

THE DETECTION OF BICYCLIC SESQUITERPENOIDS IN ACID SOLUBLE FRACTION OF SOURCE ROCKS AND ITS SIGNIFICANCE ON BIOGENIC INTERPRETATION

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Introduction

Analysis of organic matter on the molecular level is proved to be an effective method to identify possible biogenic composition of hydrocarbon source rocks. In conventional geochemical studies, the free fraction of organic matters is generally obtained by solvent extraction, and then analysed by Gas Chromatograph – Mass Spectrometry (GC-MS) to provide its molecular composition. Based on n-alkanes and biomarkers distribution characteristics, the organic matter sources could be inferred. Furthermore, the potential of source rocks could be assessed, and the phases of hydrocarbon products could be predicted, which is of significant importance in guiding petroleum exploration and development. Thus, source rock biogenic interpretation is a fundamental, but important work in geochemical studies. However, as the conception of “organic matter occurrence” is universally accepted, source rock biogenic interpretation somehow failed to be renewed on this level. Results from previous studies reveal that organic matters in source rocks are composed of several different occurrences, including clay mineral interlayer absorbed fraction, clay mineral surface absorbed fraction, carbonate crystal wrapped fraction, asphaltene occluded fraction, and asphaltene/kerogen covalently-bond fraction. Previous source rock biogenic studies generally overlooked the geochemical information carried by the bound fractions (contrast to the free fraction). Whether or not the bound fraction is of value in source rock biogenic interpretation still need to be explored. In order to shed some light on this problem, we chose the major source rocks developed in Dongying Sag (Jiyang Depression, Bohai Bay Basin, China) as experimental subjects, and analysed the molecular composition of both the solvent extracted fraction (also the free fraction) and the acid soluble fraction (also the carbonate crystal wrapped fraction). The characteristic biomarkers, which are capable of indicating organic matter sources, would be carefully examined to determine whether or not the bound fraction could carry biogenic information.

Results

Both the solvent extracted fraction (also the free fraction) and the acid soluble fraction (also the carbonate crystal wrapped fraction) were analysed by GC-MS, and the TICs are displayed in Fig. 1. The n-alkane distribution of both fractions show similar characteristics: unimodal distribution, with n-C₁₆ being the peak. The sterane and hopane series could be detected in both fractions: Despite the relatively low abundance of steranes and hopanes in the acid soluble fraction, the distribution patterns of both fractions are quite similar. The marked distinction existing between the solvent extracted fraction and the acid soluble fraction are as follows: (1) The light ends of hydrocarbons are quite well preserved in the acid soluble fraction; (2) The bicyclic sesquiterpenoids are only detected in the acid soluble fraction, which is also a major constituent of the total ion chromatograph (TIC).

Conclusions

The acid soluble fraction (also the carbonate crystal wrapped fraction) is proved to be of great value in source rock biogenic interpretation. Experiment results demonstrated that this bound fraction could also carry valuable geochemical information on organic matter sources: The bicyclic sesquiterpenoids, which is indicative of terrestrial input, is only detected in the acid soluble fraction. This may be the result of better preservation of organic matters of low molecular weights in the mineral-bound fraction, due to the closely bounding relationship between organic matters and inorganic minerals. Thus, in order to achieve comprehensive analysis of organic matter sources, the conception of occurrence should be definitely taken into consideration. Further research is still needed to elucidate the molecular composition of other occurrences of organic matters to determine its significance on source rock biogenic interpretation, such as the asphaltene/kerogen covalently bound organic matters, which could be released via catalytic hydrolysis.

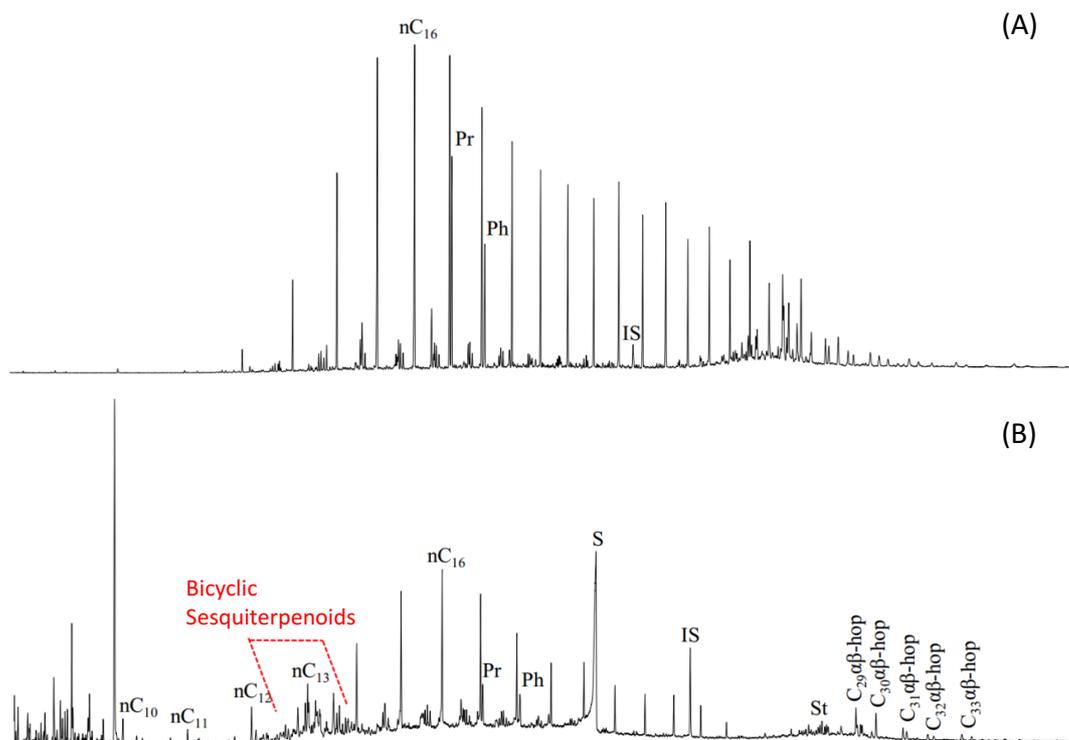


Figure 1 (A) TIC of the solvent extracted fraction (also the free fraction). (B) TIC of the acid soluble fraction (also the carbonate crystal wrapped fraction). It is obvious that the bicyclic sesquiterpenoids are only detected in quite high abundance in the acid soluble fraction. The bicyclic sesquiterpenoids are highlighted in the chromatograph of the acid soluble fraction. Abbreviations: IS = Internal Standard, here refers to C₂₄D₅₀; St = Steranes; S = Elemental Sulfur; hop = hopanes; Pr = Pristane; Ph = Phytane.

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