

CHARACTERIZATION AND SOURCES OF HYDROCARBONS
IN LAGOON SEDIMENTS OF SETIU WETLAND

HASRA MASRIFAH BT WAN JUSOH @ AB. RAHIM

MASTER OF SCIENCE
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sediments of Setiu Wetland / Hasra Masrifah Wan Jusoh @ Ab
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September 2006

Chairperson : Associate Professor Norhayati Mohd. Tahir, Ph.D.

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Faculty : Science and Technology

**Thesis submitted in Fulfilment of the Requirement for the
Degree of Master of Science in the Faculty of Science and Technology
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Chairperson : Associate Professor Norhayati Mohd. Tahir, Ph.D.
Member : Professor Mohd. Radzi Abas, Ph.D.
Faculty : Science and Technology

In this study, hydrocarbon contents, (aliphatic and polycyclic aromatic hydrocarbons (PAHS), sterols, long chain fatty acids, alkanones and alkanals), in surface and core sediments of five stations within Setiu Lagoon, Terengganu were determined using Gas Chromatography Mass Spectrometry (GC-MS). Surface and core sediments were collected using a grab sampler and section D-corer, respectively, during February and April 2004. Freeze-dried sediment (< 500µm fraction) were soxhlet extracted using dichloromethane for eight hours. Separation of hydrocarbons into aliphatic, PAHs and polar fractions were carried out using partially deactivated silica-alumina column chromatography technique. Identifications and quantifications of these compounds were done using GC-MS.

Method recovery analyses yield recoveries of aliphatic hydrocarbons, PAHs and sterols in the region of 76%-91%, 70-81% and 63%-80%, respectively. Results showed total identified resolved n-alkanes (TIRNA) ranging from 0.47 µg/g dry

weight to 11.6 µg/g dry weight. The distribution of the aliphatic fraction showed the presence of n-alkanes ranging from C₁₂ to C₃₆ with high predominance for long chain homologues (C₂₅-C₃₁) and a carbon maximum at C₃₁ with CPI > 3; these observations provide evidence for the presence of biogenic terrigenous input corresponding to epicuticular plant waxes into the lagoon sediments. Positive and strong correlation between n-alkanes associated with terrigenous input (ALK TER) and TIRNA suggest terrestrial input is the main sources of TIRNA in this study area. The absence of unresolved complex mixture (UCM) in the chromatogram and the absence of PAHs compounds except anthracene and perylene is indicative of an uncontaminated sediment with respect to petrogenic and pyrogenic sources. The source of perylene and possibly anthracene is likely to be of natural origin.

The concentration of total identified sterols (TIS) ranged from 1.41 µg/g dry weight to 3.11 µg/g dry weight. Cholesterol, β-Sitosterol and stigmasterol were generally the most dominant and abundant components detected at almost all stations. A positive and strong correlation was observed between B-Sitosterol and TIS suggests that terrestrial input is the major source of TIS in the study area. The distribution of long chain n-alkan-2-ones in the range of C₂₁ to C₂₇ with odd to even predominance and n-alkanals (C₂₀ to C₂₈), n-alkanols (C₂₂-C₃₀) and n-alkanoic acids (C₂₂-C₃₀) with even to odd predominance provide further evidence for biogenic sources of hydrocarbons with terrestrial plant input as the predominant source. It is noted that a minor contribution associated with marine phytoplankton (algae) as well as bacteria is also observed in some of the sediment samples superimposing with the terrigenous plant wax input.

Thus, it can be concluded that the lagoon sediments of Setiu Wetland are relatively in uncontaminated (pristine) condition where terrestrial plants input are the dominant contributor of organic compounds in the sediments with a minor input from marine organisms.

