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"Petroleum Exploration into Black Shale System": Characteristics and Potentials

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Oils and gases in black shale strata, including tight oils and gases, shale oils and gases and coal-bed gases, are oil-gas accumulations located in the co-existing sources and reservoirs and penetrating into hydrocarbon-generation kitchens. "Petroleum exploration into source rocks" is to enter into or approach to the hydrocarbon generation strata and explore the shale oils and gases in the source rocks, tight oils and gases near the source rocks, immature shale oils, coal-bed gases and other resource formations. Tight oil is the most feasible nonconventional oil resource of China, whereas shale gas is the nonconventional natural gas resource with the most potential. "Shale oil revolution" might be a new development after "shale gas revolution". Comparison of Chinese and American shale strata oil and gas geological characteristics indicates that the shale oil and gas of the United States have unquestionable advantages: (a) considerable scale of shale rocks are in the optimum oil and gas generation window (R_o is 0.9-2.0%), (b) the distribution is continuous across a large area ($(1-7) \times 10^4 \text{ km}^2$), (c) the reserve strata have good homogeneity, (d) the physical property is good (porosity is more than 7%), (e) the gas-oil ratio is high (several hundred - dozens of thousand m^3/m^3), and (f) the pressure is high (pressure gradient is 1.3-1.8 MPa/100m). For China's continental shale oil and tight oil, the thermal evolution degree is low (R_o is 0.5-1.0%), the distribution area is small (several hundred to dozens of thousand km^2), the reserve strata have high non-homogeneity, the physical property is variable (porosity is 3-15%), the oil mass is heavy (crude oil density is more than $0.85\text{g}/\text{cm}^3$), and the strata pressure is changeable (pressure gradient is 0.6-2.2 MPa/100m). For China's marine shale gas, the thermal evolution degree is high (R_o is 2.0-3.5%), the shale strata has gone through several periods of tectonic movement and the reserve condition is inferior. According to the above review, the "sweet area (section)" will be the core of "petroleum exploration into source rocks". The study of shale strata oil and gas "economic sweet area" distribution involves the matching and superimposing of "geological sweet area", "engineering sweet area" and "performance sweet area". There is tremendous amount of shale strata oil and gas reserve. Horizontal well fracturing technology is a "mass production" approach. The marine shale strata oil and gas reserve of the United States often have 10-15 years of high yield period. In large scale exploration of China's continental shale strata oil and gas, it is advised to exploit the advantages of big strata thickness and the richness of organic mass, and to develop new exploration technologies, so as to guarantee 40-70 million tons of tight oil and shale oil and 40-60 billion m^3 of shale gas production capacity in the future, and realize large scale profitable exploitation of China's marine and continental shale strata oil and gas.

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