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A process-based approach to study the effect of microporosity on flow properties in carbonate rock

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Carbonate rocks are highly heterogeneous due to post-deposition physical and chemical changes. It exhibits various types of pores and a wide range of pore size distribution, making it challenging to capture all pores in a single pore geometry model obtained from imaging techniques used in Digital Rock Physics (DRP).
Digital rock analysis has proven to be promising and time efficient in deriving the pore-scale perspective of reservoir rock using simulation based on 2D or 3D image data. 3D models of rock microstructures are required to predict the rock properties without performing lab experiments; however, in the case of carbonate, DRP is affected by a trade-off between image resolution and Field of view.
Here we are presenting a process-based approach to creating 3D pore geometry of carbonate rock which incorporate micro and macro pore in the 3D geometry. The developed 3D model was used to study the effect of microporosity on rock permeability and elastic properties.
In the present study, SEM images, thin sections, and XRD data are analysed for the size and shape of pores, pore geometry, mineral composition, and diagenesis process.
Two 3D digital samples of highly heterogeneous carbonate rock, one with micro porosity and the other without micro pores, were synthetically created based on the input of pore characteristics, mineral content, and diagenesis. The pore scale simulation was performed on synthetic 3D geometry using the Finite volume method and Pore Network modelling.
In parallel, we have scanned an actual sample at two scales (high and low resolution), we used the extracted pore network information from two data sets to create a single pore network stochastically.
The results from the process-based and stochastical pore networks were compared and analysed for their efficiency in predicting the rock properties. We have also compared our results with experimental data, which is in good agreement.

Participation

In-Person

References

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