Spatial and Seasonal Difference in Physio-Chemical Features of Sediment Cores from Selected Creeks in Niger Delta, Nigeria

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Research Article

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Abstract

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The researcher studied the spatial and seasonal changes in pH, electric conduction and total organic carbon in sediment cores of Ubeji, Ifie, and Egbokodo Creeks in the Niger Delta, Nigeria. The researcher took a total of 222 sediment core samples during wet and dry seasons. The researcher dried, sieved, and analyzed the samples using standard calculus methods. The pH of the sediment ranged from 2.25 to 4.80 (wet season), and 2.12 to 4.42 (dry season). Which implies that the sediment cores are acidic in both wet and dry season. The Electrical conduction of the core sediment ranged between 620 and 5,620 μS/cm (wet season) and between 800 and 5900 μS/cm (dry season). Total Organic Carbon of all nine cores decreased slightly with increase of sediment core depth. This study provided data on the physio-chemical properties of sediment cores, which may be useful for control actions, surrounding quality governance, and eco forensic studies.

Introduction

In the Niger-Delta, the threat of sediment vitiation has been of serious concern to all partners concerning the rate as-well-as the extent of decadence of the environs and aquatic bodies by human actions, specially from domestic and factory-made sources. Oil search and production and its other related practice within the Niger-Delta have ballooned the people's growth rate in the region as well as the magnitude of waste yielded (Adesuyi *and other authors* 2015). This region is the wealthiest area of Nigeria in terms of abundant native resort with large deposits of crude (Braide *et al.* 2004) .

Dregs is the slack sand silt and other soil fragments that relax at the base of a body of water (USEPA, 2002). Sediment is also the major site for primal matter rot which is greatly carried out by microbes.

A sediment core is a type of sample that captures the strati-graphic layers with depth while preserving the deposit sequence with younger sediments at the top while older sediments are at the bottom (Oschwald, 1972). There are several tools, techniques and types of cores. The researcher used the technique based on the type of core collected and the nature of the environs and the research questions he asked

Sediment cores give important data on the sediment bed properties, deposit history, and biota change (such as; climate change, pollution, crowding, city planning, etc.) (Eguvbe *et al.* 2015). They provide raw data for a wide range of research such as studies of global warming, pale-aquatic, slope constancy, substance processes, oil search, pollution appraisal and control, and sea-floor report for laying cables, pipelines and siting of sea-floor structures (Rothwell and Rack, 2006).

The physio-chemical framework of the sediments such as electric conduction, dissolved oxygen, pH, and total organic carbon can control the occurrence and abundance of species dispensed in them (McLusky and Elliott, 1981). Sediment also provide a reservoir for pollutants and therefore a probable source of pollutants to the water column, organisms, and finally human consumers of those organisms (Adesuyi *and other authors* 2016). polluted sediment can cause hazardous and sub-lethal effect in saltwater and other sediment related organisms (USEPA, 2001).

The control of sediment quality is an essential part of protecting and restoring the biological probity of our Nation's water as well as preserving aquatic life, wild life, and human health. Sediment is an indispensable component of aquatic ecosystem supplying habitat, feeding, nurturing as well as rearing areas for multiple aquatic creatures.

A survey of the literature showed that finite data is available on the physio-chemical features of dregs cores in the aquatic environment of the Niger Delta. We have previously reported the combination profile and risk assessment of PAHs in sediment cores of these coastal creeks (Eguvbe *et al.* 2014).

Results from studying the physio-chemical features of the dreg cores from Ubeji, Ifie and Egbokodo streams in the region will facilitate the management of the streams and similar water bodies. It will also generate findings on recurrent circulation models, historical trends, and base line data for further studies. Such knowledge is sine qua non for ecosystem quality management and environmental forensics.

Materials And Methods

Study Area

The study areas are Egbokodo, Ifie, and Ubeji streams (Figure 1). Each of these creeks are tributaries of the Warri-River. Egbokodo, Ifie, and Ubeji streams are lying within 05^{o} 34.7' N and 005^{o} 40.9'E, 05^{o} 33.7'N and 005^{o} 41.2'E, and 05^{o} 34.3'N and 005^{o} 41.8'E respectively. The creeks receive discharges from the Warri Refinery and Petrochemical Company (WRPC), Nigeria Gas Company (NGC) and other oil serving industries located within the catchment of these creeks as well as run off from the riparian communities. These creeks have on several occasions received crude oil spillage from the pipeline that transverse the creek and barges that carry crude oil. Other activities in the study areas include fishing, periwinkle picking, boating activities and local sand dredging.

There are three sampling points on each creek, giving a total of nine sampling points as shown in Table 1.

Sediment Sampling and Analyses

The researcher collected a total of 222 sediment core samples in August 2010 (wet season) and January 2011 (dry season) from three designated stations (Egbokodo, Ifie, and Ubeji creeks). The researcher used a Global Positioning System (GPS) besides visual clues to record the exact position of each sample. The researcher obtained sediment cores using a stainless steel Corer (6 cm diameter, 1 m long). The researcher took three to five core samples at each sampling points within four m^2. The researcher collected the samples at 12-14 depths (0-5 cm, 5-10 cm, 10-15 cm, 15-20 cm…………65-70 cm). The researcher combined equivalent depths (sections) to give a composite sample of a particular site and depth to reduce variance due to heterogeneity (Birch *et al.* 2001; Iwegbue, 2011). The researcher homogenized the samples in pre-cleaned glass bottles, and transported the samples on ice to the laboratory, where he stored the samples in a freezer at -20 ^{o}C until further treatment.

The researcher defrosted the dreg specimen at ambient climate. The researcher dried the samples for five days, and also crunched the sample into powder and sieved it using a 2 mm mesh sieved to remove coarse substances, and he used it to conduct the ensuing physio-chemical analyses. The researcher determined pH and electrical potential of the specimen using a meter (model H1 8314, sheath HANNA appliance). The researcher mingled the dreg specimen in a ratio of 1:1 with pure water in a tumbler afore injecting the probes. The researcher recorded interpretations after enabling the HANNA appliance to balance. The researcher ascertained the overall natural carbon (TOC) using wet flaming procedure of Walkley and Black procedure of ASTM and APHA (Walkley and Black, 1934; APHA, 1998).

The researcher processed the statistical analysis results using Microsoft Office Excel.

Results And Discussion

Sediment Physio-chemical Characteristics

Table 2 and Figures 2-7, provide the results of some physio-chemical characteristics of sediment cores from Ubeji, Ifie and Egbokodo creeks. In the present study, the pH of the sediment ranged from 2.25 at Ifie core II to 4.80 at Ubeji core III (wet season), and 2.12 at Egbokodo core II to 4.42 at Ubeji core III and Ifie core I (dry season). pH of these sediment cores are acidic in nature in both wet and dry season. Such acidic properties is typical of the Niger Delta (Isirimah, 1987; Odu *et al.* 1985). pH values of all nine cores fluctuated with the sediment core depth (Table 2 and Figures 2-7). Jeng (2007) determined similar sediment fluctuation in short sediment cores from the Southern Okinawa Trough, which shows that the fluctuation is caused by the sediment disturbance and mixing due to human activities in the creeks, such as, fishing, canoe, boating, and other recreational activities.

Electrical potential is an evaluation used to determine mineralization of sediment. Certain physiological effects on flora and fauna are often influenced by the accessible ions in the sediment. In this study, the electrical potential of core sediment ranged between 620 at Ubeji core III and 5,620 µS/cm at Ubeji core III (wet season) and between 800 at Ubeji core II and 5900 µS/cm at Egbokodo core I (dry season). Electrical conductivity levels obtained are moderate compared to that reported for Niger Delta rivers and creeks (Courant *et al.* 1985; Iwegbue *et al.* 2006). It was higher during the dry season (Table two and Figures 8-13) due to evaporation [20]. Electrical potential values of all nine cores (Ubeji core I, II, and III; Ifie core I, II, and III; Egbokodo core I, II, and III) fluctuated with the sediment core depth (Table 2 and Figures 8-13).

