Original article

Hydrocarbons Composition of Water and Suspended Matter of the Ham Luong River (Southeast Asia)

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Abstract
The qualitative and quantitative composition of water and suspended matter hydrocarbons was assessed. The transformation of these compounds during their migration in the «water-suspension» system of the river delta in a tropical climate was studied on the example of one of the deepest branches of the Mekong River (Ham Luong River) in Vietnam. The material for the study was samples of surface and bottom water taken along the riverbed in November–December 2022. The physicochemical parameters of the environment were measured using a multimeter *in situ*. The qualitative and quantitative composition of hydrocarbons in the water and suspended matter was determined by gas chromatography on the basis of the Scientific and Practical Center for Spectrometry and Chromatography of the FRC IBSS. Biogeochemical markers of the origin of hydrocarbons were used to identify probable sources of organic matter. Individual physicochemical indicators of the aquatic environment (pH, O_2, salinity, temperature, concentration of suspended matter) were characteristic for the rivers of the lower Mekong River and were within the limits characterizing the favorable state of the reservoir during the wet season. The content of hydrocarbons in the water of the Ham Luong River averaged 0.061±0.019 $mg \cdot L^{-1}$. These indicators were quite high, exceeding the sanitary standards (0.05 $mg \cdot L^{-1}$) for fishery reservoirs, or approaching this value. The concentration of hydrocarbons in suspended matter averaged 0.019±0.009 $mg \cdot L^{-1}$. An increase in the content of hydrocarbons in the suspended phase was noted in the area where the river flows into the sea, in comparison with the sections of the river located upstream. Hydrocarbons in the water were of mixed origin, and contained both biogenic components of autochthonous and allochthonous origin, and traces of oil pollution. In suspended matter, along with biogenic compounds, there are also biodegraded petroleum compounds. Organic compounds, both of allochthonous and petroleum origin, coming from the catchment areas of the Ham Luong River, which is especially pronounced during the wet season, as well as from the surface of the river, further undergone biotransformation during the transition to a suspended state. As a result, the composition of n-alkanes in suspended matter differed significantly from that in water samples.

Keywords: hydrocarbons, n-alkanes, water, suspended matter, biogeochemical markers, tropical river, Mekong River, Ham Luong River, Vietnam

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Углеводородный состав воды и взвеси реки Хамлуонг (Юго-Восточная Азия)

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Аннотация

Проведена оценка качественного и количественного состава углеводородов воды и взвешенного вещества с учетом их трансформации при миграции в системе вода – взвесь дельты реки на примере одного из самых полноводных рукавов Меконга (р. Хамлуонг) на территории Вьетнама в условиях тропического климата. Материалом для исследования послужили пробы поверхностной и придонной воды, отобранные вдоль русла реки в ноябре – декабре 2022 г. Физико-химические параметры среды измеряли *in situ* с помощью мультиметра. Качественный и количественный состав углеводородов в воде и взвеси определяли методом газовой хроматографии. Для идентификации вероятных источников поступления органических веществ использовали биогеохимические маркеры происхождения углеводородов. Значения отдельных физико-химических показателей водной среды (pH, O_2, соленость, температура, концентрация взвешенного вещества) являются характерными для исследуемой р. Хамлуонг. Эти значения находились в пределах, характеризующих благополучное состояние водоема во влажный сезон. Содержание углеводородов в воде р. Хамлуонг в среднем составляло 0.061 ± 0.019 мг·л$^{-1}$. Данное значение является достаточно высоким и превышает санитарные нормы (0.05 мг·л$^{-1}$) для рыбохозяйственных водоемов или приближаются к ним. Концентрация углеводородов во взвешенном веществе составляла в среднем 0.019 ± 0.009 мг·л$^{-1}$. В районе впадения реки в море содержание углеводородов во взвешенной фазе было выше, чем на участках реки, находящихся выше по течению. Углеводороды в воде были смешанного происхождения. Во взвешенном веществе наряду с биогенными соединениями отмечаются также биодеградированные соединения нефтяной природы. В результате биотрансформации состав н-алканов в пробах взвешенного вещества и в пробах воды существенно различается.

