



Terrestrial tight oil reservoir characteristics and Graded Resource Assessment in China

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The success of shale/tight plays and the advanced exploitation technology applied in North America have triggered interest in exploring and exploiting tight oil in China. Due to the increased support of exploration and exploitation [U+FF0C] great progress has been made in Erdos basin, Songliao basin, Junggar basin, Santanghu basin, Bohai Bay basin, Qaidam Basin, and Sichuan basin currently. China's first tight oil field has been found in Erdos basin in 2015, called xinanbian oil field, with over one hundred million tons oil reserves and one million tons of production scale. Several hundred million tons of tight oil reserve has been found in other basins, showing a great potential in China.

Tight oil in China mainly developed in terrestrial sedimentary environment. According to the relations of source rock and reservoir, the source-reservoir combination of tight oil can be divided into three types, which are bottom generating and top storing tight oil, self-generating and self-storing tight oil [U+FF0C] top generating and bottom storing tight oil. The self-generating and self-storing tight oil is the main type discovered at present. This type of tight oil has following characteristics: (1) The formation and distribution of tight oil are controlled by high quality source rocks. Terrestrial tight oil source rocks in China are mainly formed in the deep to half deep lacustrine facies. The lithology includes dark mudstone, shale, argillaceous limestone and dolomite. These source rocks with thickness between 20m-150m, kerogen type mostly I-II, and peak oil generation thermal maturity (Ro 0.6-1.4%), have great hydrocarbon generating potential. Most discovered tight oil is distributed in the area of TOC greater than 2%. (2) the reservoir with strong heterogeneity is very tight. In these low porosity and permeability reservoir, the resources distribution is controlled by the physical property. Tight sandstone, carbonate and hybrid sedimentary rocks are three main tight reservoir types in China. The porosity is 2-14% (average 5-10%) and the permeability is less than 1mD. The laboratory test and exploration practice confirmed that the oil content was positively related to physical property. The higher the porosity, the better the oil content will have. (3) Source rock and reservoir are superimposed. From the contact relationship of source rock and reservoir, the reservoir developed in the source rock has the advantage of capturing oil and gas, so the oil saturation can be as high as 70-80%. (4) The increased pressure caused by hydrocarbon generation and the connected fracture are the key factors for tight oil accumulation. The Fuyu tight oil formed underling source rock in Songliao Basin is a good example. The fracture system is the key factor for tight oil accumulation.

Considering the strong heterogeneity of terrestrial tight oil reservoir in china, we create hierarchical resource abundance analogy, EUR analogy, cell element volumetric methods to evaluate tight oil resource potential. In order to find exploration "sweet spots", establishing tight oil resource classification evaluation standards are key steps to objectively evaluate tight oil resource distribution. The resource classification evaluation standards are established by the relationship analysis between reservoir properties and oil properties, and the correlation analysis between production, resource abundance, and reservoir thickness. The first-grade tight oil resource, which is recently available and can easily be developed, has following main parameters: the porosity is greater than 8%, thickness is over 10m, resource abundance is above 150,000 tons / km², and pressure coefficient is greater than 1.3; The second-grade tight oil resource is currently unavailable, but with advanced technology can expected to be developed. The main parameters are as following: the porosity is 5% -8%, thickness is less than 5-10m, resource abundance is 50000-150000 tons / km², the pressure coefficient is 1.0 to 1.3; The third-grade resource has poor quality, need long-term to be effective explored, has following main parameters: porosity is less than 5%, the thickness is less than 5m, resource abundance is less than 50,000 tons / km², the pressure coefficient is less than 1.0. Using created resource evaluation methods, the tight oil resources has been calculated in china. The first-grade recoverable resource of tight oil is about 610 million tons. The second-grade recoverable resource is 450 million tons. And the third-grade recoverable resource is 400 million tons. The first-grade and second-grade recoverable resources are mainly distributed in the Ordos basin, Bohai Bay basin, Songliao basin, Junggar basin, and Qaidam Basin. The third-grade resources are mainly distributed in Sichuan and Santanghu basin.