Geological Model and Natural fracture Characteristics in Carbonate Rocks Gas Reservoir Constrained by Multi-factors as an Example of HT Area Fractures

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ABSTRACT

Geological model and natural fracture characteristics in carbonate rocks gas reservoir constrained by multi-factors play a significant role in gas exploration and exploitation.Based on seismic, geological, logging and thin sections data, we discussed the fracture formation mechanism and re-characterized the core fractures in HT area. The formation periods of fracture were inferred by means of balanced cross-section technique and fluid inclusions tests, so that we can establish geological model for fractures. Then the relationships between the fracture parameters and tectonics, lithology, physical properties, interlayer frequencies, filling degree were analyzed in detail, and the main controlling factors for distribution of fracture parameters were concluded and optimized. Combined with the principle of ancient tectonic restoration and structural physical simulation test, the distribution of carbonate reservoir fractures was predicted through fold principal curvature method, fractal theory and fracture mechanics simulation method.The result indicated that the structural fractures are dominated in HT area and make up a great proportion in the west. High angle fractures (60°-90°) are well-developed in the west, while low angle (0-30°) fractures in the east. Filling degree decreased from west to east with full-filling in the west and half-filling in the east. The development of fractures was divided into three stages: late Caledonian (calcite, mud full-fulling, mainly invalid fractures), late Hercynian (high angle fractures, half-fulling and full-filling) and Himalayan (high angle fractures, open, half-filling and un-filling). Based on finite element numerical simulation and superposition of fractures, present fractures were mainly influenced by Himalayan movement and corresponding with Himalayan fractures. Structural fractures were mainly developed in well X8 and X2, and the degree of fracture development reduced from west to east. The connectivity between well X5 and X401 was poorer in the lateral, and better between well X401 and X4. The development characteristics of single well vertical fractures were researched through finite element and discrete element numerical simulation. Fractures were not developed in thick mudstone, while it was well developed in cross layer of sand-mudstone and marlite-limestone. Reticular fractures were well developed in thick limestone, and performed a well connectivity. Only faults can penetrate the interlayers, while fracture