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Study the effect of fracture roughness on the relative permeability of a fractured porous medium using pore-scale simulations

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Modeling of flow properties in fractured porous media is important due to the existence of a significant contrast in the storage properties and flow conductivity in the matrix and fracture parts. In the case of two-phase flow, one of the flow properties, which can be affected by fluid flow mechanisms at the pore scale are relative permeability, curves. However, the existence of fracture and the roughness of fracture walls are among the factors that affect these curves. In this research, the micro CT image of a two-dimensional section of rock was used as a basic porous media, and then by adding a horizontal fracture, simulation of a two-phase flow of water and oil was investigated, and two-phase relative permeability curves were extracted by extended JBN method. The simulation of two-phase flow is done using the equations of the phase field method and in the COMSOL software and the effects of parameters such as the width of the fracture and the roughness of the fracture wall on the relative permeability curves of the phases are investigated. The simulation results showed that the presence of a fracture causes a delay in the relative permeability curves. With the increase of the fracture width, the relative permeability values of the phases increase significantly, especially for the wet phase. In addition, the presence of roughness on the fracture surface reduces the relative permeability values of the phases. With the help of the obtained results, a more complete understanding of the flow in the fractured porous media can be obtained.

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