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Editorial: Overpressure in sedimentary basins and petroleum geomechanics

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Editorial on the Research Topic
Overpressure in sedimentary basins and petroleum geomechanics

Understanding sedimentary basin overpressures and petroleum geomechanics is critical in the oil and gas industry. Figure 1 depicts some key concepts in overpressure zones and petroleum geomechanics. For enhancing our understanding on overpressures in sedimentary basins and petroleum geomechanics, we initiated this Research Topic and have gathered 8 papers from scientists working in the related disciplines. The papers mainly focus on the following aspects: 1) overpressures in sedimentary basins and petroleum geomechanics; 2) Geochemical characteristics related to pore fluids; 3) Natural fractures, faults and sedimentary facies.

These papers are briefly introduced in the following, and for more details readers can access each full paper from the links shown in the paper.

1 Overpressures and petroleum geomechanics

Abnormal pore pressures or overpressures in the subsurface formations can greatly increase drilling non-productive time and cause serious drilling incidents if the abnormal pressures are not accurately predicted before drilling and while drilling. Pore pressure also affects the direction of hydrocarbon migration. Geomechanics plays a significant role in petroleum exploration and development, as well as safe drilling. Herein several papers are presented here that discuss overpressures and related petroleum geomechanics.

Radwan introduced a multi-proxy approach to detect the pore pressure and the origin of overpressure using well-logging, basin modelling, drilling-based interpretations, and reservoir measurement methods. He studied the overpressure and its generation mechanisms in the Gulf of Suez Basin. The introduced approach by this paper can be applied in PPFG studies for both development and exploratory geomechanical studies in other areas of the Gulf of Suez Basin or elsewhere in the world.

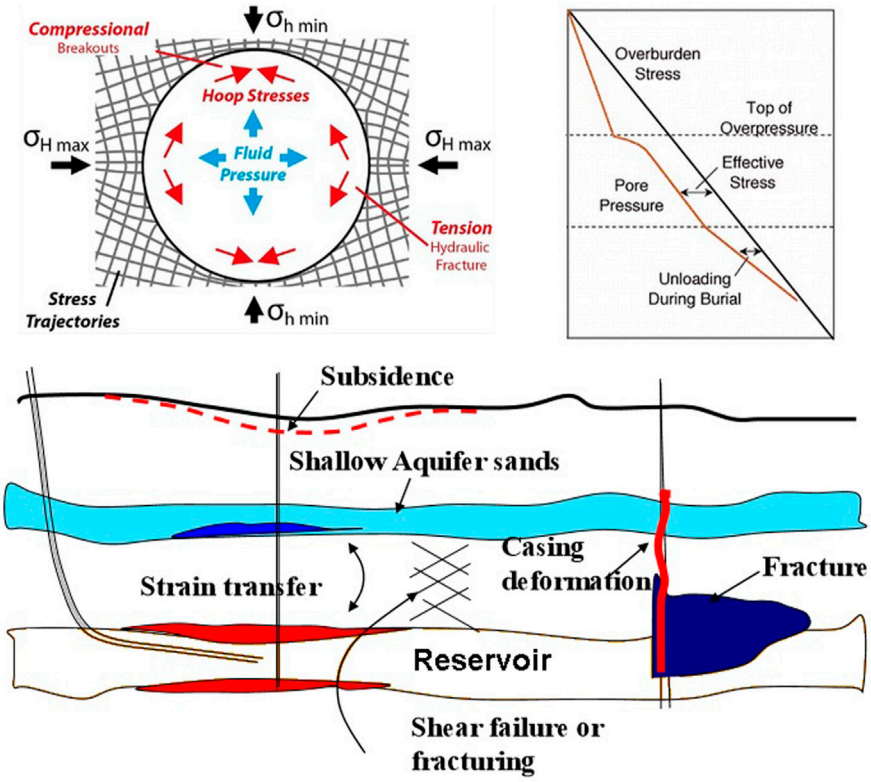

FIGURE 1
Some key concepts in overpressure zones and petroleum geomechanics.

Li et al. studied overpressure generation in the Paleogene source rock in the Linnan Sag, Eastern China using basin modelling. They found that the overpressure increased the driving force for oil migration. The oil from the source rock had a migration trend from the center of the sag to the uplift belt. This mechanism is useful for exploration in the Linnan Sag and other extensional basins.

Amjad et al. examined overpressures induced by compaction disequilibrium within structural compartments of Murree formation, eastern Potwar, Pakistan. They considered that compaction disequilibrium and tectonic stresses were two major factors to control pore pressures. They used Eaton's method to predict the pore pressure, which showed a very good correlation with measured pressure data.

Deangeli and Marchelli conducted the stability analysis of wellbores by considering the mutual interaction of far-field stresses, fluid overpressure, and strength parameters of isotropic rock. They performed analyses with the Mohr–Coulomb and Hoek–Brown criteria in two overpressured fields in the North Sea basin and Browse basin to determine the influence of the uncertainties related to the rock strength.

Liang et al. studied the movement and dynamic characteristics of drill string to better use downhole tools for pore pressure measurement. They considered the drilling process with rock-breaking process in vertical wells by the finite element method. The simulation results are helpful for understanding the real situation of the bottom hole during the drilling process.

2 Geochemical characteristics related to pore fluids

The geochemical characteristics of pore fluids can provide significant information about the depositional environment and can help in searching for favourable reservoirs. Herein is presented one paper that discusses this topic.

Wang et al. studied the origin of the formation water in the Xujiahe Formation, which was determined based on the latest major and minor elemental concentration data, hydrogen and oxygen isotope data of formation water, and carbon and oxygen isotope data of carbonate cements. They indicate that the formation water of the Xujiahe tight sandstone in the study area is of seawater origin. Their results provide strong evidence for the determination of the marine sedimentary environment of the Xujiahe Formation in the study area and can

provide scientific guidance for the search for high-quality reservoirs.

3 Natural fractures, faults and sedimentary facies

Natural fractures and faults have a significant role in oil and gas exploration and hydrocarbon migrations, and a better understanding of their distribution can help in searching for favourable reservoirs and better geological modelling. Two presented papers are linked to this topic.

Anees et al. studied the second and third members of the Lower Shihezi Formation to understand the controlling factors of faults and sedimentary facies distribution, aiming to identify the favourable zones of gas accumulation within the Hangjinqi area, Northern Ordos Basin on a regional scale. They suggest that the favourable zones of gas accumulation lie in the northern region within the Hangjinqi area based on the faults and sedimentary facies distribution.

Li et al. studied fracture identification and their characterization using cores and imaging logging. Then, they constructed the comprehensive fracture development indicators to predict the distribution of fractures in wells by conventional logging. They indicate that the critical pressure of the natural fracture is approximately 16.5–25.4 MP/km; when the pore pressure exceeds this value, the fractures become effective fractures. Their results provide guidance for the exploration and development of LD-A gas fields and other low-permeability tight sandstone reservoirs.

4 Summary

In summary, the papers in this collection present an overview of research and case studies on formation overpressures, petroleum geomechanics, geochemical characteristics related to pore fluids, natural fractures, and fault development. We hope these articles can enhance our understanding on these topics and provide guidance for petroleum exploration and development, as well as safe drilling.

Author contributions

AR, MM, JZ: Writing–review and editing.

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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