Ключевые слова: углеводороды, н-алканы, вода, взвесь, биогеохимические маркеры, тропическая река, река Меконг, река Хамлуонг, Вьетнам

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Introduction

The total area of Vietnam's inland water bodies is about 6 % of the country's territory, so water resources are essential to the region's economy [1]. The Mekong River is one of the most important river systems in Vietnam and the twelfth longest river in the world [2]. One of the Mekong's branches with the highest water content is the Ham Luong River, which is 70 km long and 2800 m wide, it has an average depth of 11.3 m and an average water discharge [1)] of 10.2 $m \cdot s^{-1}$.

There are more than three thousand rivers and streams in Vietnam (over a hundred of them flow into the sea), many of them are characterized with a high degree of water pollution. The most polluted (due to various causes) are the Cau, Dai, Thi Vai, Dong Nai and Mekong Rivers. A 2018 report by the Ministry of Natural Resources and Environment of Vietnam notes that in the river catchment area, water pollution occurs due to mining activities. In the middle and lower reaches of the rivers (in these areas, cities, industrial areas, and rural settlements are usually located), their ecological state is deteriorating due to all kinds of waste entering the water. The pollution degree depends on hydrological factors (their influence increases in the dry season), as well as on the degree of control over pollution sources. In almost all ecologically unfavourable areas, organic substances are the cause of pollution [3].

Natural waters are a complex mixture of solutions of mineral salts and gases, as well as organic compounds in suspended and dissolved forms. At the same time, the content and qualitative composition of organic matter in a water body are determined not only by the natural features of the latter, but also by the nature and degree of influence of human activity on the water body [4]. Among important factors affecting the redistribution of organic matter in water, including hydrocarbons (HC), there are also physical and chemical parameters such as pH, salinity, temperature, etc. The pH level determines the development and activity of many organisms, the aggressiveness of water impact on metals and concrete. The water pH level also influences the processes of transformation of various forms of nutrients

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[1)] Phung Thai Duong, 2015. [*Ecological and Geochemical State of the Mekong River Mouth (Republic of Vietnam) Based on Studies of Bottom Sediments*]. Extended Abstract of Doctoral Dissertation. Tomsk: NITPU, 26 p. (in Russian).

and changes the toxicity of pollutants [2)]. Oxygen dissolved in water is one of the most important biohydrochemical indicators of the environment. It ensures the existence of aquatic organisms and characterizes the quality of water [5] used for various economic purposes. Oxygen deficiency is more often observed in water bodies with high concentrations of organic pollutants and in water bodies containing a large amount of nutrients and humic substances. In addition, oxygen concentration determines the direction and rate of processes of chemical and biochemical oxidation of organic and inorganic compounds [2)].

HC genesis can be identified using various markers. In order to differentiate allochthonous and autochthonous origin, the ratio of terrigenous and autochthonous compounds C_{31}/C_{19}, C_{31}/C_{17}, the ratio of low-molecular-weight and high-molecular-weight homologues (LWH/HWH) is often used [6, 7]. Some biomarkers allow specifying the biogenic nature of compounds, in particular to assess the contribution of herbaceous and woody vegetation to the formation of the allochthonous component of HCs entering the bottom sediments. These are, e. g., C_{31}/C_{29} and ACL ratios [7]. To differentiate the petroleum and biogenic origin of detected HCs, such ratios are used as the carbon preference index (CPI), in particular CPI_2 (calculated for the high-molecular-weight part of the spectrum), ACL, LWH/HWH, and the ratio of isoprenoid alkanes (pristane and phytane), both one to the other and to individual normal homologues (Pr/Ph, C_{17}/Pr, C_{18}/Ph) [6, 7].

