



# The group component and isotopic compositions of artificially expelled oil and retained oil from Tasmanian oil shale in Australia

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## Introduction

Tasmanite oil shales from Australia is typically riched in Tasmanites algae (Fig 1). Tasmanites is a unicellular planktonic marine alga characterized by a simple spherical morphology, locally with radial pores and canals (Dutta et al., 2006). oil shale with one-type organic matter is an ideal thermal simulation experiment sample, which provides a good material for studying the geochemical characteristics of expelled oil and retained oil. The present work aims to examine the hydrocarbon product which are retained or expelled out of source rocks, which allows better understanding the inter-relationship between retained and expelled hydrocarbon and improve the knowledge of formation mechanism of self-sourced unconventional hydrocarbon resource such as tight oil accumulations.

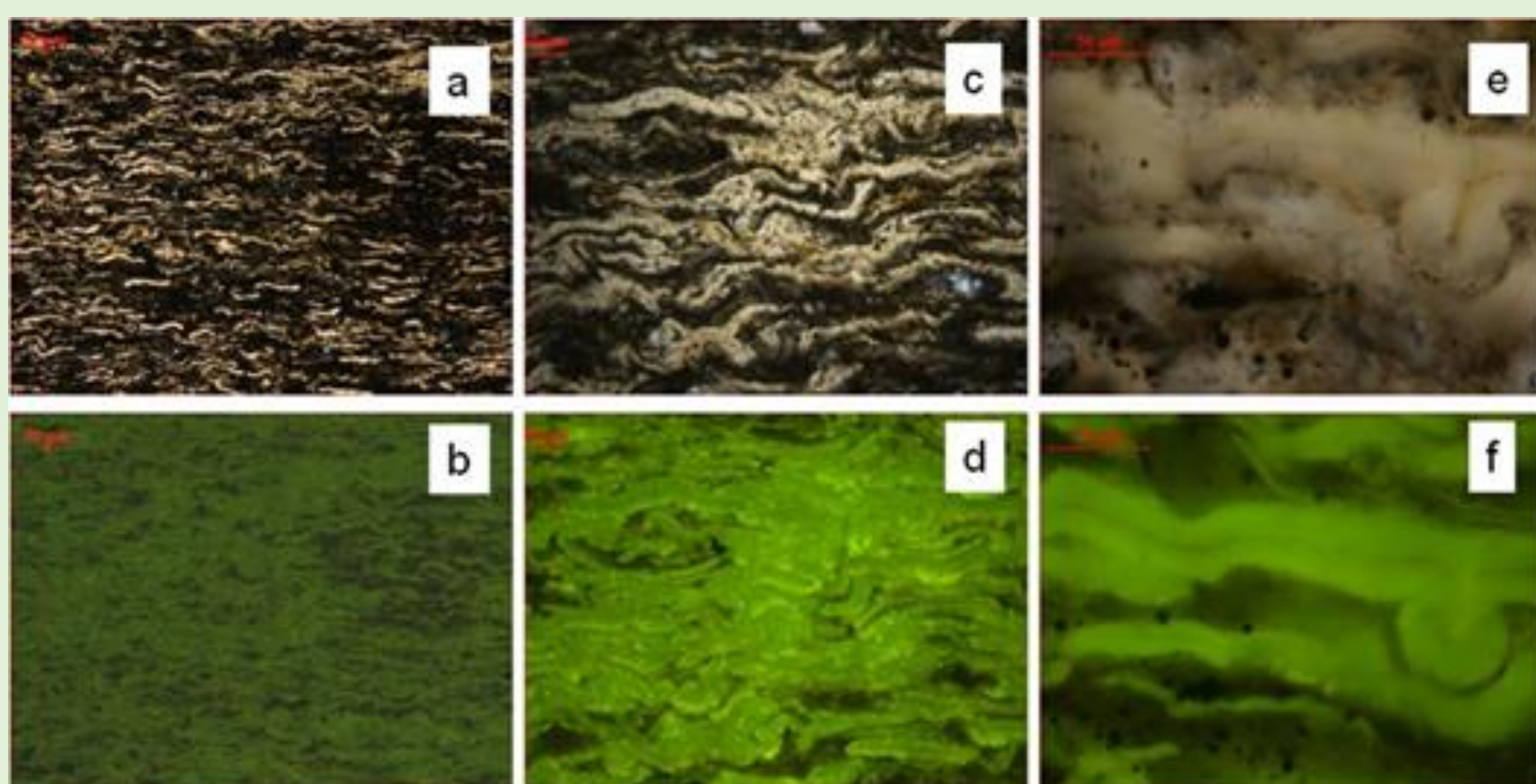


Fig.1 Photomicrographs of Tasmanian oil shale sample A. a, c, e were microphotos under transmitted white light, and b, d, f were corresponding fluorescence microphotos , scale bar = 50μm.

