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Sedimentological and Paleoenvironmental Assessment of Anthropogenic Impacts on Urban Lakes In Yamoussoukro (Côte D'ivoire), West Africa

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ABSTRACT: The urban lakes of Yamoussoukro, situated in central Côte d'Ivoire, play a crucial ecological and hydrological role by regulating stormwater, mitigating floods, and enriching the urban landscape. However, rapid urban expansion and intense human activities on their watersheds have increased erosion and sediment deposition, threatening their long-term sustainability. This study aims to characterize sedimentation processes in Lakes 5 and 9 in order to assess the origin and dynamics of recent deposits. Twenty sediment samples were collected using a Van Veen grab and subjected to granulometric, morphoscopic, and mineralogical analyses. Three main lithological facies were identified: sands, muds, and mixed sediments. The sands are predominantly coarse to medium (mean size: 630 µm) and poorly sorted, reflecting variable hydrodynamic conditions. Quartz grains, ranging from sub-angular to sub-rounded, indicate short-distance transport. Analysis of transport modes reveals a predominance of saltation (60% in Lake 5 and 51% in Lake 9), accompanied by bedload for coarser fractions. The mineralogical composition, dominated by quartz (74%), feldspar (20%), garnet (4%), and muscovite (1%), points to derivation from the local Paleoproterozoic basement. Overall, the results suggest that current sedimentation is mainly controlled by urban soil erosion and anthropogenic inputs. These findings highlight the urgent need for integrated watershed management and erosion control strategies to maintain the ecological functionality and sustainability of Yamoussoukro's urban lakes

Keywords: sedimentation, granulometry, morphoscopy, urbanlakes, Yamoussoukro, Côte d'Ivoire

INTRODUCTION

Urban lakes play a fundamental role in anthropized environments by providing a range of ecological, hydrological, and social functions, including local thermal regulation, water storage, flood control, and landscape and recreational development. However, these ecosystems are increasingly under pressure from rapid urbanization, domestic and industrial discharges, and the effects of climate change, includingincreased rainfall variability and intensified extreme events (Pickard et al., 2025).Worldwide, numerous studies have highlighted the informational richness of sediments. For example, Pickard et al. (2025) demonstrated, through hydroacoustic surveys and sediment analyses in a Dutch urban lake, that urbanization largely controls the spatial distribution of organic carbon in deposits. In Africa, research has primarily focused on large basins, such as the East African Great Lakes, where Olago and Odada (2007) demonstrated that increased sediment inputs were directly correlated with deforestation and soil erosion. In the Malian Sahel, Ragettli et al. (2022) used remote sensing to quantify sediment inputs into Lake Wégnia, concluding that water erosion contributed more to siltation than evaporation.In West Africa, several studies have demonstrated that rapid urbanization, land-use changes, and inadequate watershed management have increased sediment inputs into both large natural and artificial lakes. These processes promote siltation, enhance eutrophication, and degrade aquatic habitats, compromising the ecological quality and functionality of these ecosystems (Kouadio et al., 2023; Koua et al., 2024). However, few investigations have focused on small urban lakes within planned cities, where artificial networks and impervious surfaces strongly influence hydrological regimes.In Yamoussoukro, the political capital of Côte d'Ivoire, the network of artificial lakes is a significant component of urban planning. These lakes, created for aesthetic and drainage purposes, are now experiencing accelerated sedimentation due to urban expansion and insufficient watershed management. Previous studies have primarily focused on the hydrological and physicochemical aspects of these lakes (N'Guessan et al., 2014), but their sedimentological and mineralogical characteristics remain poorly understood.Although several studies have examined sediment dynamics in tropical urban lakes in West Africa, few have analyzed the granulometric, morphological, and mineralogical composition of sediments in small artificial systems, such as those in Yamoussoukro. Moreover, the influence of rapid urbanization and land-use changes on sediment sources and transport mechanisms remains poorly understood.

This study aims to fill this gap by characterizing the granulometric, morphological, and mineralogical properties of sediments from Lakes 5 and 9 in Yamoussoukro, to identify the main sedimentary facies, determine the modes of sediment transport, and clarify their provenance in relation to the local geological context and human activities. The results offer new insights into the sedimentation dynamics of tropical urban lakes, providing a basis for developing integrated management strategies to preserve these fragile ecosystems.

MATERIAL AND METHODOLOGY

Zone Of The Study

The urban lakes of Yamoussoukro are located in the commune of Yamoussoukro in the central Ivory Coast. With a total area of 144.41 ha, the lakes are located between latitudes 6°40' and 7° North and longitudes 5°10' and 5°20' West (Figure 1). The climate of Yamoussoukro is characterized by the Baoule climate, which features two distinct dry seasons and two rainy seasons: a long rainy season (March to June), a long dry season (November to February), a short dry season (July to August), and a short rainy season (September to October). Annual rainfall varies from 900 mm to 1700 mm. Relative humidity is high during the rainy season, ranging from 60% to 85%. The minimums are around 60% to 65% with drops to 40% from December to March (Martin, 1973; BCEOM, 1997). The lakes are generally small (Table I) and initially covered approximately 140 ha (Parinet *et al.*, 2000). This study focused only on the large lake (Lake 5) and Lake Fanon (Lake 9). The city of Yamoussoukro is situated on the Precambrian basement of the West African Craton, primarily composed of migmatitic gneisses and granitoids (Tagini, 1971; Vidal & Alric, 1994). These rocks are deeply weathered, forming lateritic crusts and reddish ferrallitic soils typical of tropical alteration processes (Yacé, 2002). The topography is gently undulating (slopes < 3%), with a poorly organized dendritic drainage network controlled by bedrock fracturing. The two urban lakes in Yamoussoukro occupy natural depressions that have been modified for hydraulic regulation and landscape enhancement. They are hydrologically connected by a temporary channel active during the rainy season, allowing partial sediment transfer between them. The watershed is now highly urbanized and impervious, resulting in intense runoff, soil erosion, and sediment inputs enriched with contaminants (Adopo, 2009; Kouassi, 2007). These geological and geomorphological settings strongly influence the sediment dynamics and ecological quality of the lacustrine system.

