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Dynamic Evaluation Method of Low Porosity and Permeability Sandstone Reservoir

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Physical properties of sandstone reservoir in accumulation period are crucial parameters to decide whether hydrocarbon can be accumulated[1]. Traditional reservoir evaluation methods are mainly established according to present reservoir physical properties. Due to the neglect of the changes in reservoir properties after accumulation stage, traditional reservoir evaluation methods are static and ineffective in oil-bearing property prediction. Based on this, we propose a new method to assess reservoir quality dynamically and establish the evaluation index system preliminarily by using paleoporosity (porosity in accumulation stage).

The new evaluation method involves two steps: (1) Based on the principle of effect-simulation, the porosity evolution process can be divided into two independent processes: porosity decrease (mainly caused by compaction and cementation) and porosity increase (mainly caused by secondary dissolution). Under the constraint of present porosity , an evolution model of sandstone porosity can be established by combining both the pore increase and pore decrease effects, then paleoporosity can be recovered; (2) By using statistic method ,the relationship between paleoporosity and production testing result is determined and the relevant evaluation index system can be established.

The new method is applied in reservoir evaluation of Yanchang formation, Ordos basin. First, based on analysis of 30 physical properties points selected from Xifeng, Jiyuan and Ansai area, we find that, compared with present porosity, paleoporosity has higher relevance with production tests (e.g.,oil production, fluid production and oil yield). According to the relationship between paleoporosity and production tests, we rank sandstone reservoirs into three categories: (1) superior reservoir (with paleoporosity value larger than 16.5% and oil yield rate between 70% and 100%), (2) medium reservoir (with paleoporosity value between 13.5% and 16.5% and oil yield rate between 70% and 100%) and (3) inferior reservoir (with paleoporosity value smaller than 13.5% and oil yield rate below 30%). In order to verify the validity of the evaluation method, 8 samples from Zhenjing (another area in the southwest of Erdos Basin) are assessed with this method. The overall coincidence rate of reality reaches 87.5%, which indicates that the dynamic evaluation method established in this research is valid for Yanchang formation in Ordos Basin. Therefore, we conclude that this new method can achieve higher accuracy for oil-bearing property prediction compared with traditional methods.

References:

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