Natural matter concentration is an essential parameter governing the circulation of hydrophobic contaminants in base sediments (King *and other authors* 2004). The quantity of natural material amassed is a consequence of the primary production yield, sedimentation rate and mineralization in the sediments and water column (Lubecki and Kowalewska, 2010). In the present study, total natural carbon (TOC) for the silt ranged from 1.98 % at Egbokodo core I to 5.05 % at Ubeji core I (wet season), and from 1.71 at Ifie core III to 5.1 % at Egbokodo core III (dry season). TOC of all nine cores decreased slightly with increase of sediment core depth (Table 2 and Figures 14-19).

Conclusion

The policing of silt grade is sine qua non in the restoration and protection of the existent probity of our country's waters and our marine resources. This research presents the results of the physio-chemical quality of the sediment cores of Ubeji, Ifie and Egbokodo creeks in the Niger Delta, Nigeria. pH of the sediment cores are acidic in nature in both wet and dry seasons, which is typical of the Niger Delta rivers and creeks. Electrical conductivity levels gotten are moderate compared to that in the Niger Delta. It was higher during the dry season due to evaporation. Total organic carbon for all nine cores decreased slightly with increase of sediment core depth. The researcher concluded that Ubeji, Ifie and Egbokodo creeks should be constantly monitored for trends in sediment core physio-chemical parameters.

References

Adesuyi, A. A., Njoku, K. L. and Akinola, M. O. (2015). Assessment of Heavy Metals Pollution in Soils and Vegetation around Selected Industries in Lagos State, Nigeria. *Journal of Geo-science and Environment Protection*, 3: 11-19. https://dx.doi.org/10.4236/gep.2015.37002.

Adesuyi, A. A., Ngwoke, M. O., Akinola, M. O., Njoku, K. L. and Jolaoso, A. O. (2016). Assessment of physio-chemical features of sediment from Nwaja creek, Niger Delta, Nigeria. *Journal of Geo-science and Environmental Protection*, 4: 16-27. http://dx.doi.org/10.4236/gep.2016.41002.

Birch, G., Siaka, M. and Owen, C. (2001). The sources of anthropogenic heavy metals in fluvial sediment of a rural catchment:Cox River, Australia. *Water, Air and Soil Pollution*, 126: 12-35.

Braide, S. A., Izonfuo, W. A. L., Adakwu, P. U., Chinda, A. C. and Obinwo, C. C. (2004). Water Quality of Miniweja Stream, a Swamp Forest Stream Receiving Non-Point Source Waste Discharge in Eastern Niger Delta, Nigeria. *Scientia Africana*, 3: 1-8.

Courant, R., Power, B., and Michael, J. (1985). Water type classification for Niger Delta Rivers and creeks. Proceedings of the 1985 Conference organized by Federal Ministry of Works, housing and Nigerian National Petroleum Corporation. Pp. 295-310.

Eguvbe, P. M., Iwegbue, C. M. A., Egboh, S. H. O. and Ogala, J. E. (2015). Aliphatic Hydrocarbons Distribution in Sediment Cores of Select Creeks in Delta State, Nigeria. *Environmental Forensics*, 16(3):

275-295. DOI: 10.1080/15275922.2015.1022838.

Horne, R. A. (1978). The Chemistry of our environment. A Wiley-Inter-science publication, U.S.A. Pp. 303-452.

Isirimah, N. O. (1987). An inventory of some chemical properties of selected surface spoils of Rivers State of Nigeria: In proceeding of 15th Annual Conference of soil science association of Nigeria. Kaduna. 217-233.

Iwegbue, C. M. A., Egobueze, F. E. and Opuene, K. (2006). Preliminary assessment of heavy metal levels of soil of an oil field in the Niger Delta, Nigeria. *International Journal of Environmental Science and Technology*, 3(2): 167-172.

Iwegbue, C. M. A. (2011). PAHs profiles of spent drilling fluids deposited at Emu-Uno, Delta State, Nigeria. *Bulletin of Environmental Contamination and Toxicology*, 87: 469-472.

Jeng, W. (2007). Aliphatic hydrocarbon concentrations in short sediment cores from the Southern Okinawa trough: Implications for lipid deposit in a complex environment. *Continental Shelf Research*, 27: 2066-2078.

King, A. J., Readman, J. W. and Zhou, J. L. (2004). Dynamic behavior of PAHs in Brighton Marina, UK. *Marine Pollution Bulletin*, 48(3-4): 229-239.

Lubecki, L. and Kowalewska, G. (2010). Distribution fate of PAHs in recent sediments from the Gulf of Gdansk. *Oceanologia*, 52(4): 669-703.

McLusky, D. S. and Elliott, M. (1981). The Feeding and Survival Strategies of Estuarine Mollusks. In: Jones, N.V. and Wolff, W.J., Eds., *Feeding and Survival Strategies of Estuarine Organisms*, Plenum Press, New York, 109-122. http://dx.doi.org/10.1007/978-1-4613-3318-0_9

Odu, C. T. I., Nwoboshi, L. C., Esuruoso, O. F. and Ogunwale, J. A. (1985). Environmental study (soil and vegetation) of the Nigeria Agip Oil Company process areas. Proceeding of the international seminar on crude industry and the Nigerian environs, PortHarcourt, Nigeria. 117-123.

Oschwald, W. (1972). Sediment-Water Interactions interface. *Journal of Environmental Quality*, 1: 360-366. http://dx.doi.org/10.2134/jeq1972.00472425000100040005x.

USEPA (2001). Method for Assessing the Chronic Toxicity of Marine and Estuarine Sediment-Associated Contaminants with the Amphipod *Leptocheirus plumulosus*. US Environmental Protection Agency, Office of Water, Washington DC. http://water.epa.gov/polwaste/sediments/cs/upload/guidancemanual.pdf

United States Environmental Protection Agency (USEPA) (2002). Water Quality Monitoring for Coffee Creek (Porter County, Indiana). http://www.usepa/research.htm.modecode=62-28-00-00.

Walkley, M. and Black, G. C. (1934). Organic Carbon in Soils and Sediments. Standard Testing Methods for Oil Pollution. ASTM, Philadelphia.

APHA, (1998). Standard Methods for the Evaluation of Water and Waste Water. 20th Edition, United State Public Health Association Inc., New York, Washington DC.

Tables

Table 1: Sampling Points on Ubeji, Ifie, & Egbokodo Creeks

S/No	Name of Creeks	Sampling Points
1.	Ubeji	Ubeji core I
2.	Ubeji	Ubeji core II
3.	Ubeji	Ubeji core III
4.	Ifie	Ifie core I
5.	Ifie	Ifie core II
6.	Ifie	Ifie core III
7.	Egbokodo	Egbokodo core I
8.	Egbokodo	Egbokodo core II
9.	Egbokodo	Egbokodo core III

Table 2: Some Physio-chemical Features of Sediment Cores from Ubeji, Ifie and Egbokodo Creeks.

