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Editorial: Mechanisms and applications of coupled technologies in unconventional resources for enhancing oil/gas recovery

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Editorial on the Research Topic
Mechanisms and applications of coupled technologies in unconventional resources for enhancing oil/gas recovery

With the depletion of conventional oil and gas resources, unconventional oil and gas reservoirs have become the focus of exploration and development. However, the poor petrophysical properties of unconventional reservoirs often result in low recovery. Improving the recovery of unconventional reservoirs has become one of the key issues for the petroleum industry. The application of enhanced oil/gas recovery methods in combination with various technologies has significant potential to improve the development benefits of unconventional reservoirs.

This Research Topic is entitled "*Mechanisms and Applications of Coupled Technologies in Unconventional Resources for Enhancing Oil/Gas Recovery*". The aim of this Research Topic is to collect information on single and coupled technologies that have significantly improved the recovery of unconventional resources. The topic consists of four articles. Hu et al. employed improved experimental methods to investigate the microscopic migration of shale gas. Rong et al. used self-developed experimental equipment to study the rock fracture mechanism of PDC under pressure. Yong et al. conducted molecular dynamics simulations to study the wettability of the CO_2-H_2O-CH_4 system. Zhang and Liang conducted an evaluation experiment of a hot water chemical flooding system and designed a scheme for the Bohai B oil field. The main research contents of each paper are summarized below.

Hu et al. conducted gas migration experiments in the shale matrix and studied the macroscopic experimental permeability from a microscopic perspective. They used a numerical model that takes into account the microscopic migration mechanisms. The research shows that Knudsen diffusion and slippage effects control the microscopic transport in the shale matrix. The slippage flow weight factor increases the proportion of slippage flow with increasing pressure. Higher pore radii and tortuosity can weaken the effect of Knudsen diffusion. This research provides microscopic theoretical guidance for the macroscopic exploitation of shale gas reservoirs.

Rong et al. developed a new experimental device to analyze the influence of PDC on rock failure characteristics under original formation pressure and hydrostatic pressure, and revealed the rock failure mechanism. The results indicate that the force increase of principal stress and hydrostatic pressure causes larger cutting forces and reduces the rock cutting efficiency. Only a fraction of the cutting force is directly utilized to break rocks, while the remaining force is applied to overcome the friction induced by the flow of cuttings along the cutter surface. These results provide a theoretical basis for further understanding of the rock fracturing process under downhole pressure conditions.

Yong et al. conducted molecular simulations of the water contact angle on graphite in a CH_4/CO_2 environment for various droplet sizes. They investigated the effect of surface roughness on the water contact angle. The research demonstrates that surface roughness increases the hydrophobicity of the solid surface, resulting in a wetting transition from the Wenzel state to the Cassie-Baxter state with an increased RMS height of the surface. The research provides insight into the interaction and multiphase migration mechanisms of water/methane in unconventional reservoirs.

Zhang and Liang conducted an evaluation test and scheme design of the oil displacement system based on the geological parameters of the Bohai B oilfield. They optimized the injection parameters that affected the chemical flooding effect of hot water, such as hot water temperature, chemical agent concentration, and dosage. The results show that as the temperature increases, the effect of chemical agents on improving the water-oil mobility ratio and reducing the viscosity of crude oil is weakened. The comprehensive economic indicators decrease rapidly when the temperature is higher than 115°C. As the concentration of chemical agents increases, the enhanced oil recovery increases monotonically. The research results are useful for optimizing the production system and improving the recovery of the Bohai B oil field.

This Research Topic presents relevant research on coupling technology to enhance unconventional oil/gas recovery, including experimental research, theoretical models, molecular simulation, and field applications. The aim is to disseminate well-founded knowledge to improve the recovery of oil and gas from unconventional reservoirs.

Author contributions

LH: Conceptualization, Project administration, Writing–original draft, Writing–review and editing. WZ: Writing–review and editing. HH: Writing–review and editing. ZC: Writing–review and editing. HX: Writing–review and editing. Senbo Xiao: Writing–review and editing.

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