BOUND BIOMARKERS IN SEDIMENTS FROM LAKE FUXIAN (CHINA) INDICATING THE INCRESED EUTROPHICATION

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Introduction

Biomarkers in geologic samples have been adequately understood and widely used in organic geochemistry. Due to the protection of macromolecular structure, bound biomarkers (within geological macromolecule) are less influenced by thermal alteration and secondary alterations compared to their free phase (solvent extractable). Thus, bound biomarkers can be used as geochemical indicators over a much broader range than that of their free counterparts. Such biomarkers can be released from kerogen by many kinds of methods, including hydrous/anhydrous pyrolysis, selective chemical degradation and catalytic hydropyrolysis (HyPy). The HyPy technique can maximise product yields and minimises thermal stress, due to the use of catalyst and high hydrogen pressure.

Here we try to investigate the increased eutrophication in a Chinese lake in the last three decades (since 1986) through the bound biomarkers released by HyPy from immature lake sediments. Lake Fuxian (24°17′–24°37′N, 102°49′–102°57′E) is located at 1721 ma.s.l. in the central Yunnan Province, SW China. It is surrounded on all sides by mountains, receiving water from more than 20 rivers, seven of which are flowing through cultivated fields. The industry and urbanization activities (e.g., food processing, phosphorus fertilizer, cement manufacturing) in the catchment of Lake Fuxian, has discharged domestic and industrial wastewater and agricultural fertilizers to the lake from the 1980s. In this study, the investigated sediment core (FX-1) was collected on Oct 14th, 2012 from the center of Lake Fuxian using a Kajak gravity corer with a 58-mm diameter at 120-m-deep site in the north basin (Zhang et al., 2015). Cores were sectioned into 0.5-cm interval immediately after collection, and stored on board at -20 °C, and subsequently freeze-dried in the laboratory.

Results

Figure 1 shows the total ion traces, terpanes, hopanes and steranes of saturated hydrocarbons obtained by HyPy from six core intervals (covering the sediments formed in years with and without eutrophication). All surface sediments released bound *n*-alkanes ranging from C_{16} to C_{35} with a bimodal distribution. In terms to terpanes and hopanes distributions, a full suite of C_{29}-C_{35} 17α (H) 21β (H) hopanes, C_{29}-C_{35} 17β (H) α21 (H) hopanes and C_{29}-C_{34} 17β (H) β21 (H) hopanes are all detected in all sediment HyPy products. However, no terpanes are noticed in all *m/z*191 traces. As for steranes, only C_{27}–C_{29} ααα (20S and 20R) steranes were detected. The relative abundances of C_{27}–C_{29} αααR steranes in all samples are C_{27} > C_{29} > C_{28}. The presence of C_{29}-C_{34} 17β (H) β21 (H) hopanes and the absence of geological configuration of regular steranes (αββ) both indicate the very low maturity of the investigated sediments.

The relative abundance of C_{29} αααR sterane in the bottom of sediments core (F15-F23) were ranged from 29%~32%, while they are in the range of 35%~37% for the sediments deposited

since 1986 (F3-F11). Generally, high abundance of C_{29} sterane was considered to be an indicator of higher terrestrial plants input. As major eutrophic algae, green algae can yield abundant of C_{29} ααα*R* sterane. Meanwhile, the increase in C_{29} ααα*R* sterane coincides with the eutrophication in Lake Fuxian in time. Thus, we believe that the "bloom" or great increase of green algae in this period caused by eutrophication is recorded into the sediments through bound steranes. Additionally, the "bloom" of green algae will consume most of oxygen in water body, and then cause an anaerobic (or hypersaline) condition. Actually, higher Gam/H30 ratios were existed in the top three sediments (0.55~0.62) compared to the bottom three sediments (0.28~0.32). The variation trend of Pr/Ph, Pr/*n*C_{17} and Ph/*n*C_{28} are also consistent with that of Gam/H30, which further confirmed the difference in sedimentary conditions between the period with eutrophication and without eutrophication.

Conclusions

Eutrophication in Lake Fuxian characterized by a relative increase of green algae proportion in the 1980~ period was recorded into the sediments through bound steranes. The change of water body depositional condition cause by eutrophication will further effect the distribution of bound biomarkers in sediments. Bound biomarkers released by HyPy or other method (such as MSSV-Hy) will be a useful method on the study of recent sediments.

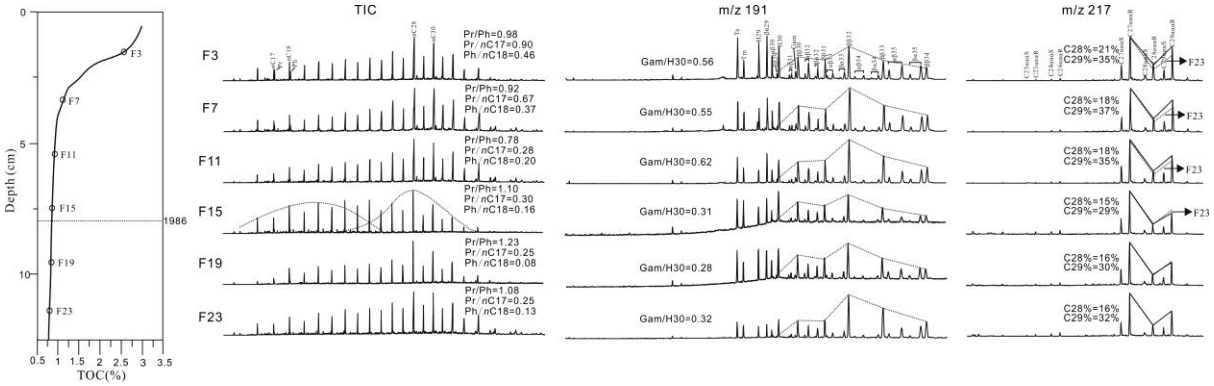

Figure 1 *The total ion traces, m/z 191 and m/z 217 trace of saturated hydrocarbons obtained by HyPy from six core intervals.*

References

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