S/No	Date of Sampling	Sediment Layer (cm)/Station	pH in Water	Electric Conduction In µS/cm	Total Organic Carbon %
1.	August	0-5 Ubeji Core I	4.45	4400	5.05
2.		5-10	3.54	4620	4.90
3.		10-15	4.05	4220	4.90
4.		15-20	3.87	3920	4.80
5.		20-25	4.03	3540	4.80
6.		25-30	4.00	2460	4.80
7.		30-35	3.36	2120	4.62
8.		35-40	4.00	2400	3.74
9.		40-45	3.60	1580	3.39
10.		45-50	3.70	900	2.50
11.		50-55	3.15	880	2.40
12.		55-60	3.19	780	2.36
13.		60-65	3.51	1160	2.08
14.	January	0-5	3.60	3700	4.82
15.		5-10	3.94	5020	4.82
16.		10-15	3.68	5080	4.82
17.		15-20	3.17	5200	4.80
18.		20-25	3.18	5020	4.59
19.		25-30	3.50	3700	3.84
20.		30-35	3.08	2600	3.75
21.		35-40	3.05	4480	3.71
22.		40-45	3.06	4000	3.43
23.		45-50	3.35	3940	3.20
24.		50-55	3.16	1400	3.17
25.		55-60	3.22	1720	2.46
26.	August	0-5 Ubeji Core II	3.60	4060	4.87
27.		5-10	3.70	4660	4.69
28.		10-15	3.70	4260	4.66
29.		15-20	3.48	2660	4.66
30.		20-25	3.46	2300	4.66

S/No	Date of Sampling	Sediment Layer (cm)/Station	pH in Water	Electric Conduction(µS/cm)	Total Organic Carbon %
31.		25-30	3.06	2960	4.62
32.		30-35	4.02	2200	4.48

33.		35-40	3.89	2140	4.45
34.		40-45	3.07	3320	4.09
35.		45-50	3.42	3900	4.06
36.		50-55	3.03	3060	3.81
37.		55-60	3.32	3260	3.78
38.	January	0-5 Ubeji Core II	3.52	4400	4.96
39.		5-10	3.27	4600	4.96
40.		10-15	3.39	4980	4.87
41.		15-20	3.67	4080	4.61
42.		20-25	3.43	3320	4.58
43.		25-30	3.16	2740	4.23
44.		30-35	3.02	2740	4.19
45.		35-40	2.49	2760	4.13
46.		40-45	2.21	1760	3.49
47.		45-50	2.87	1900	3.27
48.		50-55	2.94	800	2.59
49.		55-60	2.84	1480	2.40
50.	August	0-5 Ubeji Core III	4.80	4500	4.94
51.		5-10	4.51	5620	4.87
52.		10-15	4.47	4580	4.87
53.		15-20	4.26	3480	4.73
54.		20-25	3.05	2620	4.73
55.		25-30	3.40	4920	4.38
56.		30-35	3.77	1140	3.58
57.		35-40	3.15	860	3.58
58.		40-45	3.48	1160	3.22
59.		45-50	3.24	620	3.16
60.		50-55	3.23	1180	3.03
61.		55-60	3.66	680	2.93
62.		60-65	3.97	1060	2.80
63.	January	0-5 Ubeji Core III	4.42	5000	4.93
64.		5-10	4.25	5520	4.74
65.		10-15	3.83	5020	4.74
66.		15-20	3.76	5500	4.61
67.		20-25	3.53	4720	4.61

68.		25-30	3.63	4380	4.39
69.		30-35	3.11	4720	4.10
70.		35-40	2.74	4620	4.10
71.		40-45	2.89	3400	3.91
72.		45-50	2.80	4860	3.75
73.		50-55	3.03	4640	3.75
74.		55-60	3.00	4580	3.46
75.	August	0-5 Ifie Core I	3.80	3740	4.77
76		5-10	3.70	3620	4.93
77.		10-15	3.53	2320	3.80
78.		15-20	3.12	2740	4.96

S/No	Date of Sampling	Sediment Layer (cm)/Station	pH in Water	Electric Conduction In µS/cm	Total Organic Carbon %

79.		20-25	3.29	2720	4.35
81.		30-35	3.08	3980	4.54
82.		35-40	3.43	2460	4.67
83.		40-45	3.93	4180	4.90
84.		45-50	2.99	4680	3.96
85.		50-55	3.16	4860	4.83
86.		55-60	3.03	3460	4.12
87.		60-65	3.36	3760	3.51
88.		65-70	3.00	2820	4.77
89.	January	0-5 Ifie Core I	4.42	4660	4.99
90.		5-10	4.05	5500	4.96
91.		10-15	4.26	5260	4.83
92.		15-20	3.15	5340	4.77
93.		20-25	3.53	5500	4.74
94.		25-30	2.88	4700	4.74
95.		30-35	3.23	4640	3.97
96.		35-40	3.13	5200	3.84
97.		40-45	2.86	4040	3.59
98.		45-50	3.17	4780	3.46
99.		50-55	3.17	4340	3.30
100.		55-60	3.33	4100	3.27
101.		60-65	3.00	4900	2.85
102.		65-70	3.00	4500	1.76
103.	August	0-5 Ifie Core II	4.13	3800	4.61
104.		5-10	3.49	3160	3.83
105.		10-15	3.26	2720	4.35
106.		15-20	3.28	2560	4.25
107.		20-25	2.61	3740	4.16
108.		25-30	2.58	3740	4.83
109.		30-35	3.04	3680	4.83
110.		35-40	3.17	4100	4.38
111.		40-45	3.00	4360	4.86
112.		45-50	3.07	3440	4.90
113.		50-55	3.05	3940	4.80
114.		55-60	3.14	3340	4.64

S/No	Date of Sampling	Sediment Layer (cm)/Station	pH in Water	Electric Conduction In µS/cm	Total Organic Carbon %
115.		60-65	2.86	3200	4.74
116.		65-70	2.25	3800	4.74
117.	January	0-5 Ifie Core II	3.64	4380	4.96
118.		5-10	3.80	5200	4.96
119.		10-15	3.71	5440	4.83
120.		15-20	3.59	5220	4.61
121.		20-25	3.07	5640	4.07
122.		25-30	3.00	4940	3.65
123.		30-35	3.02	5420	3.62
124.		35-40	3.22	4720	3.46
125.		40-45	3.25	4160	3.39
126.		45-50	2.94	4900	3.30
127.		50-55	3.27	5020	3.27
128.		55-60	2.92	4620	3.27
129.		60-65	2.68	4360	3.14
130.		65-70	2.60	3000	2.79
131.	August	0-5 Ifie Core III	3.53	3620	4.35
132.		5-10	3.47	4000	4.86
133.		10-15	3.24	5040	4.51
134.		15-20	3.14	5000	4.12
135.		20-25	3.22	4860	4.06
136.		25-30	3.12	3940	2.12
137.		30-35	3.33	3980	4.41
138.		35-40	3.24	4040	4.55
139.		40-45	3.16	3460	4.73
140.		45-50	2.91	3420	4.55
141.		50-55	3.19	3680	2.72
142.		55-60	3.32	3400	3.14
143.	January	0-5 Ifie Core III	3.18	4300	4.71
144.		5-10	3.26	4180	4.67
145.		10-15	3.09	5620	4.58
146.		15-20	3.10	4460	4.29
147.		20-25	3.01	4100	3.95

148.		25-30	3.05	4260	3.87
149.		30-35	2.72	4540	3.62
150.		35-40	2.62	4480	3.59
151.		40-45	3.02	5640	2.86
152.		45-50	2.91	3420	4.55
153.	August	0-5 Egbokodo Core I	3.72	2560	4.83
154.		5-10	3.93	3940	4.73
155.		10-15	3.63	3720	4.59
156.		15-20	3.45	3800	4.55
157.		20-25	3.07	4020	4.52
158.		25-30	3.20	3600	4.27
159.		30-35	3.34	4280	4.25
160.		35-40	3.06	3880	4.16
161.		40-45	3.16	3380	4.13
162.		45-50	3.36	3360	4.02
163.		50-55	2.96	4100	3.53
164.		55-60	2.42	3800	3.49
165.		60-65	2.96	3720	2.19
166.		65-70	3.01	3780	1.98
167.	January	0-5 Egbokodo Core I	3.55	4740	5.05
168.		5-10	3.40	5080	5.02
169.		10-15	3.26	5760	5.00
170.		15-20	3.20	5160	5.00
171.		20-25	3.22	5900	5.00
S/No	**Date of Sampling**	**Sediment Layer (cm)/Station**	**pH in Water**	**Electric Conduction In µS/cm**	**Total Organic Carbon %**
172.		25-30	3.25	4780	4.88
173.		30-35	3.36	5000	4.77
174.		35-40	3.34	5080	4.68
175.		40-45	3.23	4860	4.65
176.		45-50	3.28	4120	4.65
177.		50-55	3.38	4840	4.54
178.		55-60	3.24	3740	4.49
179.		60-65	3.00	3500	4.49
180.	August	0-5 Egbokodo Core II	3.67	4760	4.98

