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Evaluation methods of tight oil and its application in China

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Due to the success of shale/tight plays in recent years, the global oil industry is entering a new epoch with simultaneous exploitation of conventional and unconventional resources. Thus, innovative evaluation ideas and improved assessment methods are needed to cope with the resource composition alterations in petroleum evaluation. Many evaluation methods for unconventional resources have been established in North America where undergoing shale boom. These methods include widely used estimated ultimate recovery (EUR), USGS FORSPAN model and its improved methodology, volumetric method used by EIA, stochastic simulation program and hydrocarbon generation method. Compared to the rest of the world, the geologic setting and accumulation evolution of unconventional resources in China have unique characteristics. It is essential to establish reasonable and effective evaluation methods for objective appraisal of unconventional resources potential. Using tight oil as a case its evaluation methods and applications has been discussed in this paper. Tight oil in China mainly developed in terrestrial sedimentary environment. Tight sandstone, carbonate and hybrid sedimentary rocks, usually with strong heterogeneity and large spread area, are three main tight reservoir types. The porosity is 2%-14% (average 5%-10%) and the permeability is less than 1 mD. Considering the strong heterogeneity of terrestrial tight reservoir in China, we established hierarchical resource abundance analogy (HRAA), EUR analogy, cell volumetric method (CVM) to evaluate tight oil resource potential. These methods also apply to shale gas and tight sand gas assessment. The bases of the three methods are classification evaluation standards of the geological setting. These standards are established by the relationship analysis between source rock, reservoir and oil properties, and the correlation analysis between production, resource abundance, and reservoir thickness. The key step of HRAA is dissecting data informative calibration areas. The aim is to calculate the resource abundance of different classification. The resource volume of assessment target can be evaluated by analogy with that of calculated abundance. A critical base of EUR analogy is EUR database. The EUR database includes EURs of wells in tight oil plays in China and other shale plays in the world. Combined with previous classification evaluation standards, the recoverable resource of evaluate target can be calculated. The process of CVM includes three steps. Firstly, the assessment target should be divided into many cells. Each cell has its particular volumetric parameters. Then, the resource volume of each cell is estimated. The total resource is the sum of volume in all cells. The results of these methods can be visualized and can simultaneously predict the location of "sweet spots" in continuous petroleum accumulation. Meanwhile, the evaluation could serve as guides in petroleum exploration. Each method has its own applicable condition in accordance with the geological data available. HRAA is applicable for evaluation of the target with insufficient geological condition data. CVM is suitable in areas with several exploratory wells. While EUR analogy is designed for targets with several producing wells. Using these created evaluation methods, the tight oil resources has been calculated in China. The total recoverable resource volume is 1.2-1.5 billion tons, mostly occurred in Erdos basin, Songliao basin, Bohai Bay basin and Junggar basin.

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