Contribution ID: **528** Type: **Poster Presentation**

Simplified simulation of two-phase flow in karst conduits in carbonate rocks

Tuesday, 31 May 2022 15:20 (1h 10m)

Oil reservoirs are composed of several combinations of matrices, fractures and cavity systems, which result in various properties of porosity, permeability and fluid transport behavior [1]. Thus, the problem of flow through a reservoir in the presence of karsts is complex and the predictive capabilities related to the flow and transport processes remain severely limited.
In this work, we perform computer simulations of the five spot problem in a domain $\Omega \subset \mathbb{R}^2$ to numerically describe an incompressible two-phase flow in a karstified carbonate rock. The methodology is based on the geometric treatment and simulation data proposed in [2], and on the application of the Karst Index (KI) concept presented by [3]. The use of the KI follows a similar approach to the application of the Well Index presented in [4]. Given the lack of knowledge of the precise geometry of karst network shape, we consider a particular arrangement of the branchwork type in the sense of the shape defined in [5] and idealized by [2]. The mathematical model used basically consists of a system of equations that includes Darcy's Law, a mass conservation equation for each component and a transport equation. The domain is discretized by an uniform mesh, where the karst is embedded, with different configurations of homogeneous and high-contrast heterogeneous media. The equations are discretized by standard finite volume schemes.
As a way of validating the results, we verified that the masses are conserved in all elements. In addition, the behavior of the pressure, velocity and saturation fields are consistent with the expected physical behavior. The results were compared with simulations in domains without the presence of karsts and substantial differences were noted between them. Our results emphasize the need to include karst regions in reservoir simulations and have potential to be used in more complete treatments that make use of Multiscale Methods and parallel simulations.

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Time Block Preference

Time Block B (14:00-17:00 CET)

Participation

Online

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Session Classification: Poster

Track Classification: (MS14) Uncertainty Quantification in Porous Media