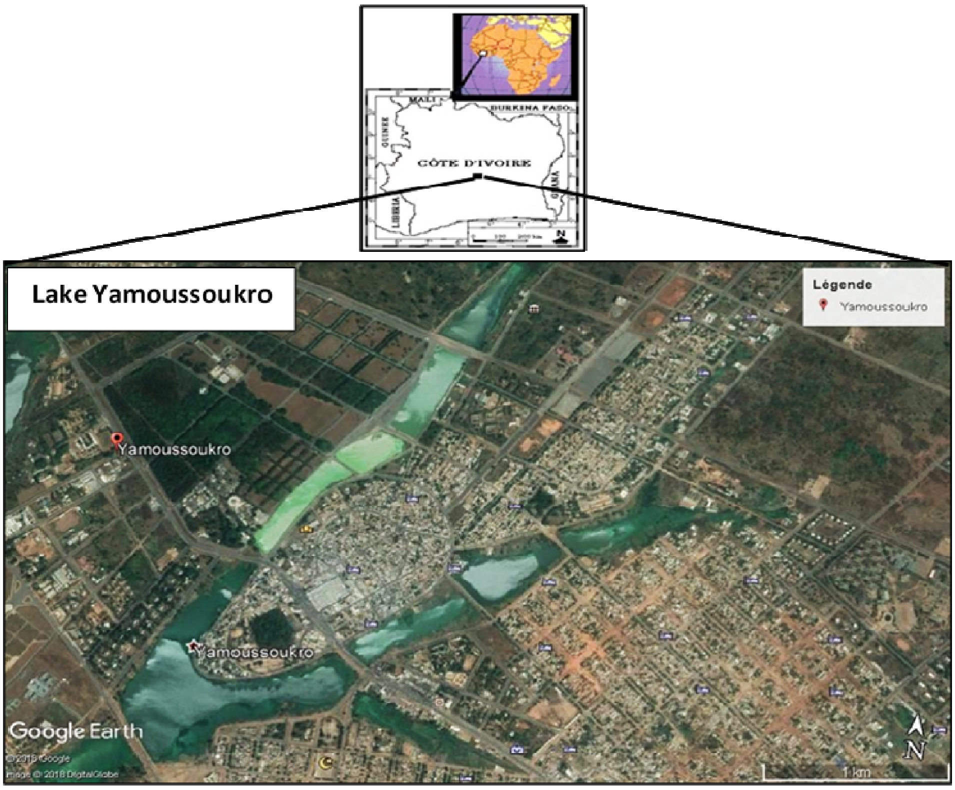

Figure 1: Geographical location of the Yamoussoukro lakes

Table 1: Lake area (Parinet et al., 2000)

Number of lakes	Localization	Lake area (ha)
1		16,20
2		14,08
3	Presidency	08,80
4		09,00
5	CHR	45,32
6	Little Bouaké	10,80
7	Hotel Bonheur II, CIE, SIPE	08,00
8	Maquis Street	10,24
9	Maquis 106	10,00
10	N'Gokro School Group	11,97
TOTAL		144,41

Acquisition of Sedimentological Data

During the mission, sampling was conducted using a Van Veen grab at 20 stations in both lakes (Lakes 5 and 9), with 10 stations per lake (Figure 2). These sampling stations were mainly distributed along the shorelines due to the difficulty of collecting samples in deeper areas and in zones covered by invasive aquatic vegetation. The grab jaws are locked in the open position by a horizontal rod fixed to the upper part of the jaws. When the grab touches the bottom, this rod is released. Then, the operator's traction on the cable acts on the lever arms, closing the grab jaws and trapping the sediment.

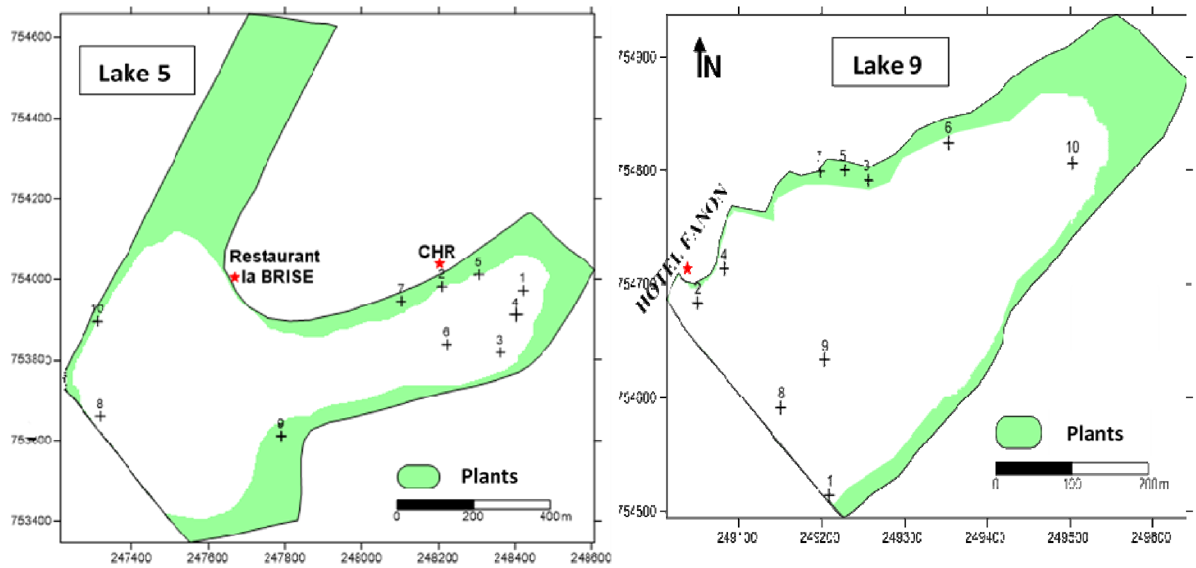

Figure 2: Sediment sampling map of the Yamoussoukro lakes

Sediment treatment

Lithological description of surface sediments

This operation involved creating a visual and tactile description of the sediment. It specifies, for each sample, the lithological nature, color, and presence or absence of plant and animal debris. For this description, the standard coloring scale published by "the Geological Society of America" (McManus, 1988) was used.

Granulometric analysis

In the laboratory, the samples were washed with fresh water 4 to 5 times. These samples were then treated with hydrogen peroxide, followed by hydrochloric acid to eliminate organic matter and carbonates, respectively, and dried in an oven at 60°C. The sediments were then sieved using a vibrating column shaker. A 100-gram sample, as recommended by Saaidi (1991), is placed on top of 16 AFNOR sieves superimposed in order of decreasing mesh sizes.

Determination of granulometric parameters

The granulometric parameters were calculated according to Folk and Ward (1957) *in* Gboko (2023).

