

Formation and Accumulation of Subtle Oil Pools in the Dongying Depression, Bohai Bay Basin, China

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Subtle traps or subtle oil pools have become an important exploration play in the Dongying Depression, Bohai Bay Basin, east China. Despite of the recent success in exploration, the formation mechanisms of subtle traps are still not well understood. The majority of the subtle traps in the Dongying Depression are developed in the E₃₃ member of the Paleogene Shahejie Formation with the traps being primarily of lenticular basin floor turbidite sands encompassed in mudstones. Oils in the subtle traps were previously thought to have migrated directly from the surrounding source rocks of the same formation (E₃₃). Detailed geochemical investigation of 47 oils and 50 rocks from the depression indicates that oils from the subtle traps cannot be correlated with the surrounding E₃₃ source rocks, which are characterized by high P_r/P_h (>1), low Gammacerane/C₃₀hopane, representing a fresh water lacustrine setting. In contrast the oils are featured by low P_r/P_h (<1) and high Gammacerane content, showing a genetic affinity with the underlying E₃₄ source rocks, which have low P_r/P_h and high Gammacerane content, indicating a brackish lacustrine setting. Oils in the E₃₃ subtle traps are likely derived from mixed sources with the contribution from the E₃₄ source rocks dominated. Therefore unconventional oil migration and accumulation mechanisms need to be invoked to pool the oils from the E₃₄ source rocks through a thick (>100 m) E₃₃ source rocks with no apparent structural or stratigraphic pathways. This finding may have significant implications to future exploration and the remaining resource evaluation in the Dongying Depression.

Diagenetic History and Gas Entrapment of the Yulin Gas Field in the Basin-Center Area of the Ordos Basin, Central China

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The Ordos Basin in China is a large craton basin with an area of 250000km². The Upper Paleozoic coal and shale sediments serve as gas source rocks with a peak generation and migration at the end of the early Cretaceous. Huge gas potential has been proved by exploration in the "basin-centered gas accumulation system". However, the mechanism for the gas accumulation is still not well understood. By using petrography, UV fluorescence microscopy, microthermometry, Raman microspectrometry, scanning electron microscopy, and X-ray diffractometry, we studied the diagenetic history of the Yulin Gas Field in the basin-centered area, where stratigraphic and/or lithologic seals have not been found in the updip portion of this field. It was revealed that three phases of diagenesis and hydrocarbon charge occurred in the late Triassic, late Jurassic and the end of early Cretaceous. During the first two phases, geo-fluid entered into the reservoirs causing dissolution and cementation and enhancing porosity. However, subsequent subsidence and diagenesis, including compaction and cementation, reduced the pore space markedly. By the end of the early Cretaceous, bulk gas migrated into the tight reservoirs. Cementation continued to occur at the updip portion of this field due to low gas saturation and has formed effective seals to retain gas for a prolonged period. The existence of diagenesis-induced seals at the updip portion of the sand and gravel bodies may indicate a huge gas exploration potential to the downdip direction of the Yulin Gas Field, even though there are no structural and sedimentary lithologic traps present.

Tectonic Characteristics of Foreland Fold-and-Thrust Belts in the Southern Junggar Basin, West China

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The foreland fold-and-thrust belts in the southern Junggar Basin are located between the northern Tianshan Mountains and the Junggar Basin in the western China. They consist of a series of fault-related folding structural belts formed by the large-scale thrusting of the northern Tianshan Mountains into the Junggar Basin since the Miocene. It is characterized by several segments along the east-west trend and several north-south oriented structural belts. On the southern Junggar Boundary Fault, the Carboniferous strata thrust over the Quaternary, exhibiting a distinct fault scarp. The southern Junggar Basin is generally under a trans-pressure setting. Deformation in the southern Junggar Basin occurred from the Permian through to the Quaternary strata and can be subdivided into the upper, middle, and lower deformation layers according to the regional detachment layer of the Paleogene mudstones and the lower and middle Jurassic coal measures.

Under the trans-pressure tectonic setting, the southern Junggar Basin is characterized by multiple detachment deformation and multi-stage superimposed deformation, exhibiting rapid variations in the structural styles both laterally and vertically. The transverse fault has a function of partitioning oil and gas pools. The study on the condition of oil and gas geology has shown that the southern Junggar Basin is rich in oil and gas resources. However, the petroleum exploration in the area is much more difficult owing to its complex structures and the rapid facies change in reservoir sandbodies.

Petroleum Geology of the Northeastern Sichuan Basin and the Characteristics of Puguang Gas Field, China

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The northeastern Sichuan Basin contains all the essential elements for a giant petroleum system with three major Silurian, Permian and Upper Triassic source rocks, excellent Permian and Triassic reservoir rocks, and good regional seals. The main reservoir is the Triassic carbonate with an average porosity of 8.1%. The reservoir rocks consist of oolitic dolomite, residual oolitic dolomite and sugary grained residual oolitic mid-macro crystalline dolomite. The late

Permian reef carbonate comprises mainly hummocky patch reefs with excellent reservoir properties. The patch reef cap dolomite is the best reservoir rock. The area east of Najiangtiechang River-Xuhan Puguang-Huangchang structural belt in the northeastern Sichuan Basin is the area where reef flat- dolomite reservoir rocks had been extensively developed. The Puguang Gasfield is a structural-lithologic gas pool and is the largest, deepest and the most abundant gas reservoir discovered recently in the Sichuan Basin with an estimated reserve in the Puguang Gasfield exceeding $350 \times 10^9 \text{ m}^3$. The Triassic reservoir lithology consists solely of dolomite with the development of oolitic dolomite and residual oolitic dolomite and is an excellent reservoir rock with a moderate to good porosity and permeability. The development and preservation of pores in deep burial may be related to the vugular dissolution by deep hot water. The favorable conditions for the formation of the Puguang giant gas field can be attributed to the proximity of a major hydrocarbon generating sag, the development of excellent reservoirs and the presence of palaeo-highs at the time of hydrocarbon charge.

Sequence Stratigraphy of the Pearl River Deep-water Fan Systems, South China Sea

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Regional geological investigation indicates that the Baiyun Sag, a deep-water continental slope region located at the palaeo-Pearl River mouth and immediately below the current sand-rich Pearl River delta, is a favorable place for the development of large-scale deep-water fan systems. Seismic and sequence stratigraphic study of the deep-water slope region has led to the discovery of multi-sequences of overlapped Pearl River Deep-water Fan Systems, which have enormous potential for major hydrocarbon discoveries.

The sequence stratigraphic analysis of the Pearl River Deep-water Fan Systems has greatly improved our understanding on the geological evolution of the region by (1) constructing a local sea-level curve, (2) identifying chrono-horizons of seismic reflection phases, sequence boundaries and their corresponding biostratigraphic ages, (3) correlating sequence boundaries with global eustatic sea-level curve and deposition bodies within the sequence frame, (4) establishing the coupled effect between the development of the deep-water fans and sea-level changes, sediments supply and palaeo-geography, (5) identifying palaeo shelf breaks and depositional sequence types, and (6) analyzing the temporal and spatial evolution of sequences and parasequences.

The established sequence stratigraphic framework led to the discovery of Pearl River deep-water fan systems and unraveled the coupled genetic relationship between the drainage basin of Pearl River, Pearl River delta and deep-water fan systems. The development of the deep-water fan systems are also found to be strongly influenced by sea level changes and the palaeo-geography.