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Research Article

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Particulate Matter Deposition at and Around Major Intra-Urban Traffic Intersections of Isheri Metropolis, Lagos, Nigeria

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Abstract Samples of Particulate Matter (PM) were collected using deposition gauges (0.2m x 0,15m) at the selected areas within Isheri Metropolis, Lagos during the period of December to January 2018 - 2019 for the dry season. The collected samples was rinsed with distilled water and dried in a desiccator. The Deposition Flux (DF) of the measured PM ranged from 0.84870 to 3.37596g/m^2.The characterization of the PM samples revealed eighteen elements as follows K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, As, Rb, Sr, Y, Zr, Nb, Ba, and Pb. The Enrichment Factor of the trace elements were determined to identify the sources of the metal, and for all the elements, the EFs are less than 10. This shows that they all crustal origin.

Keywords PM; Deposition Gauges; Crustal Origin; Enrichment Factor

1. Introduction

Pollution is the introduction of contaminants into the environment that causes adverse challenge [1-2]. There are 5 major types of pollution, which are; Noise Pollution, Air Pollution, Water Pollution, Light Pollution and Soil Pollution and they can be caused by traffic, industrial emission and other forms of pollution [3-5]. Air borne pollution is the introduction of harmful or excessive substances such as gases, particles, and biological molecules into the earth's surface; it is also detrimental to human health [1, 6]. Road transport is one of the major sources of particulate matter related pollution, as vehicle engines releases nitrogen dioxide, carbon monoxide and particles into the atmosphere [2, 5, 7-8]. Burning of fuel for power generation and industrial purposes also causes air Pollution [1, 5, 8]. The aim of this study is to determine the atmospheric deposition of particulate matter at and around major intra-urban traffic intersections of Isheri Metropolis, Lagos. The objectives of this study were to: determine the deposition flux of atmospheric particulates deposited during the dry season, characterize the deposited samples, determine the enrichment factor and determine the dry average velocity.

2. Materials and Methods

2.1. Sampling site

The sampling was carried out in Lagos State, the former capital of Nigeria and one of the largest states in the country. Lagos State lies on the latitude 6°34' 36.348" N and Longitude 3°16'48.378" E respectively. Isheri metropolis was selected for this study because it is characterized by high population, increased vehicular traffic and several other industrial activities. The choice of the selected industrial areas was borne out of their closeness to residential areas.