Determination of average particle size

The average particle size is calculated using the following formula:

$$\boldsymbol{M_Z} = \frac{Q_{16} + Q_{50} + Q_{84}}{3} \quad (1)$$

Q represents the diameter of the particles; for example, Q16 is the diameter of particles corresponding to a weight percentage of 16%. The average expresses the size of the sandy sediments and can be used to characterize the following facies:

- coarse sand : M Z> 500 µm ;
- medium sand : 500 µm > M Z> 250 µm ;
- fine sand : 250 µm > M Z> 125 µm ;
- very fine sand: 125 µm > M Z> 63 µm ;
- silts and clays: M Z< 63 µm.

Calculation of standard deviation or ranking (Q in Φ units)

The standard deviation is calculated as follows:

$$\boldsymbol{\sigma} = \frac{Q_{84} - Q_{16}}{4} + \frac{Q_{95} - Q_{5}}{6.6} \quad (2)$$

The standard deviation measures the dispersion of sizes relative to the mean of a Gaussian curve of the sample and allows us to distinguish between:

- very well graded sands: σ< 0.35;
- well graded sands: 0.35 < σ < 0.50;
- fairly well graded sands: 0.50 <σ< 0.80;
- poorly graded sands: σ > 0.80.

Skewness evaluation

Skewness indicates whether fine particles (positive values) or coarse particles (negative values) predominate in relation to the sample average. It is determined using the following formula:

$$\boldsymbol{SK} = \frac{Q_{16} - Q_{84} + 2Q_{50}}{2(Q_{84} - Q_{16})} + \frac{Q_{5} - Q_{95} + 2Q_{50}}{2(Q_{95} - Q_{5})} \quad (3)$$

With Q= -Log2.d (mm), skewness reflects the degree of asymmetry in the distribution curve relative to the median. We have:

- +1.00 > SK > + 0.30; SK very positive: strong asymmetry towards fine elements;
- + 0.30 > SK > + 0.10; SK positive: asymmetry towards fine elements;
- + 0.10 > SK > - 0.10; particle size symmetry of the sample;
- - 0.10 > SK > - 0.30; SK negative: asymmetry towards coarse elements;
- - 0.30 >SK > - 1.00; SK very negative: strong asymmetry towards coarse elements.

Median (Md)*, with Md = Q 50* (4)

Grain-size facies analysis

Grain-size facies were classified based on the shapes of cumulative curves (Tricart, 1965) for the sandy fractions (Figure 3). Three main facies were identified. The hyperbolic/sigmoid facies (“S”) indicates limited sorting under moderate flow variations. The parabolic facies reflects an exponential increase in particle proportion with grain size, indicating abrupt cessation of transport (saltation for coarse grains, suspension for fine grains). The logarithmic facies approximates a straight line, whose slope is primarily controlled by the acceptable particle content and represents deposition from an excess sediment load following a decrease in flow competence. This classification offers key insights into sediment dynamics, depositional processes, and sediment sources, informing urban lake management and restoration efforts.

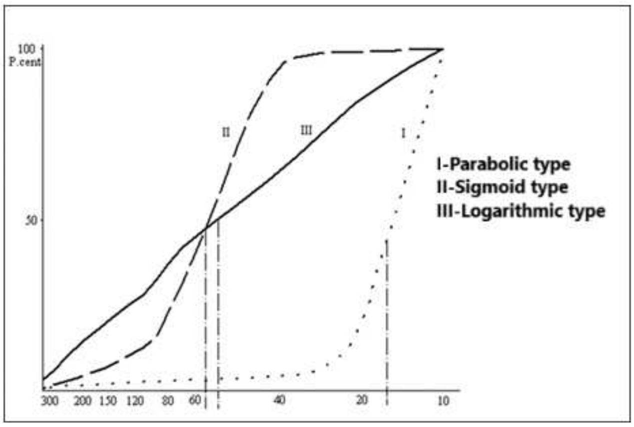

Figure 3: Fundamental Types of Grain-Size Curves (Tricart, 1965)

Paleoenvironmental reconstruction

Mode of transport

The mode of transport was determined using Visher's (1969) test. The Visher Test (1969) is a graph plotting the cumulative percentages on the Gaussian probability ordinate and the size (in phi units (Φ)) of the corresponding particle size classes on the abscissa (figure 4). The modes of transport are suspension (B), saltation (A and A'), and rolling (bedloading (C)). The proportions of the populations are determined by projecting the truncation zones onto the right of the ordinates.

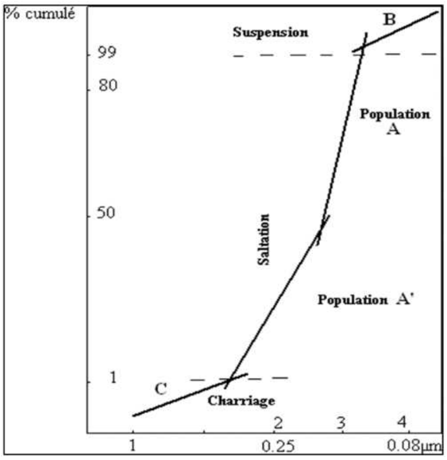

Figure 4: Test de Visher (1969) montrant la relation Granulométrie-Mode de transport

Correlation between different grain-size parameters

Correlation strength is classified based on the slope of the regression line and the coefficient of determination (R^2) (Konan, 2018):

- Perfect ($R^2 = 1.00$): data points are fully aligned, indicating no dispersion;
- Strong/Good ($0.5625 < R^2 < 1.00$): low dispersion;
- Moderate ($0.3600 < R^2 < 0.5625$): moderate dispersion;
- Weak/Poor ($0.1600 < R^2 < 0.3600$): relatively high dispersion;
- Negligible ($0.00 < R^2 < 0.1600$): very high dispersion;
- None ($R^2 = 0.00$): no correlation.

This classification provides a clear and quantitative framework for assessing relationships between grain-size parameters and sediment dynamics, facilitating reproducible interpretation in sedimentological studies.

Deposit environments

The discrimination of the sedimentary depositional environment was performed using the sorting-skewness diagram (Friedman, 1967) (Figure 5). In this diagram, a sediment can be classified as originating from a fluvial or beach/dune depositional environment. Each sediment sample is positioned on the diagram according to its sorting and skewness values.

