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Fluid solid coupling simulation of deep carbonate gas reservoirs based on digital cores

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Carbonate gas reservoirs play an extremely important role in global natural gas resources, accounting for approximately 60% of total natural gas production. In recent years, deep carbonate gas reservoirs have become an important area for increasing global storage and production. However, deep carbonate gas reservoirs are buried deep, tight, high-temperature and high-pressure, with diverse types of storage spaces and strong heterogeneity. The flow behaviors under the stress strain mechanism during the production process are unclear, making it difficult to formulate reasonable production systems. To address the aforementioned issues, this article utilizes CT scanning and digital core reconstruction techniques to finely construct 3D digital cores for different reservoir space types such as fracture type, fracture-pore type, and pore-vuggy type. Based on the Darcy Biot fluid structure coupling method, a mathematical model is constructed to couple the flow equations and stress-strain control equations of the matrix, fracture, and vuggy system, and numerical solutions are obtained using the VOF method. Finally, conduct analysis of the influencing factors such as different storage space types, production systems, and reservoir physical properties on fluid flow behaviors and stress-strain distribution characteristics.

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Primary authors: Dr ZHANG, Ruihan (Southwest Petroleum University); Ms WU, Tingting (Southwest Oil and Gas Field Company); Prof. ZHAO, Yulong (Southwest Petroleum University); Prof. ZHANG, Deliang (Southwest Oil and Gas Field Company)

Presenter: Dr ZHANG, Ruihan (Southwest Petroleum University)

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