## Results and discussion

The simulation results showed that the peak oil generation of the Tasmanite oil shale sample is at 340°C. The content of saturated and aromatic hydrocarbon (HC) decreased with temperature (T) when T ≤ 340 °C, while increased with temperature when T > 340 °C. The content of resin and asphaltene showed opposite trend with temperature compared to the saturated and aromated HC (Fig 2). This is similar to the actual oil reservoir. The oil quality in the early stage is heavier, and the oil quality in the later stage is lighter. The content of saturated HC in the expelled oil is higher and the content of aromatic HC is lower than that of retained oil. This fractionation should be mainly attributed to the selective adsorption and/or absorption of kerogen to liquid petroleum (Sandvik et al., 1992).

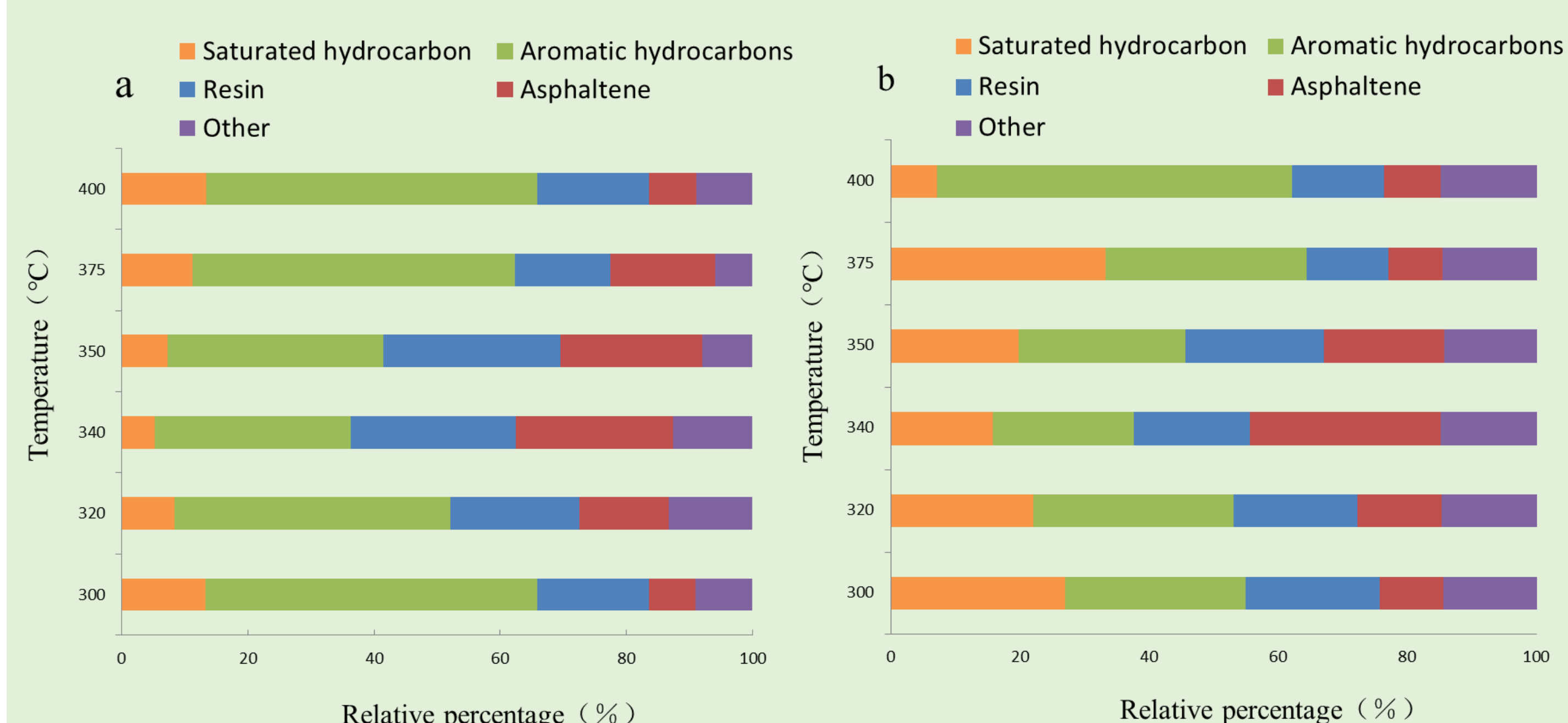


Figure.2 The relative percentages of group components of retained oil (a) and expelled oil (b)