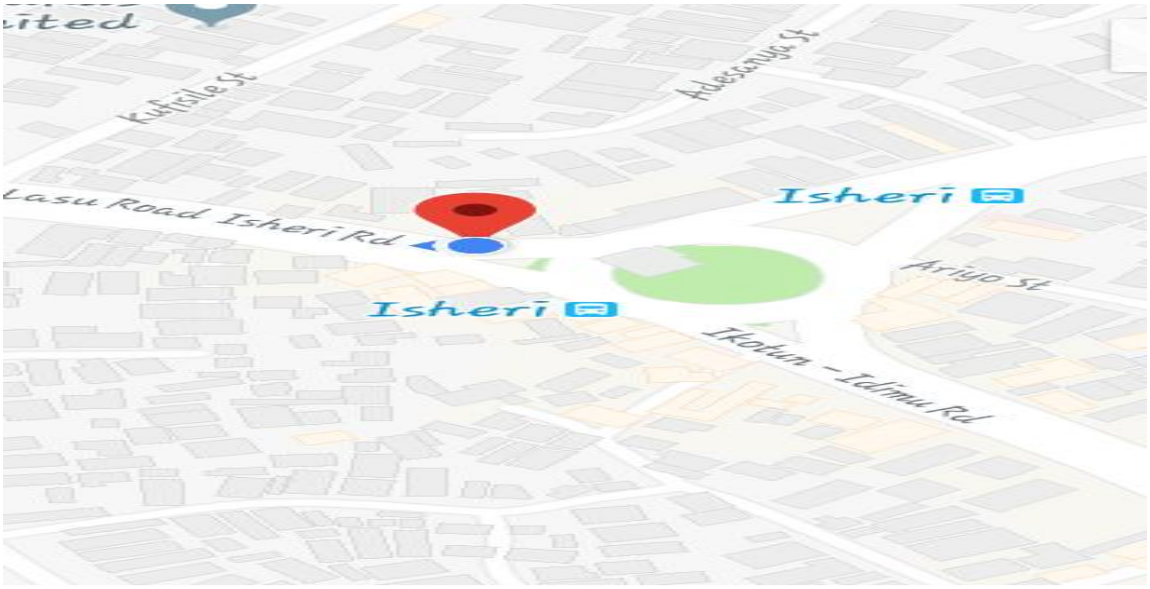

Figure 1: Location of Selected Area

2.2. Sampling Procedure

The method used for this study is the deposition method. Deposition gauges (0.2 m diameter by 015 m depth) were planted at 4 traffic locations within the sampling site [3, 5]. This was carried out for dry seasons. In this study, December 2018 to January 2019 was chosen for this work as it was typical of Lagos state climate. The deposition gauges were planted for 30 days after which they were harvested. After harvesting the deposition gauges, they were taken to the laboratory for further analysis. The particulates were rinsed with distilled water in order to account for all the deposited particles in the gauges. The samples in the gauges were collected and filtered through a dry pre-weighed Whatman (125 mm diameter, cat No. 1001 – 125) filter paper on the digital balance (model PA2102). These were dried in desiccators to prevent further settlement of particles on the particulate samples. The samples were reweighed after drying to determine the deposition flux of the particulate samples collected [9-10]. This was done by employing equation 1 below:

$$DF = \frac{\Delta W}{AT} \quad (1)$$

DF is the Deposition Flux (mg/m^2.day)

ΔW is Change in weight of samples (mg)

A is the area of the deposition gauge (m^2)

T is the Duration of deposition (30 days)

The samples were taken to the Centre for Energy and Research Development (CERD) for characterization. X-ray fluorescence (XRF) was used to characterize the samples [9, 11]. The choice of X-ray Fluorescence was as a result of its multi-elemental detector ability [12].

Enrichment factor for each metal was calculated using the equation 2 below:

$$EF = \frac{(C_{sample}\ /C_{ref})_{aerosol}}{(C_{sample}\ /C_{ref})_{crust}} \quad (2)$$

Where;

C_{sample} is the element concentration

C_{ref} is the highest concentration of element in the data.

Crustal data was obtained from the literature [13].

3. Results and Discussion

3.1. Dry deposition flux at the selected area

The deposition flux of Isheri metropolis ranges from 0.849 to 3.376was compared with studies elsewhere [10]. In Fig. 2 below, we see SP1 to have the highest number of deposition and lowest number of deposition can be found at SP2. This means that traffic activities are more at SP1 as compared to SP2.

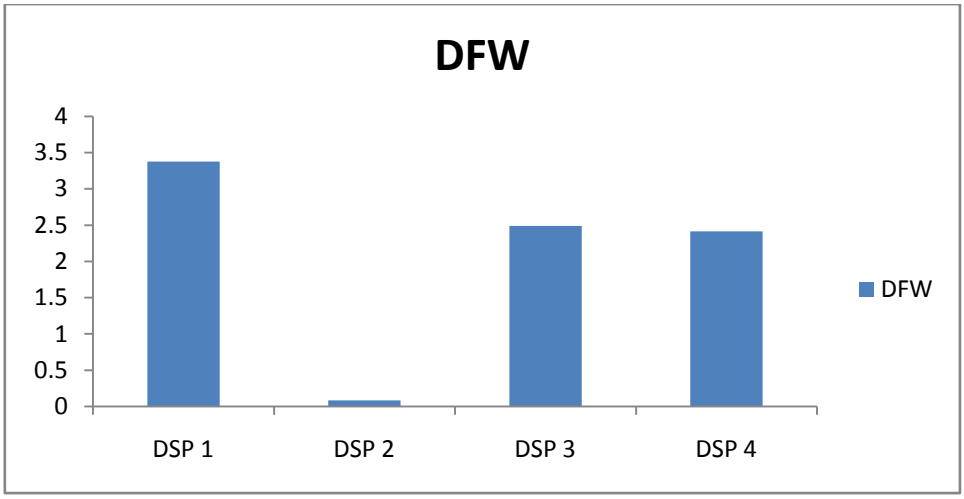

Figure 2: Deposition Flux of the Study Area

3.2. Characterization of deposition samples for dry Season

The particulates samples obtained at the sampling spots were characterized. Eighteen elements were detected from the samples across the selected spots and these are K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, As, Rb, Sr, Y, Zr, Nb, Ba and Pb. The concentrations of the elements at the selected sampling areas are presented in Fig. 3 to 6. It was observed that Ca has the highest concentrations in all the selected sampling spots.

