businesses could develop into a dynamic organism under the guidance of system theory; oil fields could realize its dynamic balance with natural resource, environment, economy, and society under the guidance of the theory of sustainable development, so as to achieve the final goal of evaluation sustainable development (Cai et al., 2013).

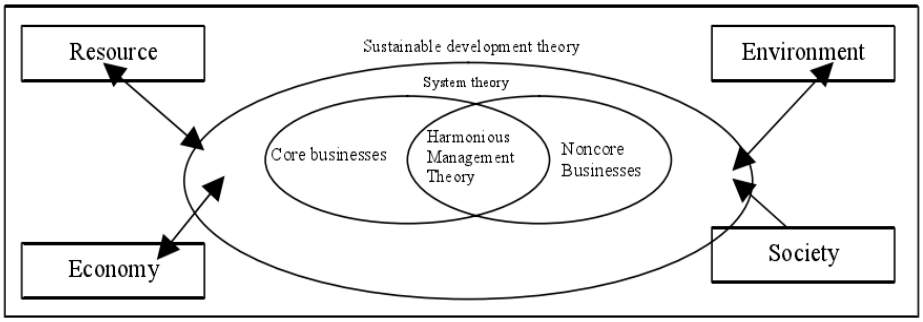


*Figure 1: The model of oil fields harmonious sustainable development*

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## 2. The Development of Evaluation System of Oil and Gas

Evaluation system management refers to the practical activities to provide solutions to achieve organization's objectives in dynamic environment by optimizing or decreasing uncertainties by optimizing or decreasing uncertainties with the recognition of evaluation topics. Evaluation development in oil fields seeks dynamic harmony in changing environment by optimizing or decreasing uncertainties to achieve its long-term evaluation sustainable objective. Evaluation management theory, taking an organization as a system based upon rules and self-governing unit, concerns on how to exert integral advantages over partial improvement to make progress in rapid and drastic external environment. As an independent unit, an oil field is engaged to solve its own problem and improve the development so as to realize its evaluation sustainable development.

Socialized evaluation society addresses the friendship among individuals, the compatibility between human beings and society, and the harmony between human beings and the nature. The evaluation development of oil fields mainly concern the evaluation relationship between resources exploitation and the natural environment, the scarcity of resources and the development of the oil fields, the economy, politics, and culture, and the development of the oil fields, and its core businesses and noncore business (Pang et al., 2009; Zou et al, 2010). There is a very close relationship between core businesses and other related noncore businesses in long term running of oil fields, and especially when the core businesses gain rapid development, they will create more developing space and opportunities for other related noncore businesses, which, in return, will promote the expanding of the core businesses.

## 3. Application of the Theories to the Evaluation System Oil Field

From the angle of ecology, resource, and environmental protection, the theory of sustainable development puts emphasis on the development under the environmental renewability, which tries to find an optimal result both maintaining ecological integrity and realizing the development of human beings simultaneously. From the perspective of economics, it focuses on maximizing net profit of economic development under the prerequisite of maintaining the quality of natural resources. From the perspective of social attributes, sustainable development is engaged to improve the living quality of human beings within the carrying capacity of the earth (Leroy et al., 2007).

From the perspective of technology, it emphasizes on building a process or technology system that produces wastes and pollutions to the minimum extent. As to the evaluation development in oil fields, it also focuses on utilizing advanced exploitation techniques and development model to achieve business economic objectives, protect ecological environment, and improve the living quality of their employees. It tallies with the theory of sustainable development form all the perspectives of ecology, resource, and environmental protection, economics, social attributes, and the technology.

We concluded the following problems based on the analysis of evaluation development in oil fields:

First: Oil and gas is not renewable, plus the excessive exploitation for a long time, so obviously the amount of oil and gas resource is far less than enough.

Second: Nowadays, it is more difficult to exploit oil and gas after many years of exploitation with higher cost, which becomes a big disadvantage to maintain stable production.

Third: During the long term construction of oil fields, there have been accumulating many problems for infrastructure. It is harder to control cost because of the higher input for security and environment protection, new equipment updating, and increasing investment.