181.		5-10	3.40	4480	4.98
182.		10-15	3.40	4860	4.93
183.		15-20	3.35	4540	4.90
184.		20-25	3.07	3840	4.87
185.		25-30	3.41	3500	4.80
186.		30-35	3.39	3900	4.77
187.		35-40	3.04	4680	4.67
188.		40-45	2.82	4140	4.64
189.		45-50	3.10	4380	4.59
190.		50-55	3.19	3500	4.53
191.		55-60	3.00	3360	4.51
192.		60-65	2.90	3260	4.17
193.	January	0-5 Egbokodo Core II	3.08	5360	5.02
194.		5-10	3.47	5040	4.99
195.		10-15	3.26	5220	4.88
196.		15-20	3.29	5200	4.85
197.		20-25	3.37	4860	4.37
198.		25-30	2.39	4760	4.35
199.		30-35	2.21	4680	4.26
200.		35-40	2.41	4940	4.15
201.		40-45	2.12	4280	2.66
202.	August	0-5 Egbokodo Core III	3.73	4340	4.93
203.		5-10	3.44	5220	4.87
204.		10-15	3.63	4380	4.82
205.		15-20	3.56	4360	4.82
206.		20-25	3.60	4080	4.80
207.		25-30	3.30	3680	4.80
208.		30-35	3.00	3560	4.77
209.		35-40	3.00	4100	4.72
210.		40-45	3.00	3580	4.51
211.		45-50	3.30	3400	3.02
212.	January	0-5 Egbokodo Core III	3.38	5040	5.10
213.		5-10	3.52	5000	5.07
214.		10-15	3.20	5500	5.05
215.		15-20	3.36	4920	5.05
216.		20-25	3.28	4960	5.02

S/No	Date of Sampling	Sediment Layer (cm)/Station	pH in Water	Electric Conduction In µS/cm	Total Organic Carbon %
217.		25-30	3.31	4960	5.02
218.		30-35	3.29	4020	4.85
219.		35-40	3.10	4320	4.70
220.		40-45	3.00	4440	4.67
221.		45-50	3.00	4980	4.40
222.		50-55	2.32	5800	4.03

Declarations

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Conflict of Interest/Competing Interests

The authors have no conflicts of interest to declare that are relevant to the content of this article.

The authors have no relevant financial or non-financial interests to disclose.

Figures

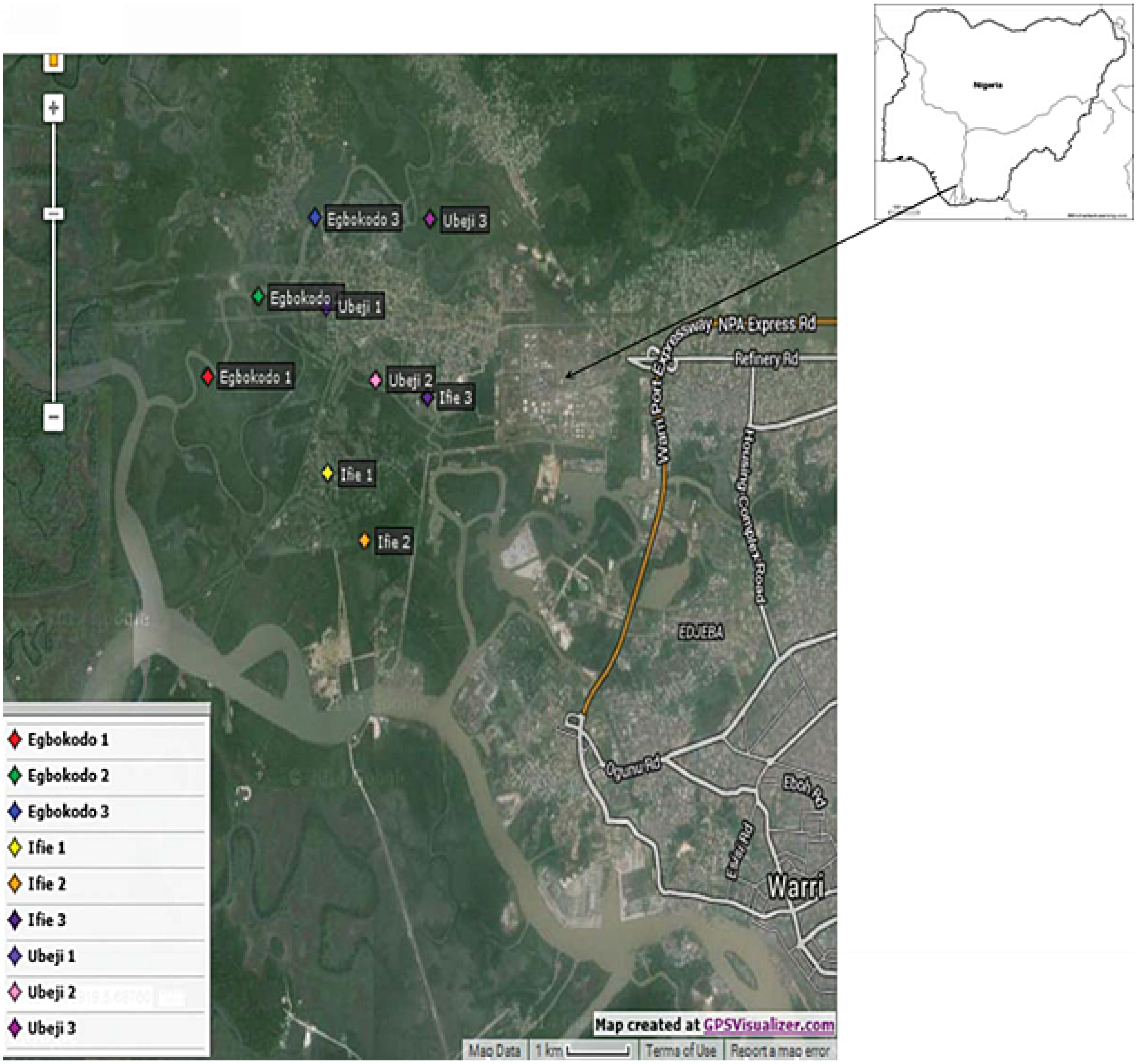

Figure 1

Map of Ubeji, Ifie, and Egbokodo creeks.

Source: Eguvbe *et al.* 2015.

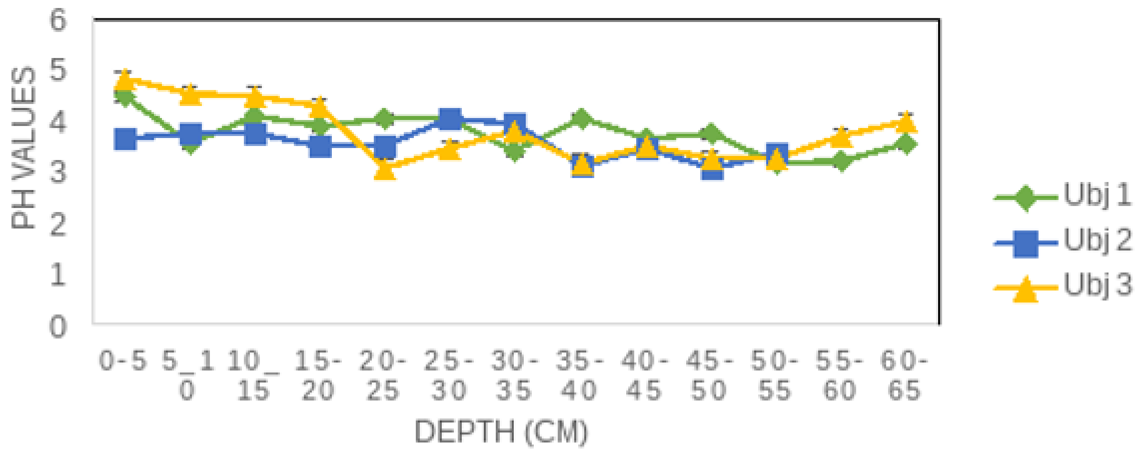

Figure 2

Difference of pH with depth of sediment cores at Ubeji Creek (Wet season)