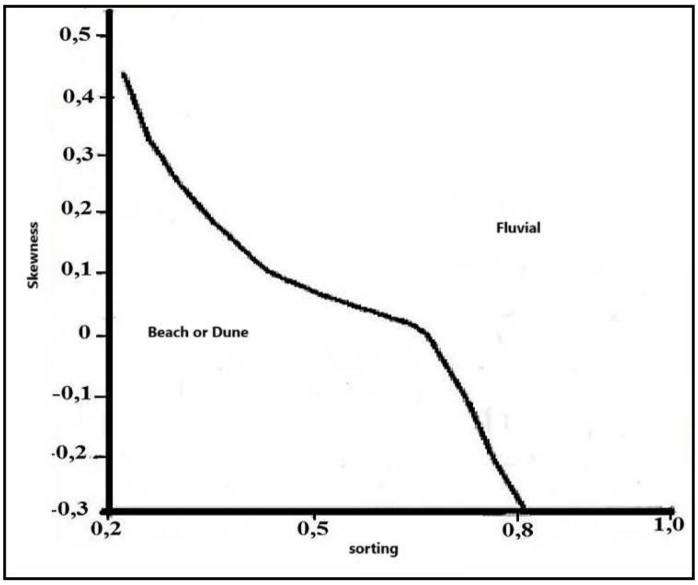

Figure 5: sorting-skewness diagram Friedman (1967)

Mineralogical analysis of sediments

After sieving, the sediment fractions of each sample, ranging from 125 to 63 µm, were pooled for mineralogical analysis. This fraction was used because it contained the maximum weight of the minerals in the sample. The samples were examined directly under a binocular microscope, and their mineralogical composition was established using test samples available in the laboratory.

Morphoscopic analysis of quartz grains

Grain morphoscopy was carried out to determine the shape and surface texture of the sand particles. For each sample, approximately 300 grains were examined using a LEICA binocular stereomicroscope coupled with computer-assisted image acquisition and analysis software, at a magnification of ×50. Observations focused on morphological characteristics (angular, sub-angular, sub-rounded, rounded) and surface texture (polished, matte, glossy, corroded), following Saaidi's (1991) classification. The relative proportions of each category were calculated and expressed as percentages. These observations enabled assessment of the mechanical maturity of the sediments and interpretation of the transport and depositional conditions.

RESULTS

Lithology and sediment types

Macroscopic analysis of the surface sediments of Lakes 5 and 9 reveals three major lithological facies characterized by the presence of organic matter. These are sands and muds (Table II). The presence of "mixed" sediments is also noted.

- the vases are Moderate Reddish Orange (10R6/6) in color and not very plastic;
- The sands range from very fine to very coarse. They vary in color from Moderate Brown (5YR4/4) to Moderate Reddish Orange (10R6/6). There is some plant debris, shells, and urban materials.
- Sediments"mixed" consists of muddy sands and sandy muds with a color varying from Moderate Reddish Brown (10Y4/6) to Moderate Reddish Orange (10R6/6).

Table 2: Description of the sediments of lakes 5 and 9 of Yamoussoukro

Lakes	*Real*	*X (long)*	*Y (years)*	*Sedimentological Descriptions*
	A1	248419,9	753971,6	coarse sand, 10R6/6*
	A2	248208,4	753981,2	coarse sand, 10R6/6
	A3	248362,2	753817,8	medium sand, 10R6/6
	A4	248402	753912	coarse sand, 5YR4/4
Lake 5	**A5**	248305	754011	medium sand, 10R6/6
	A6	248221	753838	medium sand, 5YR4/4
	A7	248102	753945	coarse sand, 5YR4/4
	A8	247319	753659,1	vase

	A9	247790,1	753611,1	vase
	A10	247311,8	753894,7	vase
	F1	249210	754513	coarse sand, 1 0R4/6
	F2	249051	754683	coarse sand, 10R6/6
	F3	249256	754791	muddy sand, 5YR4/4
	F4	249082	754713	medium sand, 10R6/6
Lake 9	**F5**	249227	754800	coarse sand, 5YR5/6
	F6	249354	754824	coarse sand, 10R6/6
	F7	249198	754799	muddy sand, 5YR5/6
	F8	249151	754591	dishes, 10R6/6
	F9	249204	754633	dishes, 10R6/6
	F10	249502	754807	dishes, 10R6/6

*** Sediment coloration (Rock-color chart (USA)):**10R6/6: red; 10R4/6: brown red; 5YR4/4: moderate brown; 5YR5/6: light brown

Grain-size distribution and parameters

Granulometric classes of sands

In Lake 5, the relative proportions of these granulometric classes indicate that very coarse sands and coarse sands are abundant, accounting for 26.50% and 20.03%, respectively. Medium sands (19.69%), fine sands (10.02%), and excellent sands are poorly represented. On the other hand, the granulometric class of sands in Lake 9 has a higher proportion of very coarse (31.02%), coarse (27.37%), medium (25.77%), fine (13.14%) and very fine (2.67%) sands than that of Lake 5 (Figure 6). This can be explained by the spatial arrangement of the two lakes and the direction of water flow.