Forth: Technicians, experts on management, and professionals, especially high-level personnel, are far less than enough, so that lack of talents a bottleneck for business development.

Fifth: The essence of a company is the effective distribution of economic resources. The efficiency of resources distribution, a mirror of management level, is determined by the managerial ability of managers in businesses, so the ability to manage the businesses plays an important role for evaluation sustainable development in oil fields.

Sixth: Because less attention has been paid to prevent and control the pollution and geological disasters due to the exploitation, mineral ecological environment and geological conditions have been worse and worse, which greatly influenced the sustainable development and life of residents.

The problems abovementioned mainly concern following aspects:

Long-term sustainable development problems of natural resources in oil fields are important. Nowadays, the exploration of oil fields has stepped into a highly matured stage, it is necessary for oil companies to intensify the exploration and exploitation to maintain production benefit and efficiency. So how to boost its core-businesses and keep evaluation sustainable development becomes the first problem for oil fields.

Evaluation sustainable development between core-businesses and noncore businesses Exploration, exploration cost, and techniques are closely correlated with noncore businesses. The future of the oil fields

depends heavily on the level of technical services and its support degree for core-businesses. So how to keep evaluation sustainable development between core-businesses and noncore businesses is very important for the future of oil fields (Guo, 2014).

Evaluation sustainable development between oil fields and the environment is also important. The ecological environment will inevitably be destructed in various degrees by natural resource exploitation. It is also important for oil fields to apply advanced exploitation techniques and development modes to achieve its economic development targets, and at the same time to protect ecological environment as best as possible, improve the living standard of employees', and create a good climate of corporate culture, so as to realize the evaluation sustainable development among nature, businesses, economy and society.

Based on the analysis above, this paper designed an evaluation indexation system of evaluation sustainable development for oil fields using the method of menu-driven multi-index system proposed by UN Sustainable Development Committee. Figure 2 shows elements for harmonious sustainable development of oil fields.

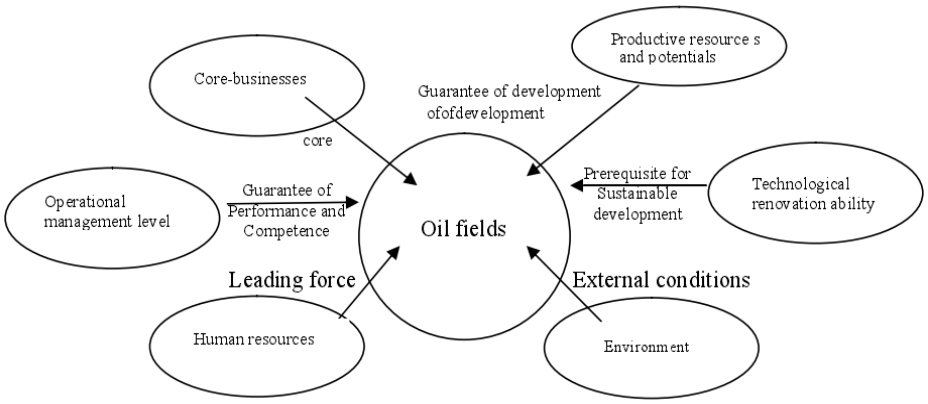


*Figure 2: The elements for harmonious sustainable development of oil fields*

## 4. The Geological Features of Oil and Gas in Salt Related Basin

Whether shale gas development has business values depend on the gas shale reservoirs identify. The seismic frequency curves of reservoirs with different fluids vary in attributes such as shape, gradient, differences between dominant frequencies and centre frequency et al. Because of the high frequency absorption characteristics of oil and gas, seismic waves through the oil and gas reservoir, the attenuation of the high frequency component energy is absorbed more serious than other fluids. So the spectrum curve slope and the energy ratio coefficient of the oil and gas reservoir is bigger. The result suggest that potential areas of shale gas can be identified and well location of well can be confirmed. The Middle Jurassic salt field formation can be divided into J2_2 and J2_1 section from bottom to top according to the Long-1 well comprehensive analysis of lithology and logging, well logging data etc. The lithology of the J2_2 section is developed sandstone, mudstone and coal seam while the J2_1 section is shale with weak gas logging abnormal in gas logging data measurement (Figure 3).