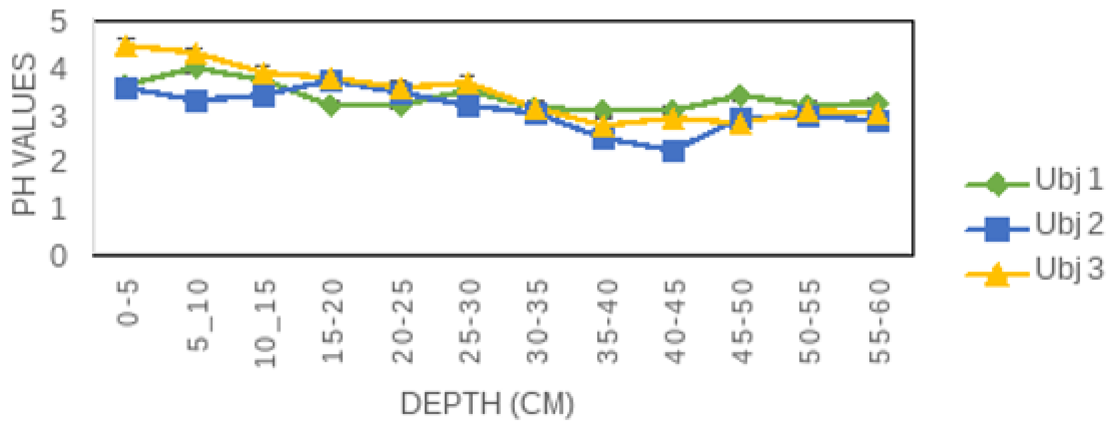

Figure 3

Difference of pH with depth of sediment cores at Ubeji Creek (Dry season)

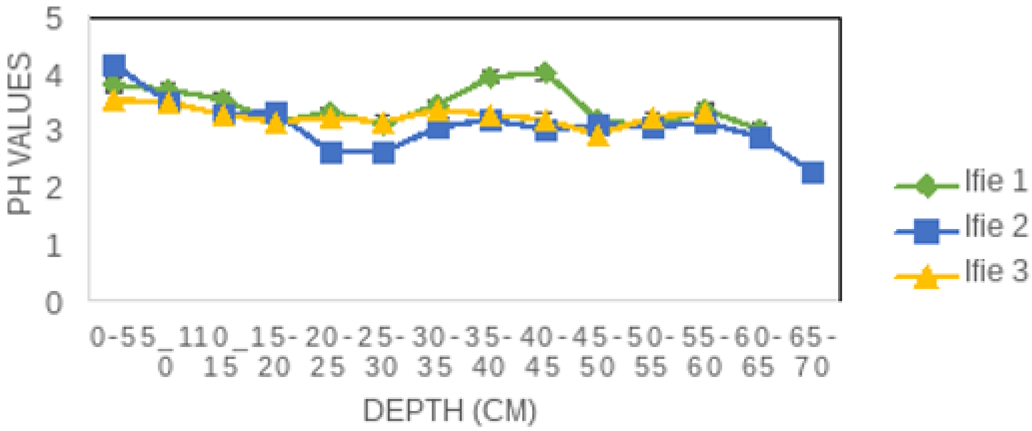

Figure 4

Difference of pH with depth of sediment cores at Ifie Creek (Wet season)

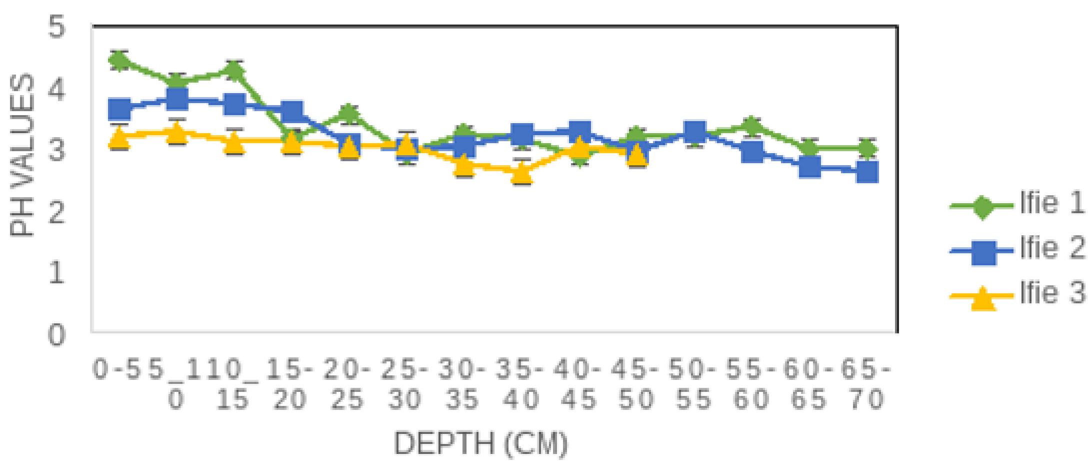

Figure 5

Difference of pH values with depth of sediment core at Ifie Creek (Dry season)

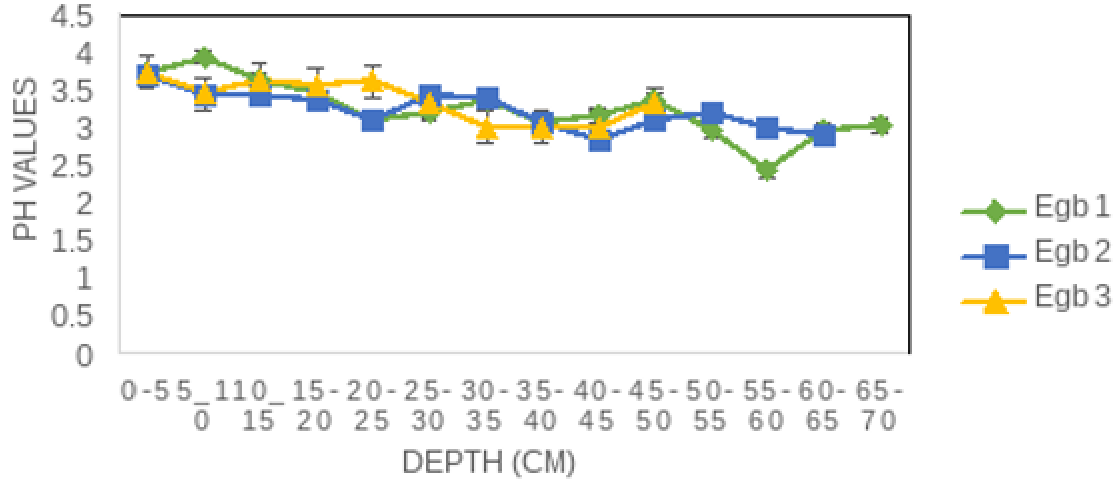

Figure 6

Difference of pH with sediment core depth at Egbokodo Creek (Wet season)