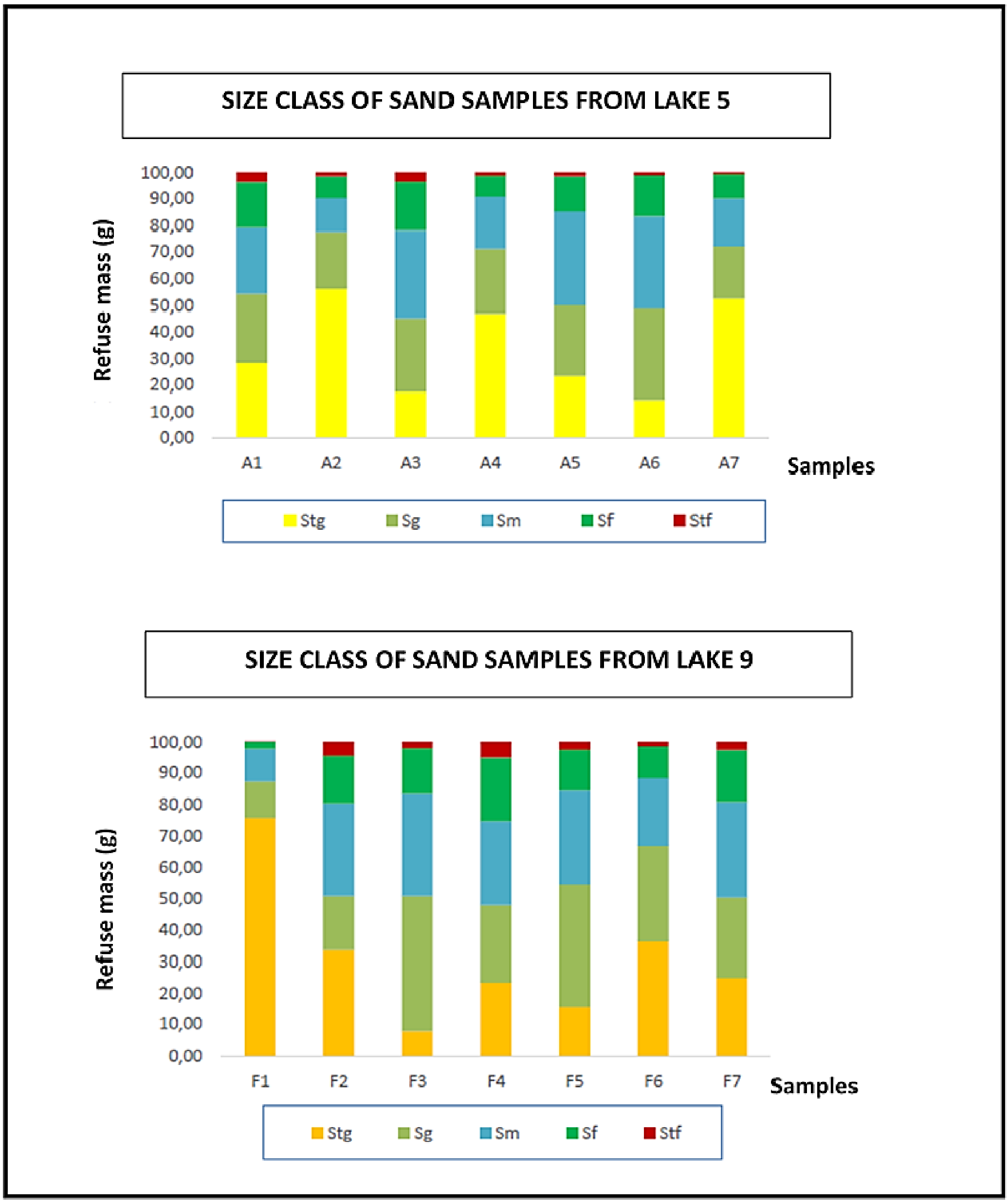

Figure 6:Granulometric classes of lake sands

Granulometric parameters of sands

The granulometric parameters calculated in the laboratory gave the following resultsTable 3:

The different averages (MWITH) calculated from the two lakes give us a single class of sand. Coarse sands with an average size greater than 500 µm.

Table 3: Granulometric parameters of sands from lakes 5 and 9

Lakes	*Samples*	*So*	**Mo**	*Sk*	*Md*	*Mz (µm)*
	A1	1.35	1.25	-0.09	0.54	969.33

	A2	1.43	3.15	0.18	-0.61	1998.33
	A3	1.13	0.63	-0.08	0.79	736.00
	A4	1.37	3.15	-0.02	-0.18	1661.33
Lake5	**A5**	1.01	0.5	-0.10	0.67	821.67
	A6	0.96	0.8	-0.01	0.69	712.00
	A7	1.48	3.15	0.13	-0.49	1949.67
	A8	-	-	-	-	-
	A9	-	-	-	-	-
	A10	-	-	-	-	-
	F1	1.16	3.15	0.64	-1.66	2783.33
	F2	1.58	0.50	-0.25	0.62	1377.67
	F3	0.88	0.63	0.14	0.65	661.00
Lake9	**F4**	1.38	0.25	-0.16	0.72	905.67
	F5	1.06	0.63	-0.06	0.59	741.00
	F6	1.34	0.63	-0.21	0.32	1305.00
	F7	1.48	0.50	-0.26	0.65	1193.67
	F8	-	-	-	-	-
	F9	-	-	-	-	-
	F10	-	-	-	-	-

- The standard deviations are all greater than 0.80, which indicates that the sands are poorly classified.

- The Skewness values obtained for the sands of Lake 5 give three trends: positive Skewness values lower than 0.30 reflecting an asymmetry towards the fine elements, Skewness values between +0.10 and -0.10 reflecting a granulometric symmetry of the sample, and negative Skewness values lower than -0.10 reflecting an asymmetry towards the coarse elements. The Skewness values for the sands of Lake 9 give a trend higher than those obtained for the sands of Lake 5. These are very positive Skewness values , higher than 0.30, reflecting a strong asymmetry towards the fine elements.

- The modes show that coarse and medium sands are the most abundant.

Depositional types

The grain-size curves of the sands from the Yamoussoukro lakes (Lakes 5 and 9) show two depositional types, corresponding to the parabolic and hyperbolic facies (Figure 7). The curves exhibit a pseudo-hyperbolic shape.

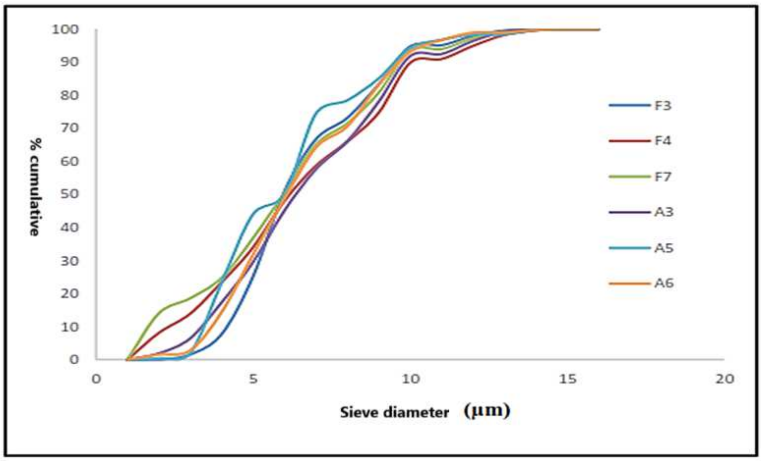

Figure 7: Pseudo-hyperbolic grain-size curves (medium sands)

The curves in Figure 8, representing sediments A1, A2, A4, A7, F1, F2, F5, and F6, exhibit a parabolic trend. These are coarse to medium sands located along the main axis of the lakes, containing a low proportion of fine particles.