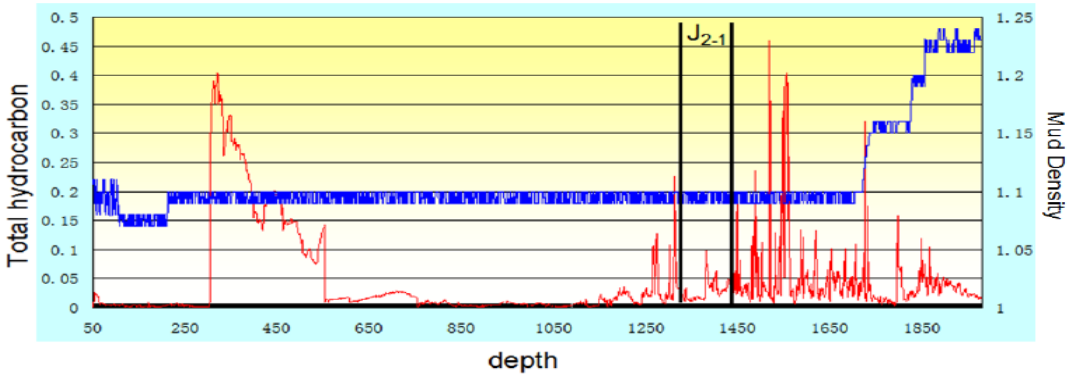


*Figure 3: The model of gas curve*

Using post-stack seismic data, we took the single-channel seismic line spectrum gathers sample of the minimum unit 2ms, and calculated the objective layer energy coefficient both inside and outside. Results showing that the energy coefficient of the Upper layer of J2_1 section is low as a whole, with an average of 0.6719, but the Lower layer is higher, with an average of 0.7521 (Figure 4). The calculation results are the same as Long 1 well curve of hydrocarbon distribution, in which the Lower layer is better than the Upper one. According to the analysis of the Long-1 well, we processed the 2D seismic data by using spectral decomposition in salt field. By studying the subtle variances of different attributes of seismic frequency spectrum, and calculating the coefficient of energy of seismic section, we can identify the abnormal area which the energy coefficient is greater than 0.7. And this area will be shale gas distribution area.

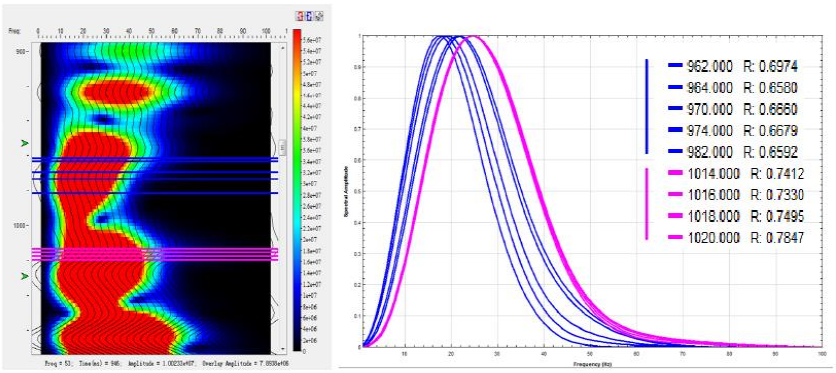


*Figure 4: The Spectrum analysis of the single channel in salt related field*

Comprehensive consider geological, seismic data, adjacent wells data and spectral decomposition data, Oil and Gas Survey of CGS carried out to evaluate shale gas resource in salt related field. On the basis of researching the gas logging abnormal, rock gas content analysis, core samples, elements and gamma energy spectrum of core samples, the shale of J2_1 section can be identified with good hydrocarbon content, an average of 1~5 m3/ton. Drilled result is in keeping with the seismic frequency division technology forecasting results.