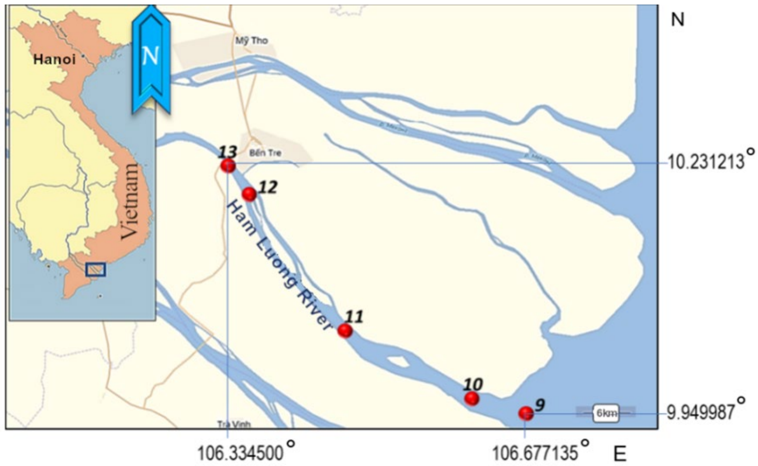
The work aims at assessment of the qualitative and quantitative composition of HCs in water and suspended matter of the Ham Luong River given the transformation of these compounds during their migration in the water–suspension system.

Material and methods

The material was water samples taken in November – December 2022 along the Ham Luong River riverbed (Stations *9–13*) taking into account the location of large industrial and urban facilities along its banks (Fig. 1). Sampling at each station was conducted in the cross section of the riverbed at three points (the right and left banks, the centre). Bottom and surface water was sampled in the central part of the riverbed, while near the banks, only surface water was sampled. The numbering of stations was retained in accordance with the schedule programme of Vietnamese rivers studies jointly with the Southern Branch of Joint Vietnam-Russia Tropical Science and Technology Research Center (JVRTSTRC). Chemical and physical characteristics of surface water (pH, Eh, salinity, temperature) of the Ham Luong River were determined *in situ* by the staff of the Environmental Analysis Laboratory of the Southern Branch of the JVRTSTRC using a YSI Professional Digital Sampling System (ProDSS) multi-parameter probe. Sample preparation was carried out in laboratory conditions by extraction of water samples with hexane [3)]. The resulting extract was purified on a glass column filled

[2)] State Standard, 1978. [*Nature Protection. Hydrospere, Use and Protection of Waters. Main Terms and Definitions*] (in Russian).

[3)] Barabashin, T.O., ed., 2018. [*Guidance Manual on Chemical Analysis of Aquatic Ecosystem Elements. Primary Toxicants in Water, Bottom Sediments, Hydrobionts*]. Rostov-on-Don: MiniTaip, 436 p. (in Russian).



F i g . 1 . Map of water sampling stations in the Ham Luong river (Vietnam) during the wet season, 2022

with aluminium oxide to remove polar compounds, concentrated to 1 mL and transported to the FRC IBSS laboratory.

Suspended matter was collected by vacuum filtration using a vacuum pump, Bunsen flask, filter unit and nitrocellulose filters with a pore diameter of 0.45 μm. The volume of filtered river water varied according to the rate of suspended matter deposition on the filters and was taken into account when calculating the hydrocarbon content of the suspension. The filters were dried under natural conditions, stored in a desiccator, and transported in airtight ziploc bags.

An aliquot of the extract (1 μL) was injected with a microsyringe into the heated to 250 °C evaporator of a gas chromatograph *Kristall 5000.2* with a flame ionisation detector (FID). HC separation was performed on a TR-1MS capillary column 30 m long, 0.32 mm in diameter, and with the stationary phase film thickness of 0.32 μm (TermoScientific). The column temperature was programmed from 70 to 280 °C (rate of temperature rise: 8 $°C·min^{-1}$). The carrier gas (nitrogen) flow in the column was 2.5 $mL·min^{-1}$ without flow splitting. The detector temperature was 320 °C.

Quantitative determination of HC content was carried out by absolute calibration of FID by HC mixture (ASTMD2887 Reference Gas Oil standard sample (SUPELCO, USA)), that of n-alkanes – by a paraffinic HC standard sample in hexane with mass concentration of each component 200 $μg·mL^{-1}$ and of pristane + phytane – 100 $μg·mL^{-1}$ in hexane (SUPELCO, USA).

Determination of HCs and n-alkanes was carried out at the Scientific and Educational Center for Collective Use “Spectrometry and Chromatography” of FRC IBSS. To process the results for the determination of HC concentrations, *Chromatek Analytic 3.0* software was used (absolute calibration and percentage normalization method).