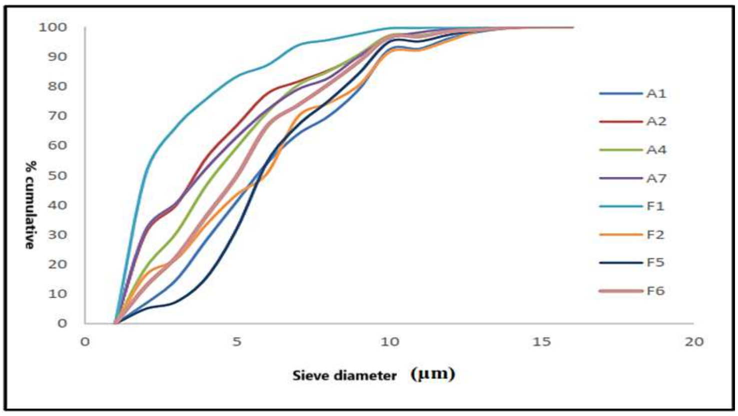

Figure 8: Parabolic grain size curves (coarse sands)

Correlation between granulometric parameters

The granulometric scatter plots depicting the interrelationships among Sk, Mz, Md, So, and Mo indicate a moderately positivecorrelation between Sk and So, with correlation coefficients ranging from 0.360 to 0.562 (Figure 9). This relationship highlights the significant control of skewness on sediment sorting: increasing negative skewness (Sk < 1) corresponds to progressively poorer sorting, whereas increasing positive skewness (Sk > 1) reflects enhanced sorting efficiency. These trends suggest that the asymmetry of the grain-size distribution plays a key role in governing sedimentary texture and depositional dynamics.

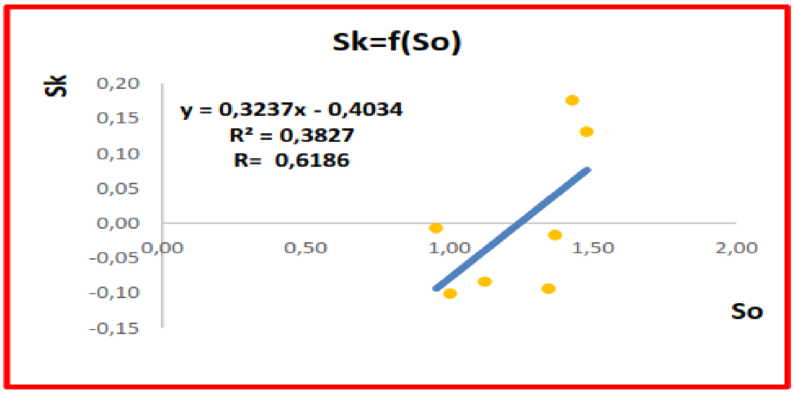

Figure 9: moderately positive correlation

A strong negative correlation (Sk–Mz), indicating considerable dispersion, is observed (Figure 10A). This relationship reflects the interdependence between the skewness (Sk) and mean grain size (Mz) parameters. Skewness significantly influences the grain-size distribution: positive skewness corresponds to low depositional energy, favoring the accumulation of fine sands, whereas negative skewness is associated with high-energy environments, leading to the deposition of coarser sands. Strong positive correlations (Mz–Md, Mo–So, and Mo–Sk) with correlation coefficients ranging from 0.562 to 1 are also observed, albeit with relatively high dispersion (Figure 10B). Both the mean and median grain sizes (Mz and Md) reflect the granulometric distribution of the sediment and the average kinetic energy during deposition. Hence, higher depositional energy results in the accumulation of coarser sediments, whereas lower energy promotes the deposition of finer sediments. Furthermore, sediments derived from a single source tend to exhibit better sorting characteristics.

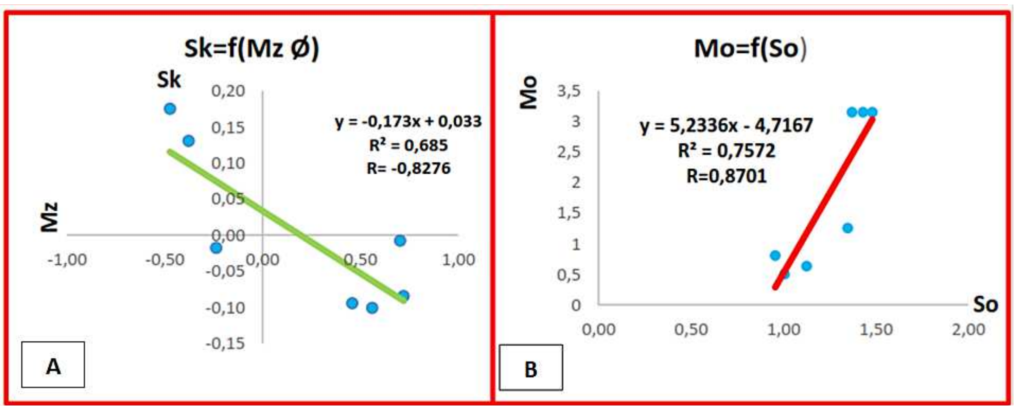

Figure 10: Strong negative correlation (Sk–Mz) and strong positive correlation (Mo–So)

Transport and depositional environment

Mode of sediment transport

Analysis of the Visher test applied to lake sediments **(**Figure 11) enables us to identify two populations, A and C, corresponding to the modes of transport, bedload and saltation. The sediments of Lakes 5 and 9 were transported mainly by saltation, with percentages of 60% and 51%, respectively. This mode of transport concerns mostly medium sands and some coarse sands. Another part of the sediments of the two lakes, notably coarse sands, is transported by bedload, with 40% in lake 5 and 49% in lake 9 (Tables4 and 5).

