COLLEGE OF ENGINEERING & APPLIED SCIENCE

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PETROLEUM ENGINEERING DEPARTMENT

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Application of Molecular Simulation in Unconventional Reservoirs

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Abstract:

With the world's fast-growing energy demand and the depletion of conventional oil and gas resources, exploration and production activities gradually shift to unconventional resources such as shale oil and tight gas reservoirs in the past decade. However, the traditional techniques developed for reservoir simulation and production forecast fail in shale reservoirs due to the distinct behavior of oil and gas in the micropores of the shale formations. Molecular simulation has been proved to be a strong tool in modeling fluid flow and hydrocarbon storage in the micropores of unconventional reservoirs. It can help build fundamental understandings of rock/fluid interactions in those unconventional resources and provide valuable insight in improving hydrocarbon recovery.

Our research focuses on studies of 1) modeling gas transport mechanism in shale nanopores and the integration with larger scale simulations; 2) gas adsorption behavior in kerogen organic matter and the potential of using zeolite-loaded CO2 for enhanced shale gas recovery and 3) modeling the CO2-CH4 exchange process in natural gas recovery from gas hydrates to recover the reaction mechanism and kinetic properties. The simulation results indicate that the traditional theories may over-/under- estimate gas transport diffusivity in nanopores and molecular simulation can be the bridge between the microscopic and macroscopic world.

Simulation at microscopic level is very critical in unconventional reservoirs as the transport and storage properties of reservoir fluid in nanopores deviates from those at macroscopic scale. Not only can molecular simulations reveal fundamental information about the behavior of oil and gas molecules in confined spaces, but also can they be a strong tool to help study the potential approaches for enhanced hydrocarbon recovery from the unconventional resources and lay the foundation for accurate numerical simulation and prediction at larger scales.

Biography:

Guan Qin currently is associate professor of petroleum engineering and he also holds SPE –Gulf Coast Section Distinguish College Professor at Department of Petroleum Engineering, Cullen College of Engineering, University of Houston (UH). Prior to his current position at UH, he also served various academic positions in University of Wyoming and Texas A&M University. Guan's research interest is focused on application of advanced mathematical and computational methods in modeling multi-scale and multi-physics fluid transport processes in porous media, which involves molecular dynamic simulation for fluid transport in nano-scale pore spaces, lattice Boltzmann simulation for fluid transport processes in porous media with multi-scale heterogeneity, and application of discrete fracture modeling in unconventional reservoir simulations. His research has been supported by US National Science Foundation (NSF), US Department of Energy, Qatar Research Funds, and international oil companies like Exxon Mobil, China National Petroleum Corporation (CNPC), China Chemical & Petrochemical Corporation (Sinopec), China National Offshore Oil Corporation (Cnooc), and Saudi Aramco. Prior to his academic positions, Guan had more than 12 years progressive industry working experience in major oil companies that include Exxon Mobil Upstream Research Company, Mobil Technology Company and, China National Petroleum Corporation. His industry experience was research and development oriented, where he built the first-hand experience in formulating and managing inter-disciplinary research projects that presented strategic importance to the company's business needs. Guan Qin received B.S. degree in Engineering Mechanics at Tsinghua University, China, M.E. degree in petroleum engineering at Research Institute of Petroleum Exploration & Development (RIPED), China National Petroleum Corporation (CNPC), and Ph.D. degree in petroleum engineering at University of Wyoming in 1995.

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