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Three-dimensional modeling of Fracture-cavity reservoirs

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Fracture-cavity reservoir is very complex reservoir. Caves, dissolution pores and fractures are the three main types of reservoir space coexisting in Fracture-cavity reservoir. The distribution and properties of different reservoir space varies considerably. Therefore, how to establish the three dimensional model of reservoirs with such characteristics is challenging. In this paper, we aim to modeling the Fracture-cavity reservoir on basis of the geological characteristics taking Tahe oilfied, Tarim basin, China as an example.

Specifically, we build cave models, dissolution pore models and fracture models respectively and then merge them into a fracture-cavity reservoir model. The focus is on selecting different modeling strategies for different reservoir space.

Caves are the most important reservoir space and has characteristics of obvious different distribution in different karst zones. The cave is defined as reservoir spaces with diameter larger than 0.5m. Caves, which are greater than 5m, can be identified by seismic impedance and we call it the big scale cave. We get the large scale cave model using different seismic attributes truncation in different karst zones and then correct the model according to the prior geological patterns manually. And the other, smaller than 5m, cannot be accurately identified by impedance, we call it the small scale cave. Small scale caves have similar genetic type of karstification with big scale caves but different karstification intensity. They have characteristics of similar distribution law but different sizes. Taking big scale cave model in different karst zones as training images, we establish the model of small caves using multiple point geostatistical simulation. This method successfully applied the conceptual pattern to a geological modeling.

The dissolution pores has characteristics similar to the sand reservoirs, and the model can be established by using the method of Sequential Gauss simulation.

The fracture size differs greatly, and we build the fracture model of different scale using different modeling method. The large scale fracture model is established using the deterministic method through manual interpretation. The mesoscale fracture model uses deterministic method with ant-tracking. Based on the characteristics of single well fractures, small fracture model is established by using object-based stochastic simulation with the constraint of the fracture density probability.

Finally, we merged all THE models together and obtained the three-dimension geological model of fracture-cavity reservoirs. This model better reflects the geological distribution of reservoir space and has successfully applied to the development and production in Tahe oilfield.