The stable carbon isotopes ( $\delta^{13}\text{C}$ ) of the group components of both expelled oil and the retained oil showed that the aromatic HC has the heaviest isotope, followed by the saturated HC and resin. The asphaltenes generally had the lightest isotope values, which were mainly related to the source of organic matter and sedimentary environment (Fig 3). The  $\delta^{13}\text{C}$  values of asphaltenes were close to the value of kerogen in the shale, suggesting that the values inherited from the mother source. During the artificial simulation process, the  $\delta^{13}\text{C}$  of aromatic were most stable (Fig 3), indicating that it was an effective indicator of oil source comparison. The order of bond separation energies of organic molecules with different carbon isotopic compositions is  $^{12}\text{C}-^{12}\text{C} < ^{12}\text{C}-^{13}\text{C} < ^{13}\text{C}-^{13}\text{C}$ . Therefore, the carbon isotopic composition of expelled oil and retained oil gradually becomes heavier with the increase of simulated temperature (Fig 4). The  $\delta^{13}\text{C}$  of retained oil showed heavier than the expelled oil with the same simulation temperature (Fig 4), which could be due to  $^{13}\text{C}$  adsorption with kerogen in rocks.

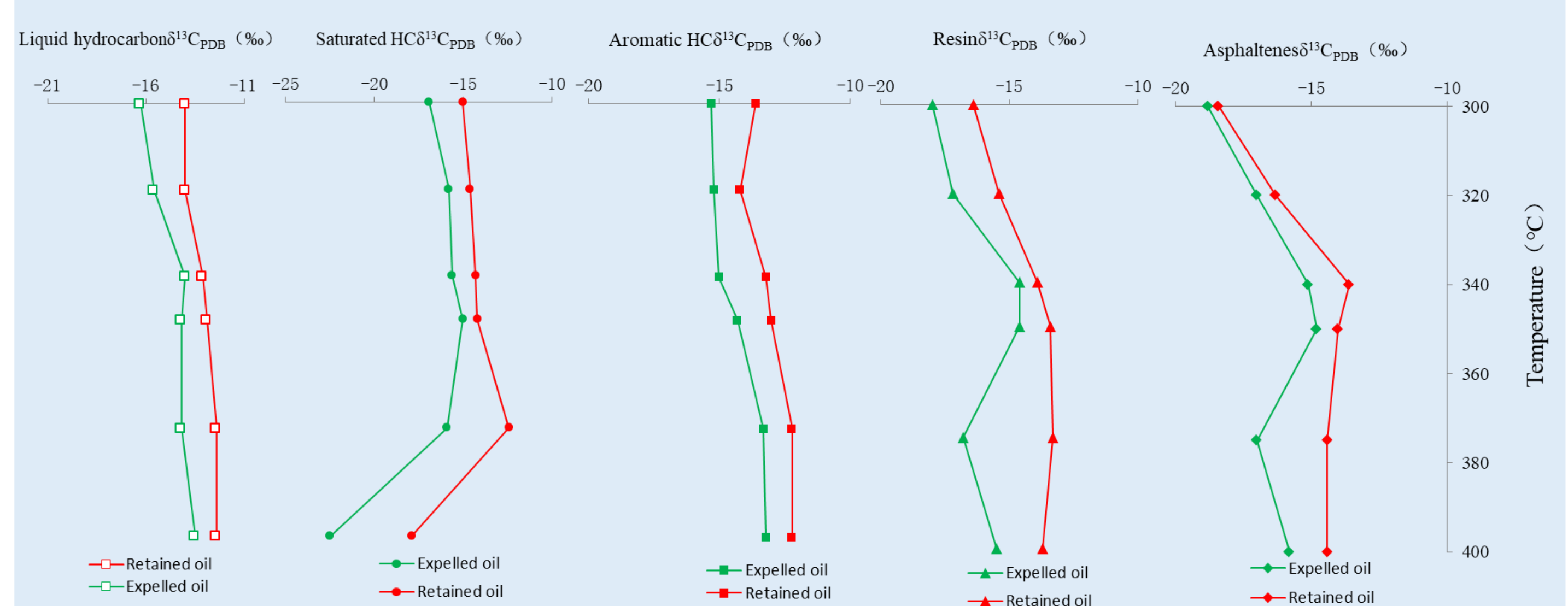


Fig.4 Carbon isotope evolution of group components in expelled oil and retained oil

## Conclusions

The evolution of oil generation and oil expulsion, and their coupling relationships for these samples with increasing maturity were investigated. The results indicate that compositional fractionation occurred in the simulation experiment. The selective adsorption and/or absorption of kerogen to liquid petroleum should be the main reason. In the whole artificial simulation process, the carbon isotopic composition of retained oil is heavier than expelled oil. The isotopic fractionation caused by hydrocarbon expulsion, primary cracking and secondary cracking may make the residual hydrocarbons in source rocks heavier than those expelled.

## Acknowledgements

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