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PETROLEUM ENGINEERING DEPARTMENT

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A Diffusion Perspective on Transport of Condensed Fluids in Ultratight Porous Media

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Abstract:

Conventional continuum approaches, such as Darcy's law, is not adequate for predicting transport of condensed fluids in ultratight porous media. Thus, we investigated transport of condensed fluids in these media from a new perspective - one that does not rely on conventional frameworks but rather on mass diffusion of components using a Fickian-like model. The form of the equations for both Fickian-like and Darcian-like models is similar, and both are valid interpretations of flowrate with pressure and density gradient. However, diffusion is mechanistically consistent due to the dependency of diffusion coefficient on pressure, temperature, and concentration, rather than indirectly as in Darcian-like models via viscosity and permeability. This is significant because, unlike the permeability, the diffusion coefficient can be directly enhanced by increasing temperature, decreasing pressure, and selecting appropriate solutes. Accordingly, we developed a semianalytical compositional model –PennShale– for primary production of multicomponent hydrocarbon as well as cyclic solvent injection in ultratight reservoirs that is dependent on diffusion-dominated transport within the matrix coupled to advection-dominated transport in the fractures. PennShale was utilized to simulate primary production and solvent huff'n'puff in ultratight oil reservoirs and to compare the performance of the huff'n'puff process under different operational conditions.

Biography:

Hamid Emami-Meybodi is an assistant professor of petroleum and natural gas engineering at PSU. He joined the Department of Energy and Mineral Engineering at PSU in 2015 following ten years in academia as Post-Doc and Research Assistant at the University of Calgary (UofC), University of Regina, Canada, and Petroleum University of Technology (PUT), Iran. Emami-Meybodi's research has been centered on the study of multiphase flow and transport phenomena in porous materials, spanning both highly applied and fundamental aspects. The focus of his research is on the development and application of analytical and numerical methods to enhance fundamental understanding aiming at developing solutions, with applications to unconventional resources and geological storage of carbon dioxide. Emami-Meybodi has authored and co-authored more than 30 technical publications. He is the current Faculty Adviser for the SPE Student Chapter at PSU, an Associate Editor for SPE Journal, and a member of the SPE International - Scholarship and Fellowship Selection Committee. Emami-Meybodi is the recipient of the 2019 SPE Cedric K. Ferguson Medal, 2018 SPE Regional Reservoir Description and Dynamics Award, Endeavour Research Fellowship (Australia), and Alberta Innovates-Technology Futures Award (Canada). He holds BS and MS degrees in chemical and petroleum engineering from PUT, and ME, MS, and PhD degrees in petroleum engineering from UofC.

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