US-EPA indices [4] applicable to water bodies of different climatic zones were used to assess the well-being of waters of the study area by individual indicators, which allows using them for tropical water bodies as well [8, 9]. Correlation analysis was performed using Microsoft Excel 2010 analysis package. The strength of the correlation relationship was estimated based on the correlation coefficient (R). The approximation coefficient (R^2) was used to estimate the reliability of approximation of dependencies by a linear function.

The markers of HC genesis were determined according to the following ratios:

– *CPI*$_2$ (*Carbon Preference Index*) = $(1/2)\{(C_{25} + C_{27} + C_{29} + C_{31} + C_{33} + C_{35}) / (C_{24} + C_{26} + C_{28} + C_{30} + C_{32} + C_{34}) + (C_{25} + C_{27} + C_{29} + C_{31} + C_{33} + C_{35}) / (C_{26} + C_{28} + C_{30} + C_{32} + C_{34} + C_{36})\}$;

– *Pr/Ph* – pristane to phytane ratio;

– *LWH/HWH* – low-molecular-weight homologue to high-molecular-weight homologue ratio;

– C_{31}/C_{19} – n-alkane C_{31} to n-alkane C_{19} ratio;

– C_{31}/C_{17} – n-alkane C_{31} to n-alkane C_{17} ratio;

– C_{31}/C_{29} – n-alkane C_{31} to n-alkane C_{29} ratio;

– C_{17}/Pr – n-alkane C_{17} to pristane ratio;

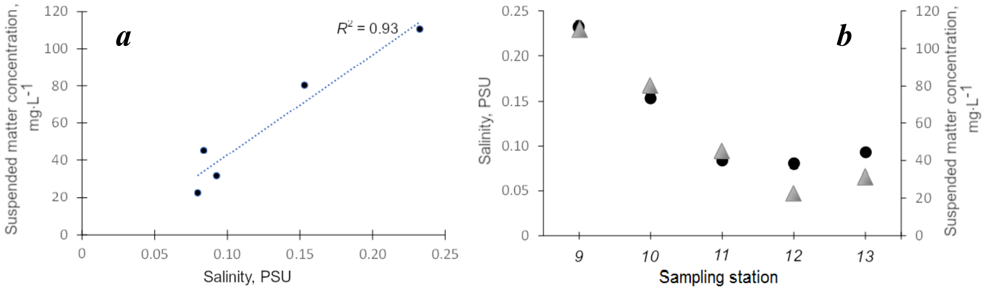
– C_{18}/Ph – n-alkane C_{18} to phytane ratio.

Results and discussion

The water temperature in the study area was around 29 °C (28.83–29.33 °C). Salinity ranged from 0.08 to 0.23 PSU and corresponded to fresh water. A regular increase of this parameter was observed while moving downstream (Fig. 2). At Stations *11–13* the salinity was the same (0.08–0.09 PSU), at Station *10* it was 0.15 PSU, and at the most seaward Station *9* it increased up to 0.23 PSU. Together with salinity, the suspended matter content of water was increasing (R = 0.97, $R^2 = 0.93$), growing approximately twofold in the mixing zone (Station *9*) (Fig. 2, *a*). The suspended matter content at the sampling stations varied from 23 to 110 mg·L^{-1} (Fig. 2, *b*) with a tendency to increase as we moved towards the river mouth. It should be noted that in most parts of the riverbed the suspended matter content in the bottom layer was on average 1.9 times higher than that in the surface layer. The exception was Station *9* located at the river mouth, where the suspended matter content at the surface was 1.4 times higher than that in the bottom layer.

Thus, a joint increase in salinity and suspended matter content was observed while moving downstream of the river. The marginal filter phenomenon formed in the river – sea mixing zone is described in the literature [10], where an increase in suspended matter content is observed as salinity increases up to 5 PSU while one moves towards the salt-water areas. This fact is associated with active processes of coagulation and flocculation, when dissolved organics, iron, aluminium,

[4] US-EPA, 1986. *Quality Criteria for Water 1986*. Washington, DC, USA: Office of Water Regulations and Standards, United States Environmental Protection Agency, 394 p. Available at: https://www.epa.gov/sites/default/files/2018-10/documents/quality-criteria-water-1986.pdf [Accessed: 27 September 2023].