Abstrak tesis yang dikemukakan kepada Senat Kolej Universiti Sains dan Teknologi Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**PENCIRIAN DAN SUMBER HIDROKARBON
DALAM SEDIMEN LAGUNA DI SETIU WETLAND**

HASRA MASRIFAH BT WAN JUSOH @ AB. RAHIM

September 2006

Pengerusi : Professor Madya Norhayati Mohd. Tahir, Ph.D.
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Dalam kajian ini, kandungan hidrokarbon (alifatik, polisiklik aromatik, sterol, asid lemak rantai panjang, alkanone dan alkanal) dalam sedimen permukaan dan sedimen dasar di lima (5) stesen di Laguna Setiu, Terengganu ditentukan dengan menggunakan Gas Kromatografi Spektrometri Jisim (GC-MS). Sampel sedimen permukaan diambil menggunakan alat persampelan *Grab* manakala sedimen turus diambil menggunakan alat persampelan *D-section Corer* pada February dan April 2004. Sedimen yang telah dikeringkan menggunakan alat *Freeze-dryer* diekstrak dengan pelarut diklorometana selama 8 jam menggunakan set pengekstrakan *soxhlet*. Pemisahan hidrokarbon kepada alifatik, polisiklik aromatik dan pecahan berpolar dijalankan menggunakan kaedah kromatografi turus dengan silica-alumina separa nyah-aktif. Identifikasi dan kuantifikasi sebatian-sebatian tersebut dilakukan menggunakan GC-MS.

Dalam kajian ini, kebolehpulangan yang diperolehi bagi sebatian alifatik, polisiklik aromatik dan sterol masing-masing adalah dalam lingkungan 76-91%,

70-81% dan 63-80%. Keputusan yang diperoleh menunjukkan bahwa kepekatan jumlah n-alkana yang dikenalpasti (TIRNA) berada dalam lingkungan 0.47 µg/g ke 11.6 µg/g berat kering. Taburan pecahan n-alkana secara amnya menunjukkan kehadiran n-alkana dalam lingkungan C₁₂-C₃₆ dengan didominasi oleh homolog rantai panjang (C₂₅-C₃₁), dan menunjukkan karbon maksimum (C_{max}) pada C₃₁ dengan CPI>3; pemerhatian ini menunjukkan kehadiran sumber biogenik daripada daratan terutamanya lilin tumbuhan epitikular ke dalam sedimen di laguna ini. Pemalar korelasi yang positif dan kuat diantara ALK TER dan TIRNA menunjukkan input tumbuhan daratan adalah sumber utama TIRNA dikawasan kajian.

Ketidakhadiran *Unresolved Complex Mixture* (UCM) dalam kromatogram dan ketiadaan sebatian hidrokarbon polisiklik aromatik (PAHs) kecuali antrasina dan perilina menunjukkan sedimen dikawasan kajian tidak dicemari oleh sumber petrogenik dan pirogenik. Sumber bagi antrasina dan perilina ini kemungkinan adalah daripada sumber semulajadi.

Kepekatan jumlah sterol yang dikenalpasti (TIS) adalah dalam lingkungan 1.41 µg/g hingga 3.11 µg/g berat kering. Kolesterol, β-Sitosterol dan Stigmasterol adalah komponen utama dan banyak dikesan di hampir kesemua stesen. Pemalar korelasi yang positif dan kuat diantara β-Sitosterol dengan TIS menunjukkan bahawa input tumbuhan daratan adalah sumber utama TIS dikawasan kajian ini.

Taburan n-alkan-2-ones rantai panjang dalam lingkungan C₂₁ hingga C₂₇ yang didominasi oleh karbon ganjil dan alkanal (C₂₀₋₂₈), n-alkanols (C₂₂-C₃₀) dan asid n-alkanoik (C₂₂-C₃₀) yang didominasi oleh karbon genap mengukuhkan lagi bukti bahawa sumber utama hidrokarbon dalam sedimen ini adalah daripada sumber biogenik yang didominasi oleh input daripada tumbuhan daratan. Selain itu, keputusan juga menunjukkan bagi sesetengah sampel, disamping

input lilin tumbuhan daratan, terdapat juga sedikit input yang boleh dikaitkan dengan sumber marin iaitu daripada fitoplankton (algae) dan juga bakteria.

Sebagai kesimpulan, sedimen dikawasan laguna tanah bencah Setiu didapati masih berada pada tahap tidak tercemar dimana input daripada tumbuhan daratan dikenalpasti sebagai sumber utama sebatian organik dalam sedimen ini. Walaubagaimanapun keputusan juga menunjukkan bahawa organisma marin turut memberi sumbangan kepada sebatian organik dalam sedimen dikawasan ini, namun begitu sumbangannya adalah kecil berbanding sumber biogenik daripada daratan.