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Origin Mechanism of Reservoir Tightness and "sweet spots" Prediction of Deep Tight Sandstone Gas Reservoir in Tuha Basin, China

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Tuha basin located in eastern of Xinjiang, China. Deep tight sandstone gas reservoirs develop in Jurassic of Tuha basin, which their burial depth exceeds 3500m. In here the porosity of reservoir is from 3% to 9% and permeability is from $0.01\times10^{-3}\mu m^2$ to $1.00\times10^{-3}\mu m^2$. But the origin mechanism of reservoir tightness has been unrevealed yet. The tight sandstone reservoir here is mainly terrigenous clastic rock and the dominant lithology is feldspathic litharenite. The reservoir is of low compositional maturity, which reflects near-source deposition. Based on thin section analysis and petrophysical experiments, the origin mechanism of reservoir tightness in this area is summarized as the following three aspects. Firstly, the Jurassic tight sandstone gas reservoir is buried more than 3500m depth and so that indicates the overlying ultra-thick sediments produced strong compaction effect on the reservoir and this is the direct cause for reservoir tightness. Secondly, the feldspar and debris content is greater than 50%, which means high content of instability component, such as metamorphic lithic and magmatic lithic. High content of instability component results in poor compression capacity and lithic plastic flow and this is the root cause for reservoir tightness. Thirdly, during late diagenetic phase, quartz and feldspar secondary overgrowth as well as calcite and siliceous cement fill the pores and porosity decreases further and also helps reservoir tightness to a certain extent.

Reservoir tightness directly affects the deep tight sandstone gas reservoir in Jurassic accumulation and natural gas distribution as well as gas reservoir exploration.

Here "sweet spots" is most beneficial gas reservoir zones in deep tight sandstone. In the light of above the characteristics of tight sandstone reservoir, a multiphase matching analysis method to predict the "sweet spots" of deep tight sandstone gas reservoirs is put forward. Major principle is that the controlling factors of "sweet spot", favorable reservoir belt, sedimentary facies belt and favorable tectonic belt are used as the first controlling factor, the second controlling factor and the third controlling factor separately. The "sweet spots" in the studied area are divided into 4 types of Ⅰ, Ⅱ, Ⅲ and Ⅳ from good to bad according to the matching degree of three single factors. Based on the analysis of the sedimentary, structural and reservoir controlling factors of Jurassic in Tuha basin. It is held that

the favorable sedimentary facies in this area is the braided river channel and superimposed river channel microfacies of the braided river delta plain, the favorable structures are the southern slope belt, the local uplift and the areas where faults are developed in central sag, and the northern large-scale long anticline structural belt, the favorable reservoir is the effective reservoir zones whose porosity is higher than 3.2% and permeability is higher than 0.1 $\times 10^{-3}\mu m^2$. On the basis of the multiphase belt matching analysis of the studied area, Ⅰ type of "sweet spots" is mainly located in the west of well Js1 and near to well J1 in the southern slope belt, the long and narrow strip in the west of central sag, and the middle of the J3 anticline, the west wing of Ds 2 anticline and local small structures between them in the north. Their potentiality of exploration and development is most. The predicting result is in great correspondence with drilling well and single well logging interpretation result. Therefore, this method can be used for effectively predicting "sweet spots" of deep tight sandstone gas reservoirs to contribute to their exploration.

References:

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