F i g . 2 . Salinity (PSU) and concentration of suspended solids (mg·L^{-1}) in the water of the Ham Luong River (Vietnam) during the wet season, 2022: *a* – the ratio of salinity and suspended matter concentration; *b* – salinity (dots) and suspended matter concentration (triangles) at sampling stations

and a number of other elements pass from solution into suspension under the influence of electrolyte. Probably, we observed the increasing intensity of this very process in the study area even at an insignificant increase of water salinity.

According to monitoring studies [5)], suspended sediment concentrations in the Mekong River branches, particularly the Ham Luong River, vary considerably ranging from 2.3 to 593 mg·L^{-1} with an average value of 80.6 mg·L^{-1}. Suspended matter concentrations depend on the season greatly: they decrease significantly from April to November and increase as the monsoon season begins. Thus, the average value [5)] for the dry season is 36.9 mg·L^{-1}, and for the wet season it is 124 mg·L^{-1}. In the material we sampled in December 2022, the average suspended matter concentration was 58 mg·L^{-1}.

The water pH at all stations ranged 7.4–7.6, which corresponds to drinking water. According to the monitoring survey data [5)], pH values in the lower reaches of the Ham Luong River are in the range of 6.3–8.7 (average 7.7). The values we obtained fall within this range and correspond to the target values (6–9) [4)] of WQIhh (Water Quality Index for the Protection of Human Health) [11].

The dissolved oxygen content also varied insignificantly within the range of 5.14–5.57 mg·L^{-1}. The oxygen content in the water complies with the health standard values [6)] for fishery water bodies (> 4 mg·L^{-1}), though it was slightly below the steady-state concentrations for this temperature range (7.62–7.52 mg·L^{-1}) [11], which is suggestive of active biological processes in the river waters.

[5)] Mekong River Commission, 2018. *Lower Mekong Regional Water Quality Monitoring Report*. Vientiane, Lao: Mekong River Commission.

[6)] *On the Approval of Water Quality Standards for Water Bodies of Commercial Fishing Importance, Including Standards for Maximum Permissible Concentrations of Harmful Substances in the Waters of Water Bodies of Commercial Fishing Importance*: Order of the Ministry of Agriculture of Russia dated December 13, 2016, No. 552 (in Russian).

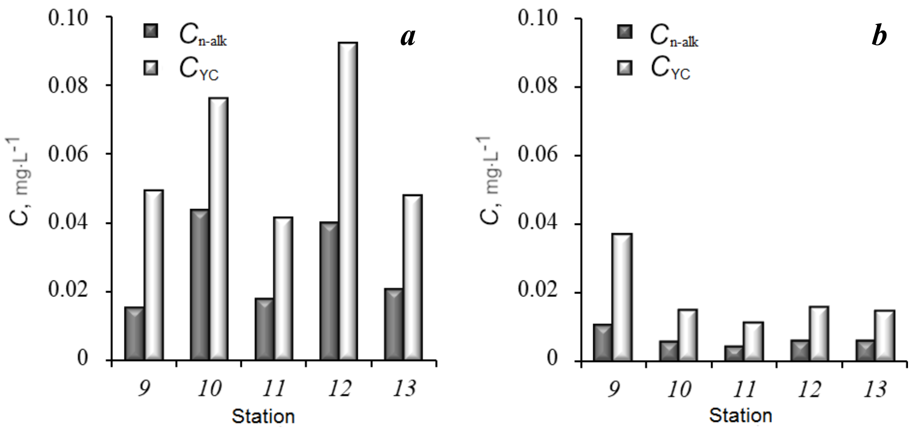
The oxygen concentration in the lower reach of the studied river ranges from 4.12 to 9.27 mg·L^{-1} (average 6.45 mg·L^{-1}) [5)]. The obtained values are typical for the water body and correspond to the target indicator (not less than 5 mg·L^{-1}).

Thus, the studied indicators were typical for the Ham Luong River and were within the limits indicating the favourable condition of the water body during the study season.

