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Editorial: Advances in geomechanics and wellbore integrity of unconventional reservoirs

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Editorial on the Research Topic
Advances in geomechanics and wellbore integrity of unconventional reservoirs

1 Introduction

Since the beginning of the new century, the exploration and development of unconventional oil and gas reservoirs has developed rapidly around the world and has become an important part of the energy supply system. However, due to the relatively short development period, there is a lack of systematic summary of development experience for unconventional oil and gas which has resulted in significant wellbore integrity problems reported on field during well construction, fracturing stimulation, and even after production, and many of these problems are closely related to the geological conditions of development. Research and optimization of these two types of problems can maximize the recovery ratio of unconventional reservoirs. Because of the important strategic position of unconventional reservoirs in the future energy structure of mankind, this Research Topic aims to explore the contributions of experts to breakthroughs, improvements and advances in geomechanics and wellbore integrity.

2 Review of the research presented in this Research Topic

The work presented in this section focuses on different aspects of unconventional oil and gas reservoirs, including rock mechanics, wellbore thermodynamics, etc.

Accurate assessment of rock mechanical properties is crucial when designing drilling and fracturing. After conducting lots of rock mechanical tests, Kong et al. found that although the failure mode of the rock remains unchanged, the strength of the rock fluctuates with the change of the sample size. Also, the mechanical properties of different types of

rocks fluctuate with the sample size in different ways. Based on this understanding, the experimental results were reorganized to construct the relationship between the strength transformation of rocks in different sizes, which can be used as an important reference for engineering applications.

As a key component of well barrier components, the cement sheath has always been the focus of well integrity research. Santos and Taleghani. believed that the weak bond between cement and casing or cement and formation will seriously affect the heat exchange process between the wellbore and the formation. A multi-physics analysis model was established to analyze the impact of cement debonding on heat transfer efficiency. The results showed that the existence of micro-annulus will cause the formation heat loss to exceed 35%. Additionally, the authors emphasized the importance of proper cementing design to wellbore integrity. Due to the loss of well annulus integrity, sustained casing head pressure always causes headaches for field engineers. Demirci and Wojtanowicz. introduced a method of eliminating annular pressure from wellhead. The principle is to inject heavy fluid from the wellhead to displace the annular fluid column above the leaking cement. The author introduced the selection process of the kill fluid in detail and the wellhead pressure fluctuations of the kill test. The results showed that the annular pressure is partially removed, and the wellhead pressure control and injection pump operation had a great influence on the removal effect.

Hu et al. focused on the microscopic reservoir characteristics, and they carried out systematic fruitful experimental tests based on samples obtained from drilling in strong-heterogeneity tight sandstone reservoirs. Rock thin sections and gas-water two-phase experiments showed that the pore types of the reservoir are mainly intragranular dissolved pores and intergranular dissolved pores (82.9%), and the difference in pore structure is mainly reflected in the size and distribution of throats. The effective porosity is 7.49%, and the permeability is $4.08 \times 10^2\ \mu m^2$ which shows the physical properties are good. At the same time, they indicated that the natural gas and water in this area are mainly distributed in the down-dip part of the main channel structure or in the island-shaped lens-shaped permeable sand bodies trapped by the surrounding tight layers. The conclusions could provide a basis for the selection of subsequent completion plans and effectively avoid potential well integrity problems.

The work presented here provides valuable insights into different aspects of unconventional reservoirs, and its findings can effectively improve the safety and sustainability of unconventional oil and gas production. At the same time, these studies also support the importance of continuing to study key issues in unconventional reservoirs in the face of increasing global energy demand and environmental concerns.

3 Conclusion

In summary, this Research Topic contains some of the latest advances in geomechanics and wellbore integrity of unconventional reservoirs. The application of these studies will be beneficial in ensuring the continuation of mining activities to meet the growing global energy demand. The interest in this Research Topic is evidenced by the subject set's cumulative view count, which at the time of writing this editorial had reached 3843. There had also been 441 downloads of the different articles.

Author contributions

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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.

The author(s) declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

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