Pore-scale study of the fracture influence on fluid flow properties in heterogeneous carbonate media

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Characterization of facture in carbonates is of great importance in studying fluid flow in heterogeneous carbonate rocks. Constructing digital cores and using pore network flow models can be used to simulate the petrophysical properties of complicated carbonate medium and it is vital to understand the multiphase flow mechanism at pore-scale level in carbonate media.Up to now, the traditional digital core construction theory is based on homogenous media, such as clastic rocks and cannot describe the special pore structures in carbonate media, to name a few, fractures, and caves, etc.

A new innovation idea to make flow simulation on the digital core of carbonate media was proposed. In this study, we choose randomly some 50\*50\*50 voxels sub samples from the original digital core of clastic rocks with a volume of 150\*150\*150 voxels and a resolution of 10 micrometers. Then flat surface fracture model and curved surface fracture model are added to the sub sample to investigate the contribution of the fracture on the fluid flow properties in the combined media. The effects of fracture are quantified using fracture parameters including fracture aperture, inclination, and the geometric center. Then Lattice Boltzmann method is applied to make flow simulation on them and the resultant effects of fracture are investigated. The new issues about association of fracture into pore network model are addressed for the future new pore network model of carbonate medium. According to our research, the addition of fracture to traditional digital cores has a strong influence on permeability on the porous media. For example, the permeabilty increases from 0.06D to 8D after adding flat surface fracture model with an inclination of 45 degree and 3 voxels aperture. Flat surface fracture model can reflect fracture aperture, inclination, and the geometric center, while curved fracture surface model can represent the more complicated features including radian and positions. The study provides a preliminary research on fracture influence on fluid flow properties in heterogeneous carbonate media at pore scale.