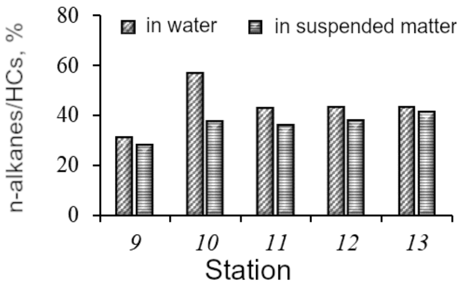
The HC content in the water of the Mekong River brunch under the study (Ham Luong River) ranged from 0.042 to 0.076 mg·L^{-1} (average 0.061 ± 0.019 mg·L^{-1}) (Fig. 3). These values are quite high and exceed the health standard limits (0.05 mg·L^{-1}) for fishery water bodies [6)] or are near this value. Since the river under study is used both for fishing and aquaculture, these indicators characterize its unsatisfactory condition. The content of n-alkanes in the water was 0.015–0.043 mg·L^{-1} (average 0.028 ± 0.012 mg·L^{-1}). The proportion of n-alkanes to total HC content ranged from 31 to 57 % (average 44 ± 8 %). The reduced proportion of n-alkanes from HCs was at Station *9* located in the area, where the river flows into the sea. In general, HC and n-alkane concentrations changed synchronously (R = 0.91).

The HC content in suspended matter was in the range of 0.011–0.37 mg·L^{-1} (average 0.019 ± 0.009 mg·L^{-1}) (Fig. 3). It is noteworthy that the HC content in the suspended phase increased near Station *9* compared to upstream river sections. This fact, as noted above, can be associated with the transition of substances from the dissolved to suspended state with increasing water salinity in the river – sea mixing zone [12]. The HC content in the suspended matter correlated with its total amount (R = 0.78), which indicates a substantial contribution of biological processes to the suspended matter formation.

The concentration of n-alkanes varied from 0.004 to 0.10 mg·L^{-1} (average 0.006 ± 0.002 mg·L^{-1}) representing 28–41 % (average 36 ± 4 %) of the hydrocarbon mixture. Based on the small standard deviation, this fraction was quite constant, which



F i g . 3 . Hydrocarbon concentrations (mg·L^{-1}) in water (*A*) and suspended matter (*B*) of the Ham Luong River (Vietnam) during the wet season, 2022



F i g . 4 . Hydrocarbon and n-alkane ratio (%) in water and suspended matter of the Ham Luong River (Vietnam) during the wet season, 2022

may be a consequence of the uniformity of HC input sources and conversion mechanisms at the different sampling stations. The contents of HC and n-alkanes in the mixture varied synchronously (R = 0.98). For both water and suspended matter, the proportion of n-alkanes from HCs decreased in the area, where the river flows into the sea (Fig. 4).

The share of HCs in suspended matter accounted for 20 to 75 % (average 34 ± 21 %) of HCs in water as a whole. That is, the range of values was rather wide. This indicator for n-alkanes ranged within 13–68 % (average 29 ± 20 %), which also characterizes the instability of this indicator.

At all stations, n-alkanes from C_{17} to C_{32} were identified in the unfiltered water sample. At Stations *11–13*, the compound C_{33} was also identified. In general, the distribution of n-alkanes was uniform, which may indicate the presence of compounds of petroleum origin (Fig. 5). A C_{17} peak was noted, which is associated with planktonic production [6]. Another group of C_{26}–C_{29} maxima stands out. The odd-numbered compounds in this range are genetically associated with terrestrial vegetation (C_{27}, C_{29}) [6]. The even-numbered compounds (C_{26}, C_{28}) are probably related to bacterial synthesis [7)] [13] and also correspond to the presence of humus admixture in organic matter and macrophyte production [14]. Given that sampling was carried out during monsoon rains, the washout of humus compounds from the adjacent territories is not improbable.

In the suspended matter, n-alkanes were present in the C_{17}–C_{32} range. Compounds with a higher molecular weight were not recorded. At Station *13*, the heaviest homologue was C_{30}, and at Station *10* it was C_{31}. The main peak in the composition of n-alkanes in the suspended matter corresponded to C_{17} (19–27 %). It is due to active primary production [15, 16], which intensifies in the wet season because of the active input of biogenic compounds and high oxygenation of water [16]. The analyzed suspended matter probably had a significant number of phytoplanktonic organisms in its composition. At Stations *9* and *10*, the second peak corresponded to C_{21} (13 and 16 %), also of phytoplanktonic genesis. In general, the graph of n-alkane distribution in the suspended matter was smoother than that in water, which may indicate a deeper transformation of organic matter in the suspended matter. Thus, n-alkanes present in the suspended phase are predominantly autochthonous in nature and are associated with phytoplankton and bacterial production.