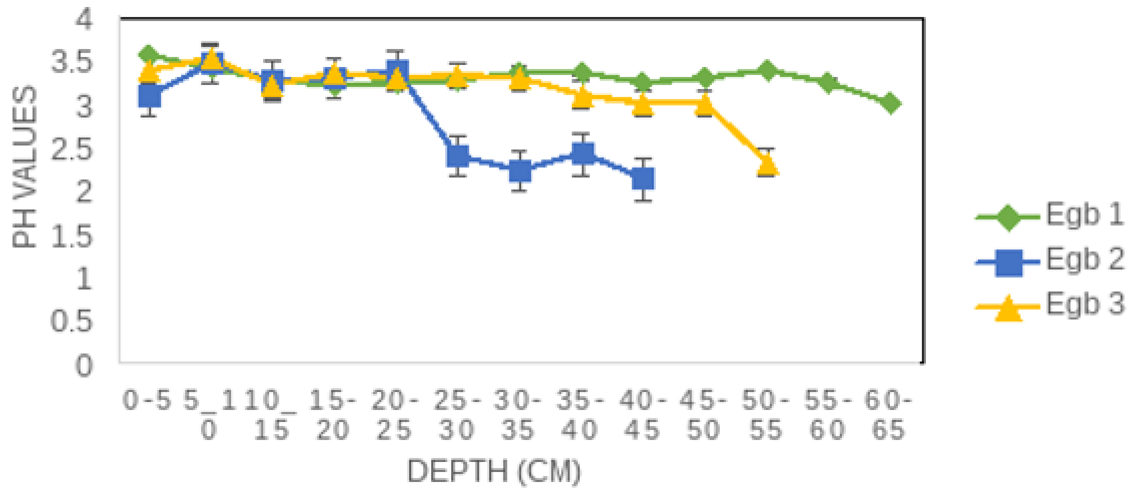

Figure 7

Difference of pH with sediment core depth at Egbokodo creek (Dry season)

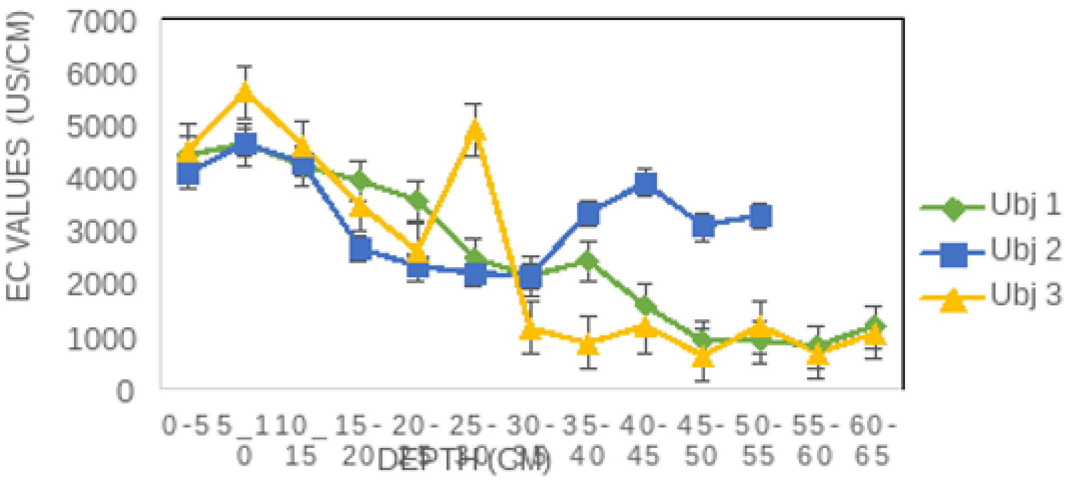

Figure 8

Difference of EC with depth of sediment core at Ubeji Creek (wet season)

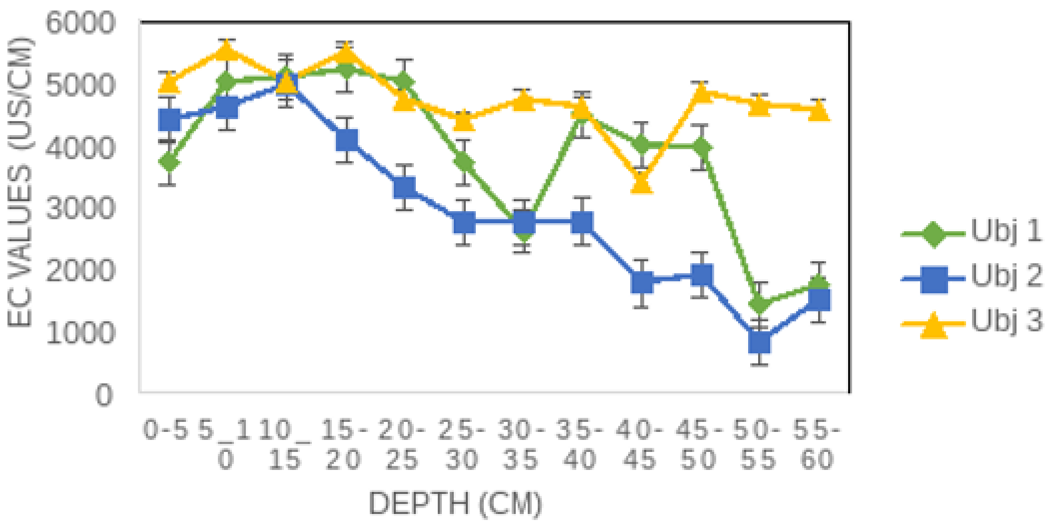

Figure 9

Difference of EC with depth of sediment core at Ubeji Creek (dry season)

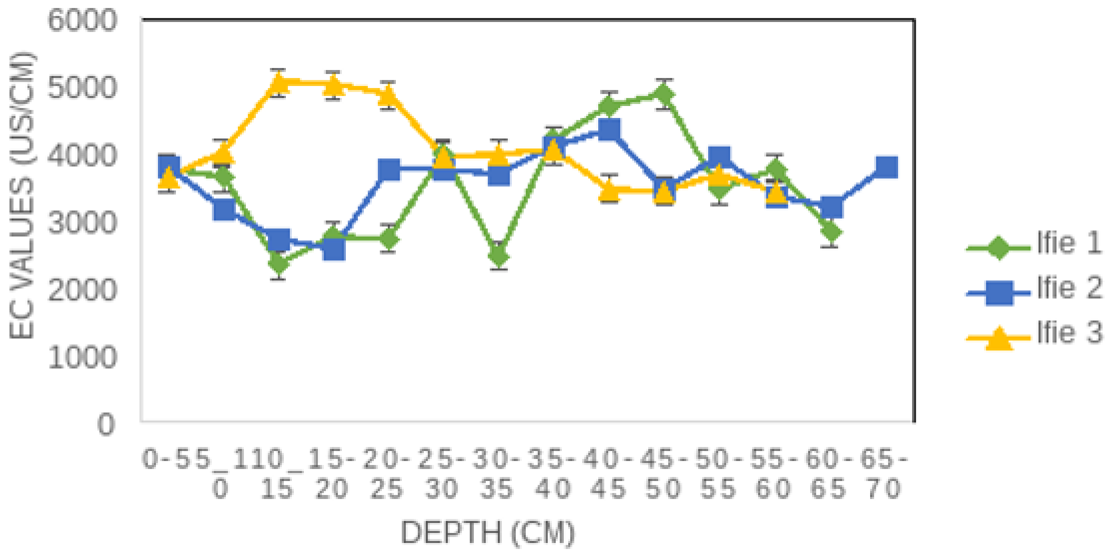

Figure 10

Difference of EC with depth of sediment core at Ifie Creek (wet season)