Southern Salt related basin consists of four A structural units from west to east: western slopes, southwest uplift, central depression and southeast uplift. Upper Cretaceous salt related Formation shale sediment in large-scale invasion of the lake, with a quick settlement, super-fast filling compensation deposition characteristics and widely deposition of organic-rich, thick black shale inter bedded oil shale, which is the most important source rocks of salt related basin. The main organic matter types of Salt related formation shale are I and II 1, Low maturity and Ro is between 0.4 to 1.5%, Shale mainly consists of quartz, feldspar, carbonate, pyrite, clay minerals and clay mineral content greater than 45%.

Shale micro pores and cracks are usually free gas reservoir space and the organic matter and clay mineral particles surface is usually gas adsorption. Currently, the technology research on Microstructural are mainly: Imaging pore systems with SEM on ion-milled samples, TEM,3D pore system renditions with focused ion beam (FIB)-SEM, Pore sizes with BET analysis and Pore throat size with Hg-injection analysis.

To research the characteristics and shale oil and gas geological significance of micro pores, we use focused ion beam (FIB)-SEM to characterize shale from the first member of the Upper Cretaceous salt related formation in the south of salt related Basin. To intuitively obtain the spatial distribution of shale Microstructural and organic matter, and measure composition of mineral samples for qualitative-semi-quantitative determination through elements spectroscopy (figure 5).

The measurement results show that there are three major pore types in the shale, including inter particle, organic, and matrix inter crystal pores (figure 6). Inter granular porosity holes, mostly present in the pores between the particles of inorganic minerals or pores between pyrite aggregates and particles of clay minerals with pore size of 0.1~2.0 μm and preferably connectivity. Since Salt related shale maturity is low, mostly organic matter pores among organic matter clumps with pore size of 0.1~0.8μm irregular strip, belonging organic primary porosity and few nearly circular pores, a pore size of 0.5~1.5μm, which no communication between the pores. Matrix inters crystal pores clay minerals, mostly among clay mineral sheets or aggregates, which this section of the pore is widely distributed in the first member of the Salt related Formation since the high content of clay minerals. In addition, there are a mass of micro-fractures of micron-submicron Nano-scale, including organic and inorganic mineral edge, filled calcium and clay minerals interlayer fractures.

North America has successful experience in shale oil and gas exploration and development, Shale oil and gas development in six main regions: Marcellus, Haynesville, Barnett, Eagle Ford and Permian Basin. Marine

shale formations in North America with micro-pore types, Marcellus, Barnett and Haynesville are shale gas main producing formations. Marcellus and Barnett shale porosity mainly grow organic matter pore, which porosity-rich, approximately circular or oval and honeycomb distribution; Haynesville organic pores smaller or no growth, as the clay mineral content>70%, which is the first member of the Salt related Formation shale is similar. Bakken and Eagle Ford shale as the main shale oil formations, shale pores mainly include inter particle, organic, and matrix inter crystal pores which is similar to the research formation. Shale porosity is extremely rich of Lower Paleozoic Salt Formation in Southern China marine, which approximately circular or oval and honeycomb distribution and preferably connectivity. Preferably similar between Marcellus, Barnett and Lower Paleozoic formation in Southern China marine porosity, the large difference between Salt related formation. As the important reservoir space, Shale micro porosity and micro-cracks have a closed relationship with the oil and gas-bearing, which this is perhaps the one of the reasons for shale gas-bearing difference between southern Salt related Basin Salt related formation represented the northern and North America, South China marine shale. Therefore, the study for Micro pores and micro-cracks in the structure, distribution and connectivity is important reservoir characteristics are important for the reservoir characteristics and shale oil and gas resources.

