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Editorial: Multiphase flow behavior in complex and critical environments

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Editorial on the Research Topic
Multiphase flow behavior in complex and critical environment

Due to an increasing demand for oil and gas resources in both developed and developing countries, producing crude oil and natural gas from offshore deep-water reservoirs and inland deep tight reservoirs becomes ever more important. However, it is a challenging job to produce hydrocarbons from such reservoirs since the working environments are normally quite tough. The wellbore temperature in deep-water wells can range from 4 to 200°C, while the wellbore pressure can range from 10 to 200 MPa. As a result, multiphase flow under such challenging environments tends to be more complex than that under normal environments. Since multiphase flow can pose a significant effect on well productivity, it is of utmost importance to study the multiphase flow behavior in such complex and critical environments.

This Research Topic aims to report recent developments related to the multiphase flow behavior in complex and critical environments and focuses on the following two aspects: 1) Gas adsorption, single-phase flow, and multiphase flow in porous media, 2) multiphase flow in wellbores and pipelines.

First, we summarize the studies related to the first aspect. Guodai et al. experimentally investigate the adsorption characteristics of CH_4 on different coal samples with different coal structures and find that the D-A adsorption potential model has the highest adaptability to describe the adsorption characteristics of CH_4 on coal. Wang et al. propose a modified desorption model for low-rank coal and couple it to a numerical simulator to study the flow dynamics of gas-water mixtures in coal seam reservoirs. Using the numerical simulation model, they are able to find out the optimal well patterns for developing high-dip-angle coal seam reservoirs. Huang et al. investigate the effects of the magnetic force on ferrofluid flow in complex porous media by the finite element method and reveal the essential mechanisms of ferrofluid flow in fractured porous media. Jia et al. further point out that the ferrofluid is a potential tracer that can locate the displacement front and can also work as a displacing fluid to enhance oil recovery. Jia et al. numerically present an improved two-scale continuum model and study the effects of the physical parameters of an isolated fracture on the outcomes of acidification. They find that the properties of an isolated fracture (including length, aperture, and position) have an obvious influence on the acidification. Cheng et al. use the Eulerian-Eulerian method to study the migration and distribution of proppants in a fracture network. Based on the simulated migration characteristics of proppants, the authors are able to define three distinct regions: corner anomaly area, buffer area and stability area. They point out that the turning angle has a large effect on proppant migration.

Second, we summarize the studies related to the second aspect. Jiang et al. numerically study the flow behavior of high-pressure gas through the orifice of a subsea throttling valve, and point out that a 7–8 MPa prefilling pressure of the pipeline downstream to the throttling valve can help maintain a downstream temperature above 0°C, thereby reducing the risk of hydrate formation and blockage. Guimin et al. propose a new model to predict the hydrate formation region in the drainage line of a gas hydrate production well. The simulation results show that the hydrate formation region is enlarged with an increase in electric submersible pump (ESP) pressure and a decrease in water production rate. Zhang et al. develop a spatio-temporal evolution model to study the hydraulic transport characteristics of particulate solids. The conclusions reached in their study provide useful insights into the optimization of the hydraulic-transport efficiency of particulate solids in pressurized pipelines and open flow channels. Wei et al. study the effect of flute tube on the liquid maldistribution and the gas maldistribution experimentally. Their experimental results indicate that a horizontal manifold without flute tube is more conducive to the suppression of the average liquid maldistribution degree under slug flow patterns and the suppression of the average gas maldistribution degree under annular flow patterns.

Author contributions

WF was a guest associate editor of the Research Topic and drafted the editorial. ZW and HL were guest associate editors of the Research Topic and edited the editorial.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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