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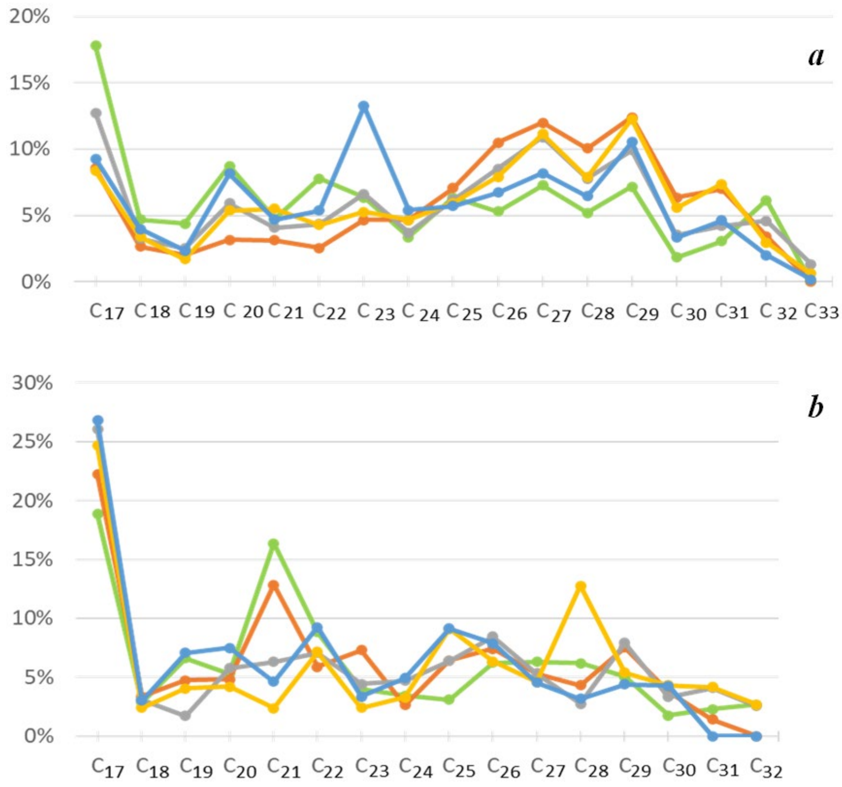
7) Poshibaeva, A.R., 2015. [*Bacterial Biomass as Petroleum Hydrocarbon Source*]. Extended Abstract of Doctoral Dissertation. Moscow: 24 p. (in Russian).



F i g . 5 . Distribution of *n*-alkanes in water (*a*) and suspended matter (*b*) of the Ham Luong River (Vietnam) during the wet season, 2022: St. *9* ( ), St. *10* ( ), St. *11* ( ), St. *12* ( ), St. *13* ( )

To identify potential sources of HC inputs, individual markers of organic matter genesis were calculated (Table). For water, the carbon preference indices for the high-molecular-weight region were almost the same and slightly exceeded a figure of one, which may be a consequence of the presence of oil contamination. The pristane to phytane ratio was also characterized by low values, which is typical of the presence of oil. The ratio of n-alkane C_{17} to pristan, C_{17}/Pr (Table) characterizes the presence of fresh oil. At the same time marker C_{18}/Ph ≈ 1 (Table), which indicates the presence of both fresh and degraded petroleum products.

It is known that the suspended matter is characterized by CPI values ≥ 1 [6]. In this study, this ratio was below a figure of one for the high-molecular-weight region, which indicates the predominance of biogenic and transformed petroleum HCs in the suspended matter phase. The pristane to phytane ratio Pr/Ph (Table) is indicative of the presence of oil, and C_{18}/Ph shows the predominance of its biodegraded components.