Table 4: Visher Statistical Analysis of the Grand Lake Sediments

A	**Population C**	**Population A**
Count	39	59
Proportion%	40	60

Table 5: Visher Statistical Analysis of the Fanon Lake Sediments

B	**Population C**	**Population A**
Count	48	50
Proportion%	49	51

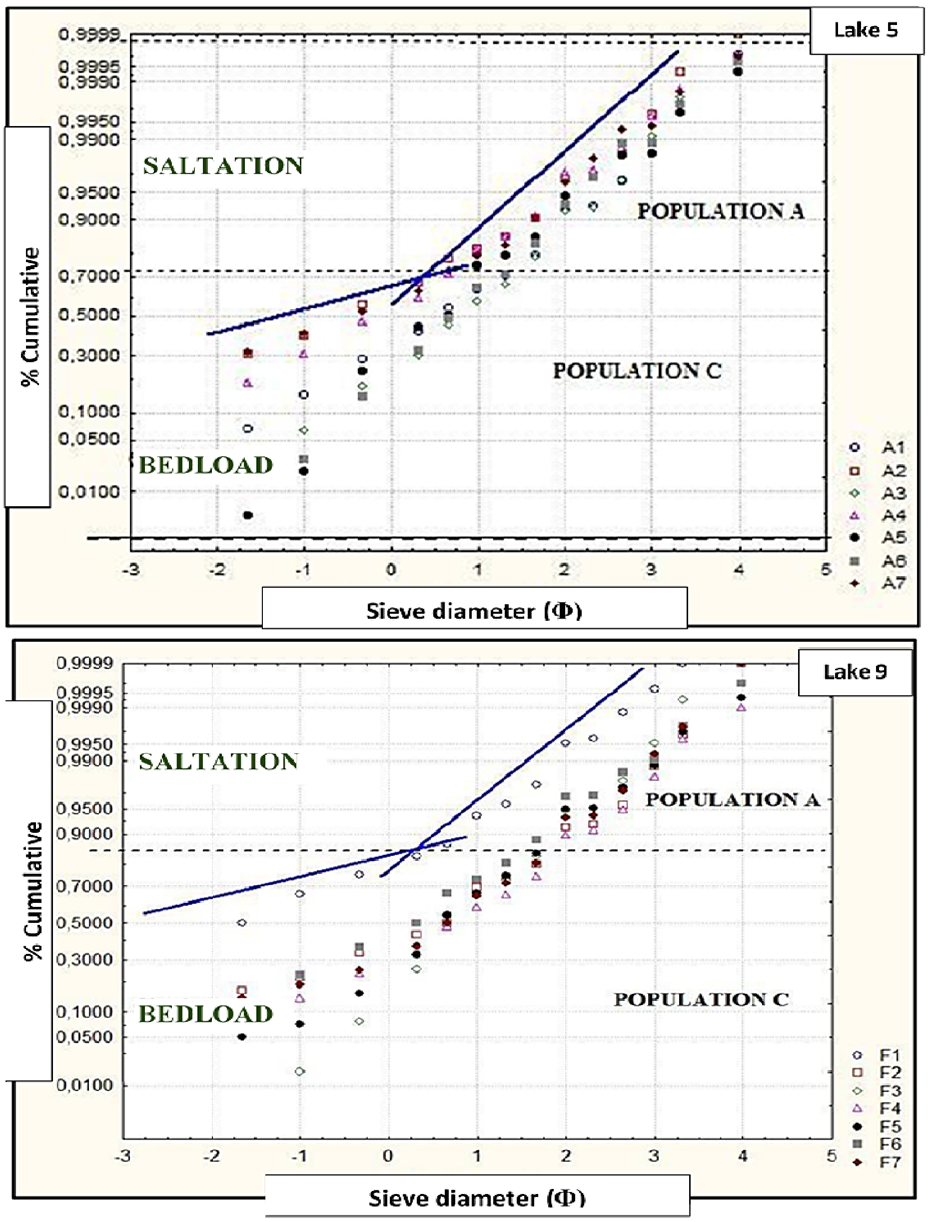

Figure 11: Visher diagram applied to sediments from lakes 5 and 9

Deposit environments

The Sk-So scatter diagram shows that 100% of the sands from the two lakes are from the fluvial domain (Figure 12). This indicates that these sands have a fluvial origin, hence continental. These sands would be the product of the erosion of the basement rocks transported by runoff water and wind in the different lakes.

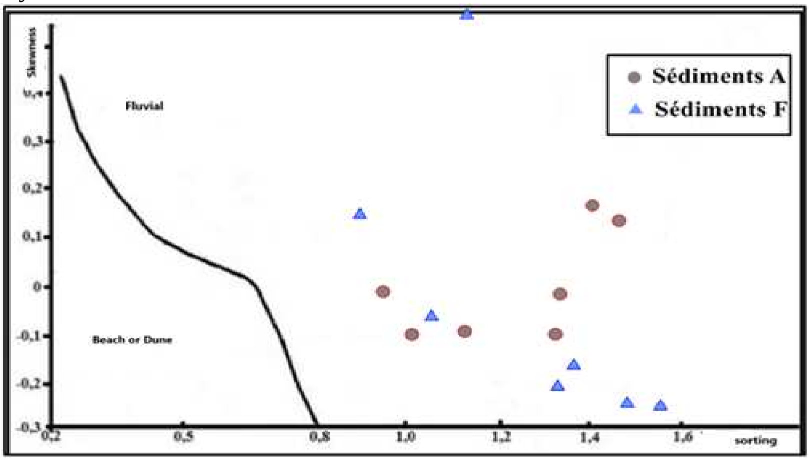

Figure 12:Friedman Sk-So diagram applied to sediments from lakes 5 and 9

Grain morphoscopy

The analysis reveals that the quartz grains predominantly have shapes ranging from sub-angular (35%) to sub-rounded (35%). Other shapes are also visible, such as angular (18%), rounded (11%), and very angular (1%).Regarding the appearance of the grains, more than 60% of the quartz grains are shiny and blunt, while 40% are round and matte.The sub-rounded, blunt, shiny quartz grains indicate that the sediments underwent long-term transport in aquatic environments (terrestrial and marine). At the same time, the matte-looking grains are characteristic of an environment where they evolved through aeolian transport (wind action). As for the sub-angular and angular shapes, they come from the immediate environment of the lake and were transported a short distance (Figure 13).