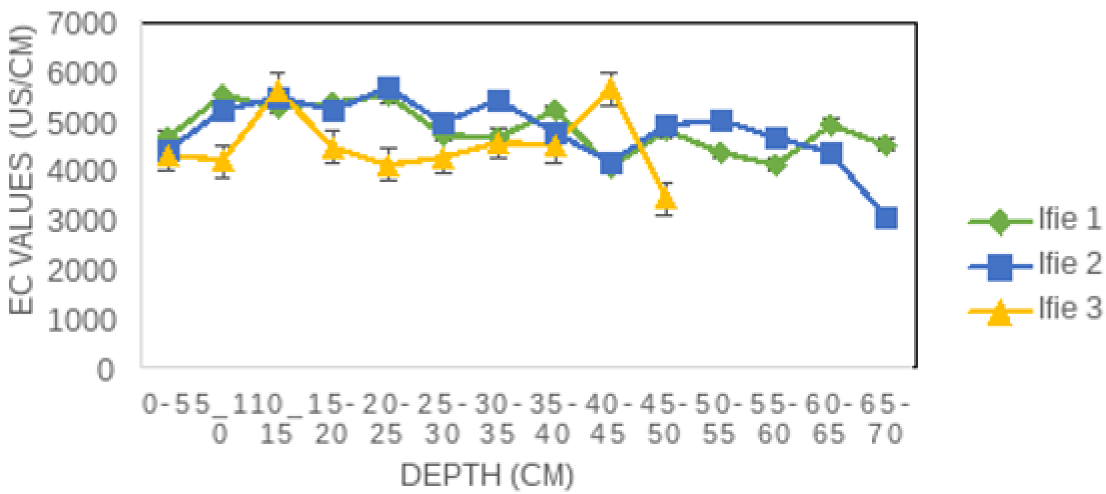

Figure 11

Difference of EC with depth of sediment core at Ifie Creek (dry season)

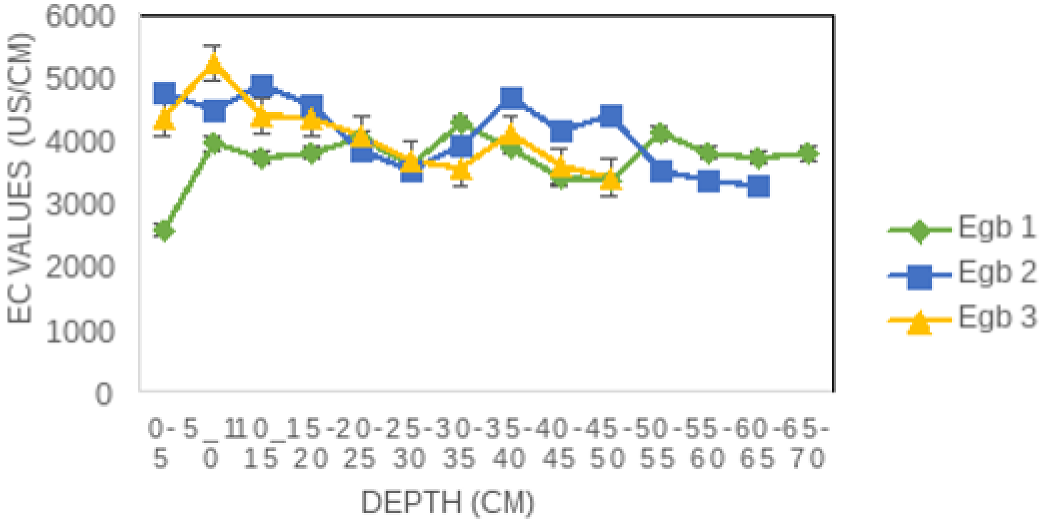

Figure 12

Difference of EC with depth of sediment core at Egbokodo Creek (wet season)

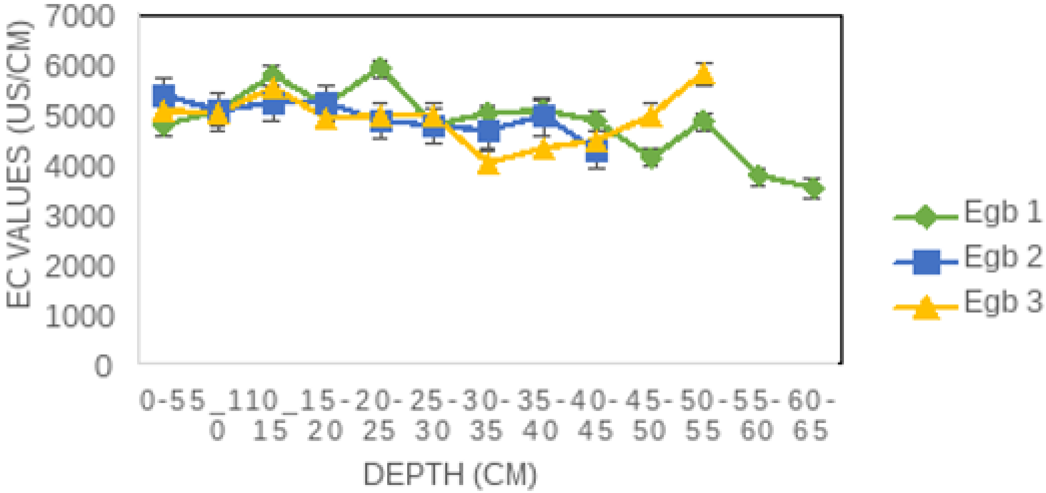

Figure 13

Difference of EC with depth of sediment core at Egbokodo Creek (dry season)

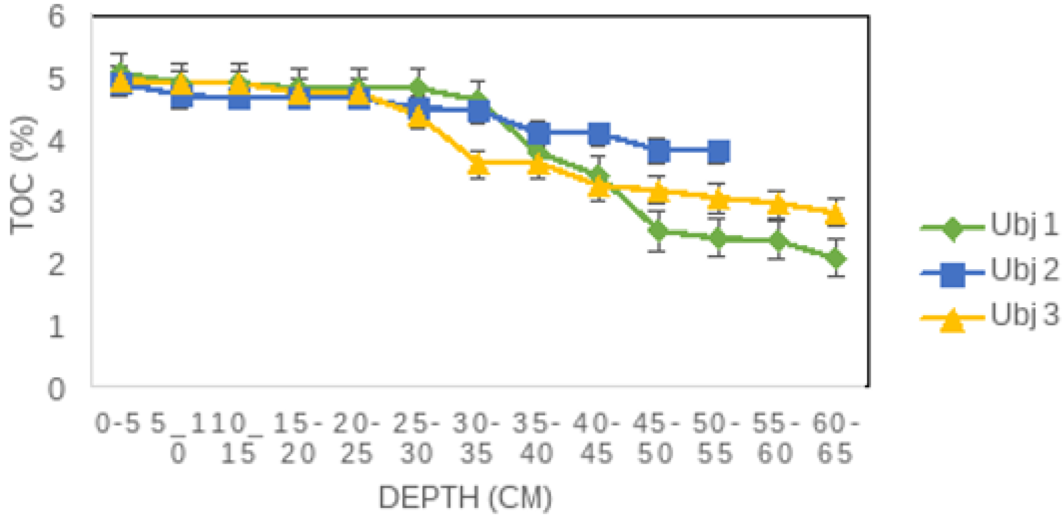

Figure 14

Difference of TOC versus depth of sediment core at Ubeji Creek (wet season)

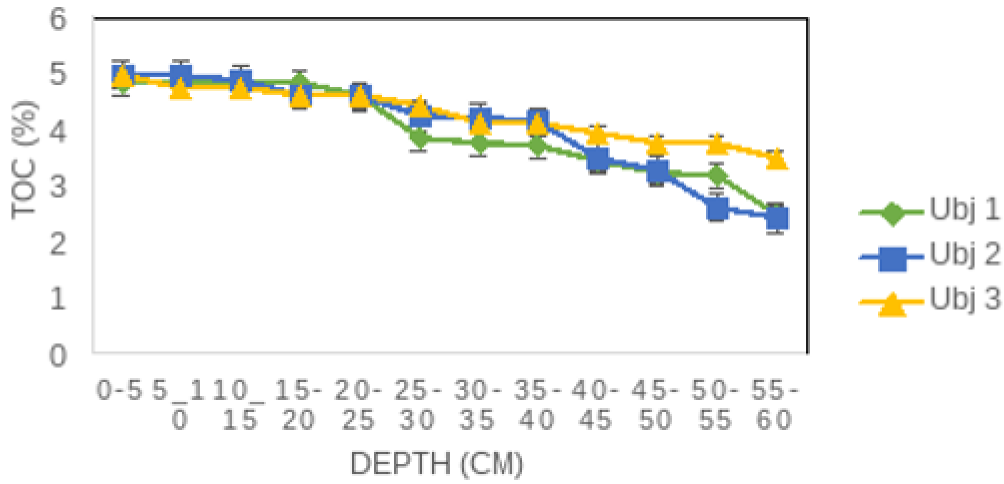

Figure 15

Difference of TOC with depth of sediment core at Ubeji Creek (dry season)

