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Editorial: New advances in light oil/condensate geochemistry

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Editorial on the Research Topic
New advances in light oil/condensate geochemistry

Light oil/condensate resources are important exploration targets in the present petroleum industry, especially for deep and shale reservoirs. However, the lack of diagnostic geochemical information in light oils/condensates makes it difficult to classify light oil/condensate types, and to reveal their accumulation mechanism and enrichment regularity. The articles in this Research Topic investigated several scientific questions with respect to the geochemistry of light oil/condensate. The findings can be used to guide and improve the explorations of light oil/condensate resources.

Although diagnostic biomarkers are generally scarce in light oil/condensate, chemometric methods can integrate information derived from multiple geochemical parameters (e.g., biomarkers and stable isotopic ratios) to identify the type and source of light oil/condensate (Wang et al.). During the generation, migration, enrichment and preservation processes, light oils/condensates commonly coexist with other geological fluids, including formation water, gaseous hydrocarbons, and inorganic gases. The noble gases in these fluids are inert, and changes in noble gas signatures well documented the accumulation processes of the accompanying light oil/condensate reservoirs (Li et al.). In the South Qilian Basin, Northwestern China, the molecular compositions and carbon isotope values of gas hydrate and free gas samples indicated that most gases in this region were wet gases derived from either the cracking of kerogen at the early stage of gas generation or the cracking of crude oils, while the secondary dry gases in this region were mainly sourced from biodegradations of the wet gases. The distributions of the wet gases indicate the potential of light oil/condensate in the Jurassic Yaojie Formation of the Muli Depression, South Qilian Basin (Tan et al.). The origin and genesis mechanism of light oil/condensate can be very complex. Although the light oils/condensates in both the Yakela and Shunbei fields in the Tabei Area of the Tarim Basin, Northwestern China, were derived from marine source rocks, the Yakela oils were directly generated by source rocks at the late stage of the oil window, while the Shunbei oils were sourced from the cracking

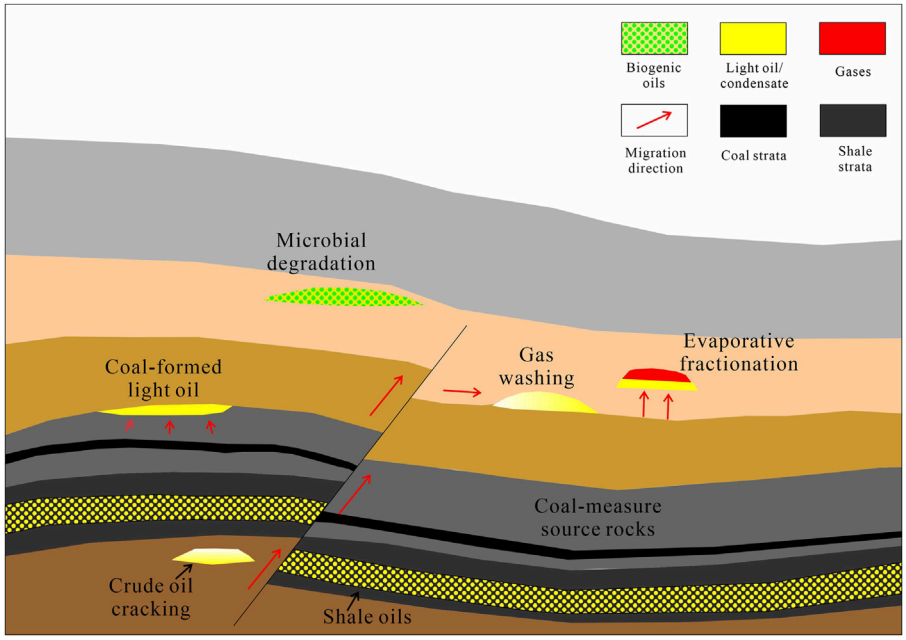

FIGURE 1
Schematic map showing various sources and genesis mechanisms of light oils/condensates.

of crude oils generated at the early stage of the oil window (Tian et al.). The generation of light oil/condensate is closely correlated with the characteristics of organic matter in source rocks. Research on the Wufeng and Longmaxi marine shales in the Middle Yangtze areas of China indicates that the types and contents of organic matter in the two sets of shales are largely controlled by their redox environments (Yi et al.).

In addition, the content, properties, distribution and occurrence state of these retained light oils/condensates are significantly affected by the generation and expulsion model of source rocks, and the retained light oils/condensates are the main exploration targets in shale oil reservoirs. A method based on the Rock-Eval pyrolysis of grain samples was established to evaluate the mechanisms of hydrocarbon generation, expulsion, and retention in oil shales. The results indicate that different types of shales have diverse capacities for retaining hydrocarbons, and the oil expulsion efficiency is largely controlled by the pore structures of shales (Liao et al.). Meanwhile, the distribution and occurrence state of retained oils directly influence the potential of shale oils and their recovery efficiency. Sequential extractions on lacustrine oil-bearing shales indicate that retained oils may block partial mesopores and can be present in different states depending on pore widths. In particular, retained oils may be mainly adsorbed onto pore surfaces of nanopores with pore widths less than 10 nm, while they may exhibit a free state when the average pore width is larger than 11.7 nm (Cao et al.).

Even with the recent development of research on light oils/condensates, including the studies in this Research Topic, the genesis and accumulation mechanisms of light oils/condensates remain poorly understood. Such knowledge gaps have caused challenges to the exploration and development of light oil/condensate resources. The following key scientific questions on the geochemistry of light oils/condensates should be further studied:

1) The sources and genesis mechanisms of light oil/condensate vary significantly under different geological conditions (Figure 1). It is critical to determine the mechanisms of light oils/condensates generation for source rocks with different kerogen types. Meanwhile, comprehensive research is needed to evaluate the influences of secondary reconstructions on light oil/condensate reservoirs, including the mixing effect, microbial degradation, gas washing and evaporative fractionation.
2) The accumulation process and enrichment regularity of light oil/condensate resources are the key scientific issues confronting the evaluations of light oil/condensate potential and their exploration and development. It is important to identify the distribution and occurrence state of light oil/condensate in shale nanopores with different types and pore widths. It is also essential to further assess the accumulation and preservation of light oil/condensate in deep and ultra-deep reservoirs, the mobility and recovery of light

oil/condensate resources in shale reservoirs, and the phase changes of light oil/condensate with the evolution of burial history.

3) New methods and techniques are required for the quantitative assessment of light oil/condensate resources. These new tools include but are not limited to spectrographic techniques, new biomarker indexes, cluster carbon isotopes, trace element analysis, and non-traditional stable isotopes. In addition, systematic geochemical studies on the gases, formation water, and fluid inclusions associated with light oil/condensate may also provide new research approaches for the geochemical studies of light oil/condensate.

Author contributions

PC and SY: Conceptualization, methodology, writing original draft. XX, BR, and TW: Conceptualization, review and editing. All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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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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