Permeability Decline in Fractured Porous Media During Mineral Scaling: A Detailed Modeling Study

- Ehsan Jafari Dastgerdi,
- Mohammad Fazaelizadeh,
- Davood Zivar,
- Afshin Davarpanah &
- Ali Shabani

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Abstract

Brine injection into underground reservoirs is performed commonly in oil, natural gas, and geothermal industries. The injected fluid may contain some reactive ions that can cause mineral scaling. In addition, a porous medium may be naturally fractured or it can be fractured through hydraulic fracking. The existence of a fracture in a porous medium can facilitate the transport of reactive ions, which leads to a change in the deposition pattern and affects the permeability decline. This study presents a numerical method for modeling mineral precipitation–deposition in the fractured porous media. This study contributes to the analysis of the impact of fracture on permeability and porosity variations in porous media caused by mineral scaling. The results of the modeling indicate that deep invasion of reactive ions through fractures leads to steeper permeability reduction. This study showed that, with constant fracture length, a single fracture pattern experiences the highest permeability reduction compared to other patterns such as an internal fracture, a deviated fracture, a looped fracture, and multiple fractures. In addition, the relationship between fracture length and modeling parameters was investigated through inverse modeling. This showed that fracture length has a linear relationship with the formation damage coefficient, but it has an exponential correlation with the reaction kinetics coefficient.