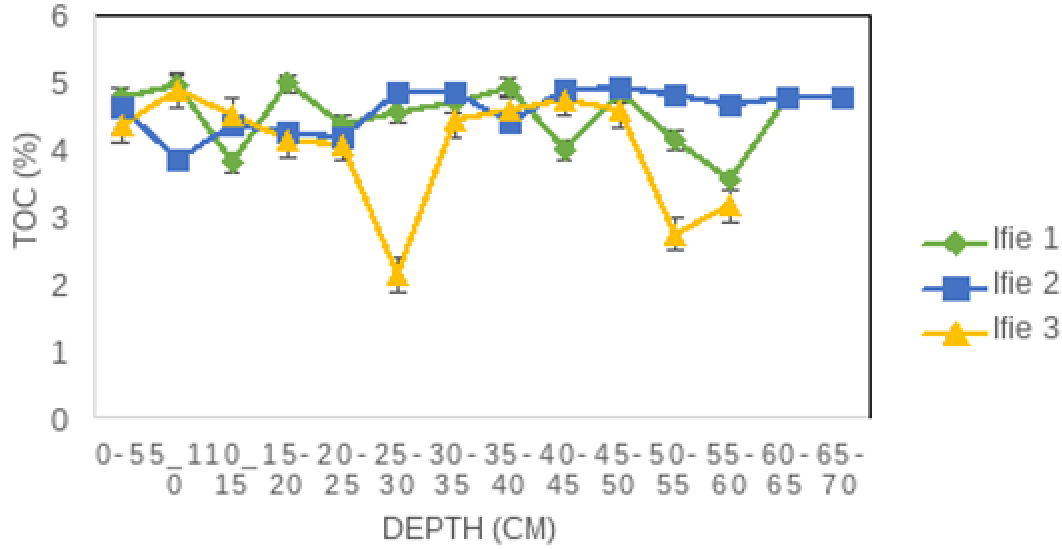

Figure 16

Difference of TOC with depth of sediment core at Ifie Creek (wet season)

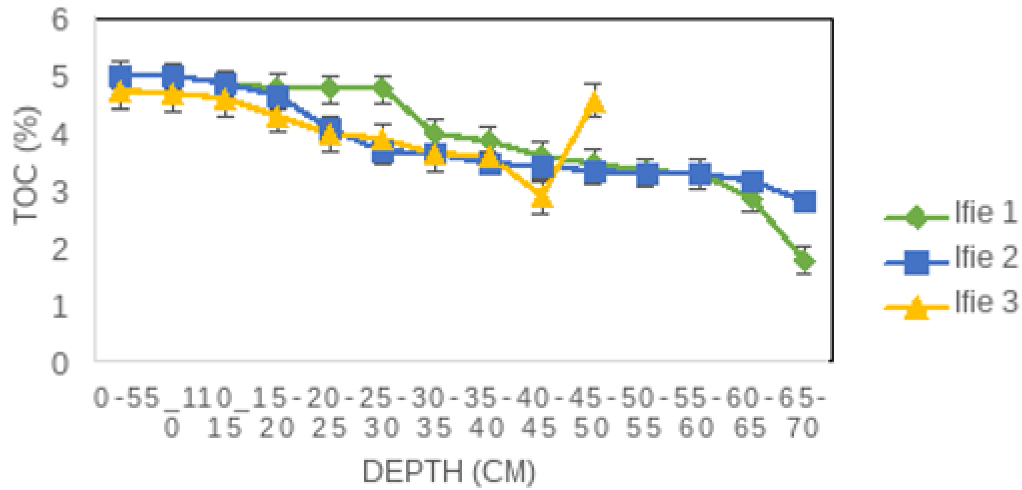

Figure 17

Difference of TOC with depth of sediment core at Ifie Creek (dry season)

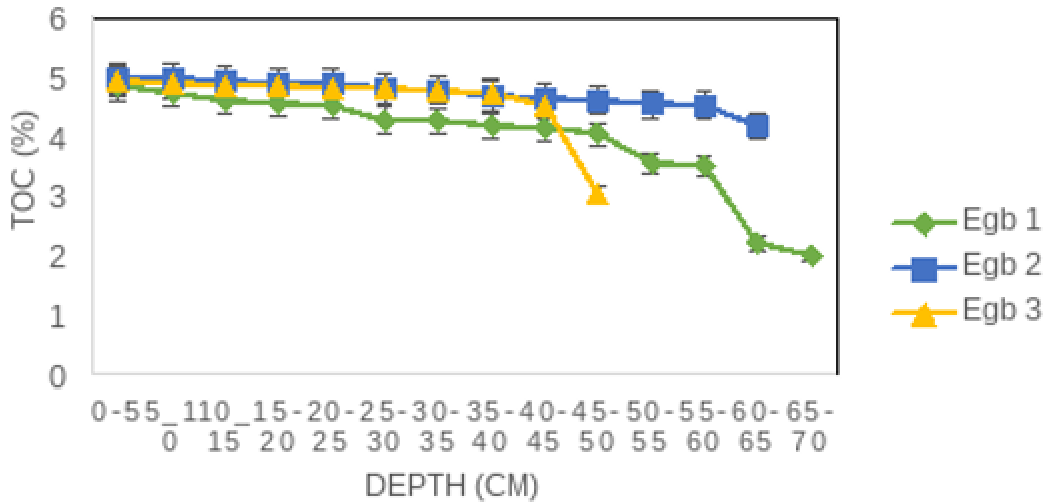

Figure 18

Difference of TOC with depth of sediment core at Egbokodo Creek (wet season)

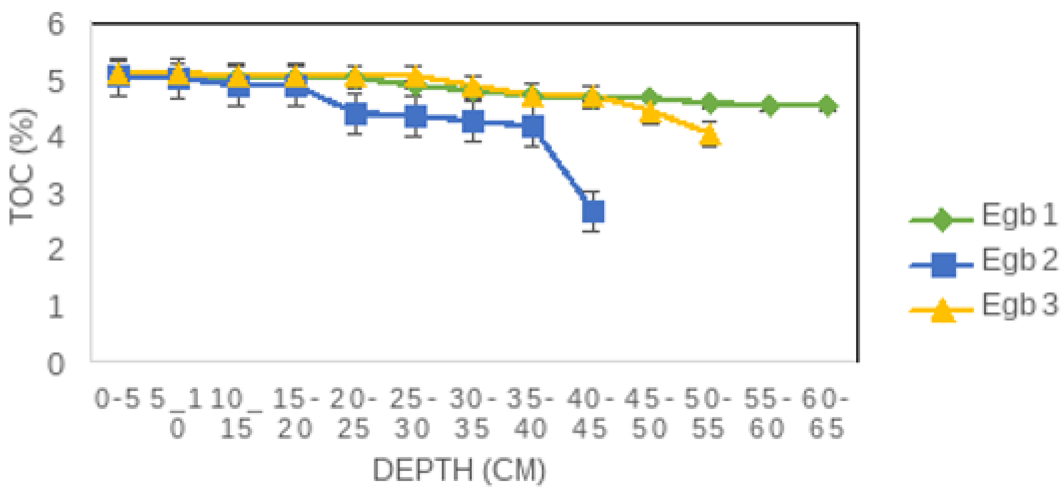

Figure 19

Difference of TOC with depth of sediment core at Egbokodo Creek (dry season)