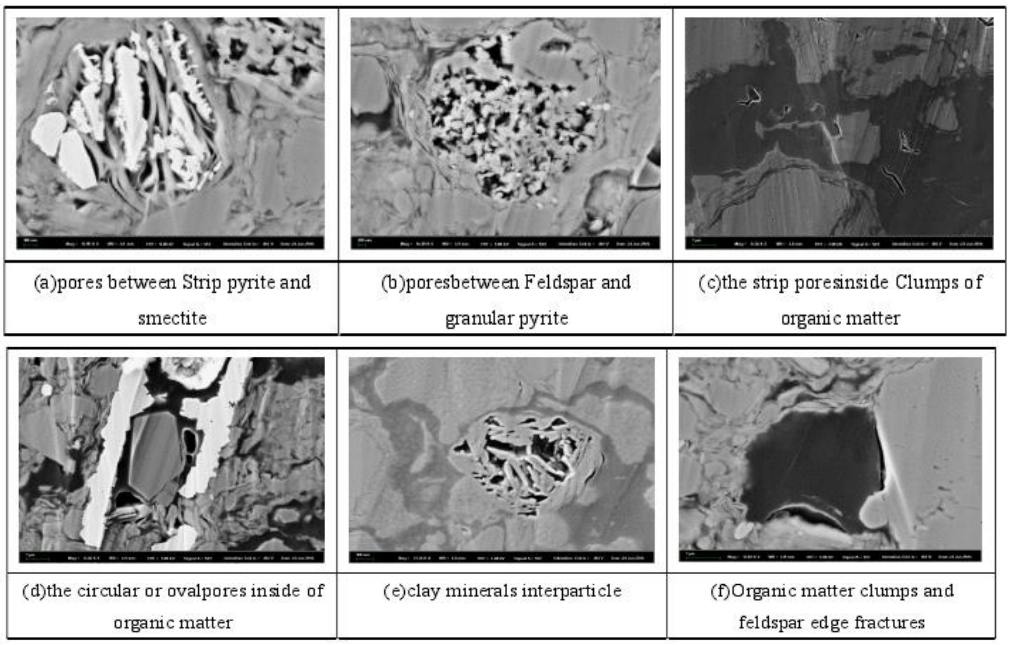


*Figure 5: Micro pores-(cracks) of shale on the salt related field*

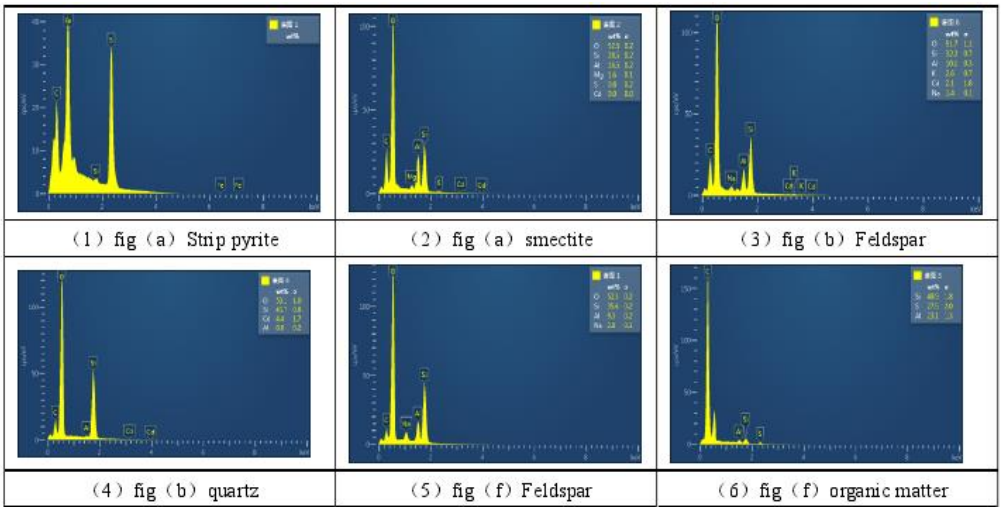


*Figure 6: Micro pores-(cracks) elements spectrum of shale on the salt related field*

## 5. Conclusion

In this paper, the author researches the geological features of oil and gas in salt related basin and its exploration. The salt basin is rich in oil and gas resources. The structures in the basin are generally rather gentle. Most of the oil and gas pools already found are belong to the types of lithology, lithology-stratigraphic and pale-geomorphic with thin reservoirs. The geology of oil and gas and the generation and distribution of oil and gas resources in the salt basin is analysed in detail in the paper. It is also pointed out in the paper that what direction should be taken in oil and gas exploration in the basin, and that the important role of the seismic prospecting technologies in the discovery of large oil and gas fields in the basin could not be replaced.

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