

Distribution and Sources of Aliphatic Hydrocarbons in Sediments from Sadong River, Sarawak, Malaysia

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Abstract

Twenty-one surface sediment samples collected from Sadong River, Sarawak were analysed for aliphatic hydrocarbons. These hydrocarbons were recovered from sediment by Soxhlet extraction and then analysed using gas chromatography equipped with mass spectrometer (GC-MS).

The sediments collected from Sadong River have high concentrations of total aliphatic hydrocarbons which ranged from 310.41 to 1296.43 $\mu\text{g/g}$. Evaluation of various *n*-alkane indices such carbon preference index (CPI: 1.32 to 1.98) and average chain length (ACL: 26.26-27.19) showed that there was a predominance of petrogenic sources of *n*-alkanes in the river and biogenic origin *n*-alkanes from vascular plants. The petrogenic source of *n*-alkanes are predominantly heavy and degraded oil with fresh oil inputs. It is believed that the hydrocarbons originated from both natural and anthropogenic sources. The hydrocarbons were mostly transferred by lateral input than atmospheric movements.

Keywords: Aliphatic hydrocarbon, carbon preference index (CPI), gas chromatography-mass spectrometer (GC-MS), Sadong River, Soxhlet extraction.

Introduction

The aquatic environment serves as an important sink for organic matter. The source and distribution of organic matter in the rivers are of great interest globally because they are primary indicators of current pollution levels. The major sources of hydrocarbon in sediments are natural sources and anthropogenic sources¹. Sediment organic matter and hydrocarbon compounds may be derived from terrestrial vascular plants and marine phytoplanktons^{2,3}. The Sadong river covers a large area of the Kota Samarahan- Asajaya district. It receives a major freshwater input from upland towards Serian and it drains into main river channels and distributaries from the meandering along Satubong to the estuary finally into the ocean⁴.

Petroleum hydrocarbons are widespread contaminants and may result to environmental problems when found in high concentration. Their effects may be toxic, mutagenic and

carcinogenic as a result of their persistence and bioaccumulation⁵. Aliphatic hydrocarbons found in the environmental samples are usually as a result of direct and indirect discharges into rivers via lateral and atmospheric transportation⁶. Aliphatic hydrocarbons are ubiquitous sedimentary contaminants due to their tendency to accumulate in sediments⁷.

The environs of the study area are characterized by extensive economic resources such as fishing, mangrove swamps, tourism spots and peat swamps. Many ratios and indexes have been used to identify the sources of *n*-alkane in the environment⁶ such as carbon preference index (CPI), major hydrocarbon (MH), average carbon length (ACL) and ratio of low molecular weight to high molecular weight (LMW/HMW). The objective of this study is to investigate the spatial distribution of petroleum hydrocarbons and determine the possible sources of petroleum hydrocarbon pollution in sediments from Sadong River.

Material and Methods

A total of 21 surface sediments were collected in March 2017 and March 2018, these samples were collected from seven stations (Fig. 1). These samples were collected using a Wedepohl stainless steel grab sampler, transferred into aluminium foil and kept frozen until further analysis at -40° C. All samples were analysed in the Gas Chromatography Laboratory, Faculty of Resource Science, Universiti Malaysia Sarawak. Sediments were allowed to thaw at room temperatures and 10 grams of sediment was weighed into cellulose thimbles. Before the extraction, sediments samples were spiked with internal standards of eicosene for aliphatic fractions. The sediments were subjected to Soxhlet extraction using 250 ml of dichloromethane (DCM).

The extracts were dried with rotary evaporator and nitrogen gas, they were fractionated on a silica gel column by elution with 30 ml of *n*-hexane for the *n*-alkanes, 20ml of hexane and DCM (3:1) and DCM⁵. Identification and quantification of the aliphatic compounds were carried out using Shimadzu QP2010 gas chromatograph-mass spectrometer fitted with a SGE BPX-5-fused silica capillary column. These *n*-alkane fractions were analysed using GC-MS at 50°C for 5 minutes and increased to 300°C at 10 minutes. The verification of peaks was based on the retention time compared to those of external standards.