Calculated biogeochemical marker values for water and suspended matter of the Ham Luong River (Vietnam), 2022

Marker	Water					Suspended matter				
	Station number									
	9	*10*	*11*	*12*	*13*	*9*	*10*	*11*	*12*	*13*
CPI_2	1.2	1.2	1.3	1.4	1.4	0.5	0.7	0.7	0.4	0.6
Pr/Ph	0.2	0.1	0.0	0.0	0.2	0.3	0.2	0.1	0.1	0.1
LWH/ HWH	0.9	0.3	0.5	0.5	0.4	1.4	1.2	1.0	0.8	1.4
C_{31}/C_{19}	0.7	3.5	1.7	4.3	2.0	0.3	0.3	2.3	1.0	0.0
C_{31}/C_{17}	0.2	0.8	0.3	0.9	0.5	0.1	0.1	0.2	0.2	0.0
C_{31}/C_{29}	0.4	0.6	0.4	0.6	0.4	0.5	0.2	0.5	0.8	0.0
C_{17}/Pr	21.0	49.2	103.4	43.8	19.5	5.7	25.1	64.0	24.3	30.2
C_{18}/Ph	0.9	0.9	1.0	0.7	1.0	0.3	0.6	0.4	0.3	0.5

Thus, there is a situation when water contains both fresh and degraded oil, while biodegraded compounds of oil origin prevail in the suspended matter. It is known that during sedimentation oil components actively degrade [17], which is the reason for the presence of transformed compounds in the suspended phase. It is natural to expect active biodegradation processes of introduced organic compounds in the warm waters of the Ham Luong River. In some cases, even in Arctic ocean areas, in spite of low temperatures, the transformation of anthropogenic hydrocarbons goes so quickly that natural compounds dominate in the water and bottom sediments [18].

The markers allowing differentiating between autochthonous and allochthonous compounds (C_{31}/C_{17}, C_{31}/C_{19}) indicate the predominance of compounds coming from land into water. In the suspended matter, based on the marker values, allochthonous compounds are of subordinate value, which links the suspended matter to the productive and destructive processes in the riverbed. The LWH/HWH ratio (Table) for water corresponds to the predominance of terrigenous HCs [18]. In the case of suspended matter, this marker has high values, which can sometimes be a sign of fresh oil input. The main contribution to the sum of low-molecular-weight homologues in this case is made by C_{17} and C_{21}, the share of which is by times higher than the specific weight of other n-alkanes. Therefore, we can speak about the predominance of autochthonous compounds, which indicates active production processes in the water body.

The HCs in water are of mixed origin and contain both biogenic components of autochthonous and allochthonous nature and traces of oil pollution. In the suspended matter along with biogenic compounds, biodegraded compounds of oil nature are also observed. Organic compounds of both allochthonous and petroleum origin come from the Ham Luong River catchment areas (which is especially pronounced during the wet season) as well as from the river surface. Further, these compounds undergo biotransformation after becoming suspended. As a result, the composition of n-alkanes in the suspended matter samples and integrated water samples differs significantly. This process is active, in part due to the high water temperature typical of the tropical region. Active biological processes in the river waters are also indicated by a slightly reduced oxygen content relative to steady-state concentrations, which is probably intensively consumed for oxidation of organic compounds.

Conclusion

Values of some physical and chemical parameters of the aquatic environment (pH, O_2, salinity, temperature, suspended matter concentration) were typical for the Ham Luong River and were within the limits indicating the favourable condition of the water body during the study season.

The HC content in the water of the studied branch of the Mekong (Ham Luong River) ranged from 0.042 to 0.076 $mg{\cdot}L^{-1}$, averaging 0.061 ± 0.019 $mg{\cdot}L^{-1}$. These values are quite high and exceed or are close to the health standard values (0.05 $mg{\cdot}L^{-1}$) for fishery water bodies.

The HC content in the suspended matter ranged from 0.011 to 0.37 $mg{\cdot}L^{-1}$, averaging 0.019 ± 0.009 $mg{\cdot}L^{-1}$. An increase in HC content in the suspended phase was observed in the area where the river flows into the sea compared to the upstream sections of the river.

The HCs in water are of mixed origin and contain both biogenic components of autochthonous and allochthonous nature as well as traces of oil pollution. In the suspended matter along with biogenic compounds, biodegraded compounds of oil nature are also observed. Due to active washout from the catchment area of the Ham Luong River (which is especially pronounced in the wet season) and from the surface of the river, organic compounds of various origins undergo significant biotransformation during transition into the suspended phase. As a result, the composition of n-alkanes in suspended matter samples and in integrated water samples differs significantly.

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