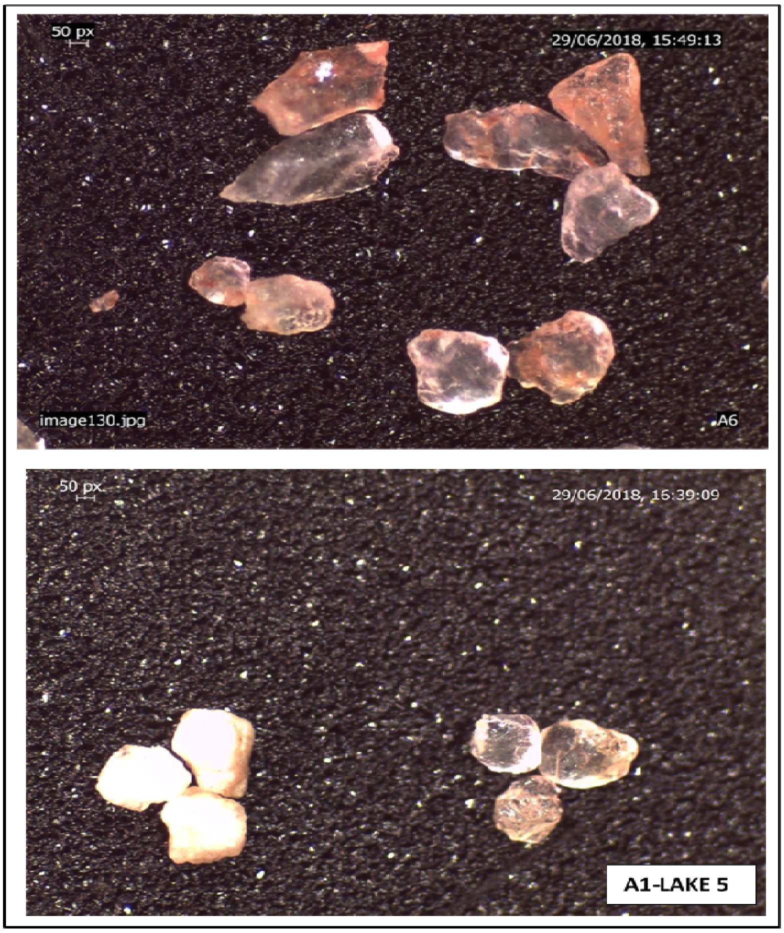

Figure 13:Shapes and appearances of quartz grains in lakes (50px)

Mineralogy

Observation of the sands with a binocular microscope revealed the presence of a heavy mineral, light minerals and unknown minerals (Figure 14). The heavy mineral is garnet (4%). The light minerals encountered consist of quartz (74%), muscovite (1%), and feldspar (20%), and accessory minerals represent 1%.

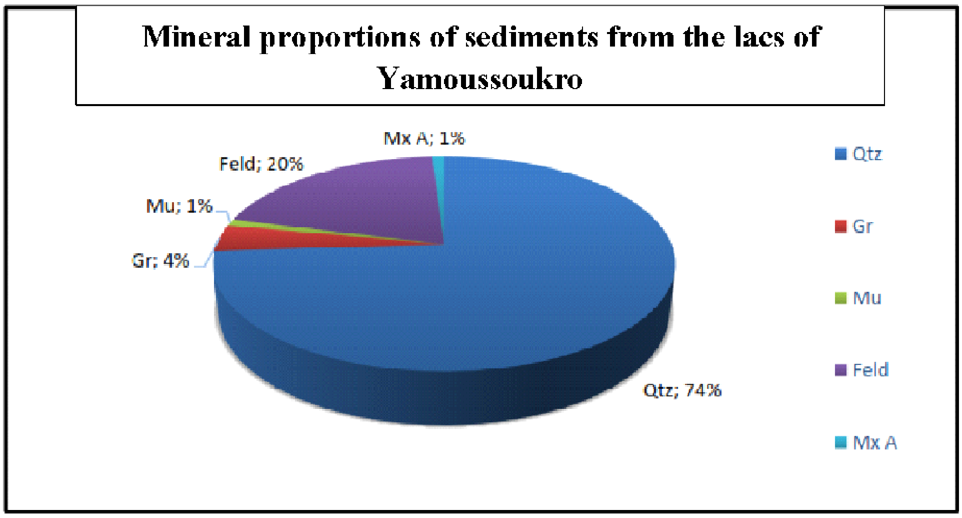

Figure 14:Mineralogical proportions of sandy sediments

DISCUSSION

The results of this study indicate that short-distance fluvial processes and anthropogenic inputs dominate the sediment dynamics of the urban lakes in Yamoussoukro. Previous studies have demonstrated that rapid urbanization increases surface runoff, soil erosion, and pollutant transport, leading to greater sediment accumulation in urban water bodies. For instance, a study conducted in the Nyando River watershed in Kenya has demonstrated that human activities, such as agriculture and urban expansion, are the primary sources of sediment in reservoirs and rivers (Humphrey et al., 2025). These findings highlight the significant impact of local land-use changes on sediment delivery to urban lakes. Mineralogical analysis revealed a dominance of quartz and feldspar, consistent with the Paleoproterozoic basement rocks of the region. Morphoscopic observations indicated a prevalence of sub-rounded to rounded grains, suggesting moderate to low-energy transport conditions. These results are consistent with observations in other tropical lakes,as in Lake Noukoué in Benin, where sediment characteristics reflect the dominant transport and depositional conditions (Yonouwinhi et al., 2025). Comparative studies on urban lakes in Bamako (Mali), Ouagadougou (Burkina Faso), and Dakar (Senegal) reveal similar trends of accelerated sedimentation associated with urbanization. For example, research on Lake Nokoué in Benin found that rapid urban growth increases runoff and sedimentation, negatively affecting water quality and biodiversity (Djihouessi et al., 2021). These comparisons suggest that urbanization-driven sedimentation is a common challenge for tropical and Sahelian urban lakes.
Enhanced sedimentation in Yamoussoukro’s urban lakes threatens water storage capacity, ecological integrity, and recreational functions. Integrated management strategies, including watershed erosion control, reduction of impervious surface runoff, and wetland restoration, are crucial for mitigating these impacts. Similar approaches have been recommended for other urban lakes in West Africa to preserve ecological health and socio-economic functions (Sintonji et al., 2022). The findings of this study emphasize the critical role of combined fluvial and anthropogenic processes in shaping sediment dynamics in urban lakes. Future research should focus on long-term sediment monitoring, modeling sediment transport pathways, and evaluating remediation strategies. These approaches will inform sustainable management practices, not only in Yamoussoukro but also in other rapidly urbanizing cities in tropical Africa.

CONCLUSION

This study provided a detailed assessment of sedimentation processes in the urban lakes of Yamoussoukro, highlighting their link with urbanization and anthropogenic activities. The results demonstrate that short-distance fluvial processes and anthropogenic inputs dominate sediment dynamics, leading to increased siltation and altering both the granulometric and mineralogical composition of the sediments.Mineralogical and morphoscopic analyses revealed a prevalence of sub-rounded to rounded grains and minerals derived from the Paleoproterozoic basement, indicating moderate to low-energy transport and local sediment sources. Compared to other urban lakes in West Africa, these findings confirm that rapid urbanization is a major driver of sedimentation in tropical lake environments.Based on these findings, it is recommended that integrated management measures be implemented, such as watershed erosion control, reduction of urban runoff, and selective dredging, to preserve lake capacity, ecological integrity, and recreational functions.Finally, the methodological approach, combining grain-size analysis, morphoscopy, and mineralogy, servesas a model for other West African cities, providing a solid foundation for monitoring, sustainable management, and environmental planning of urban lakes in rapidly expanding urban areas.

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Conflict of Interest
The authors declare no conflict of interest.

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