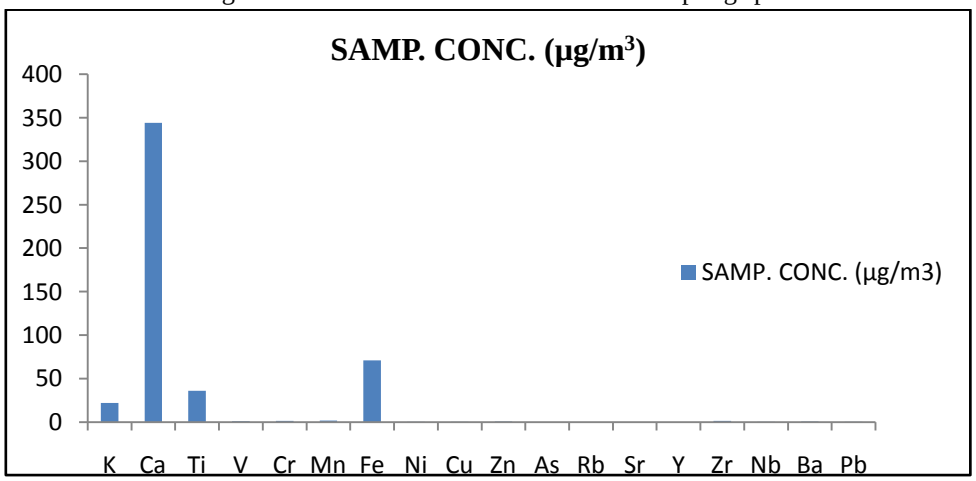

Figure 3: Characterized elements at Dry Spot 1

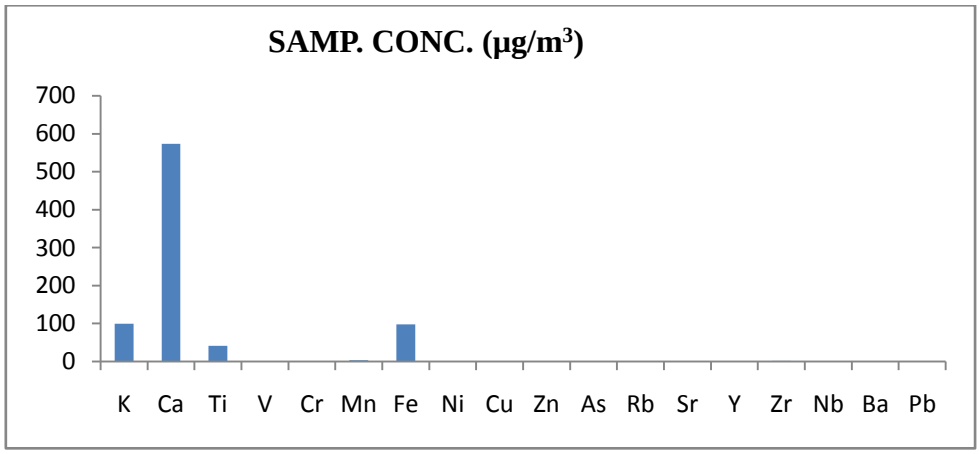

Figure 4: Characterized elements at Dry Spot 2

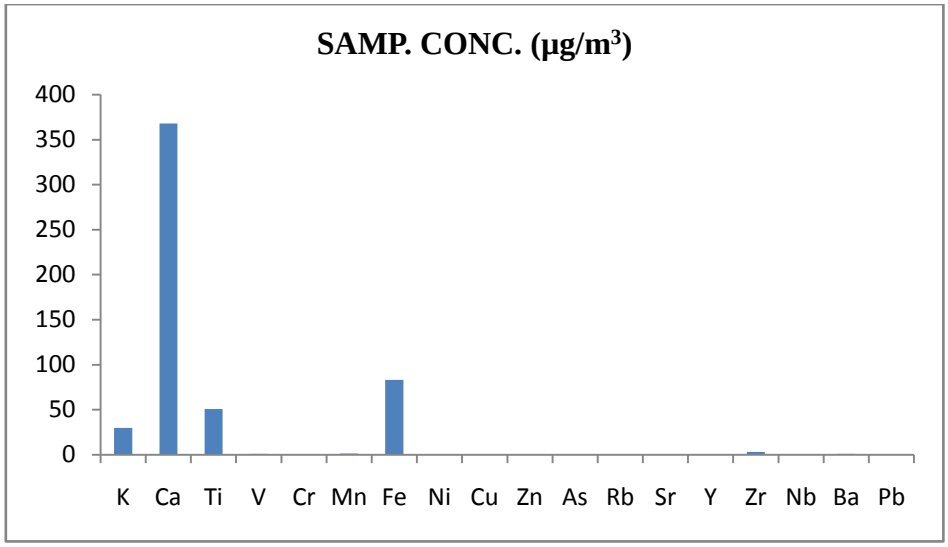

Figure 5: Characterized element of Dry Spot 3

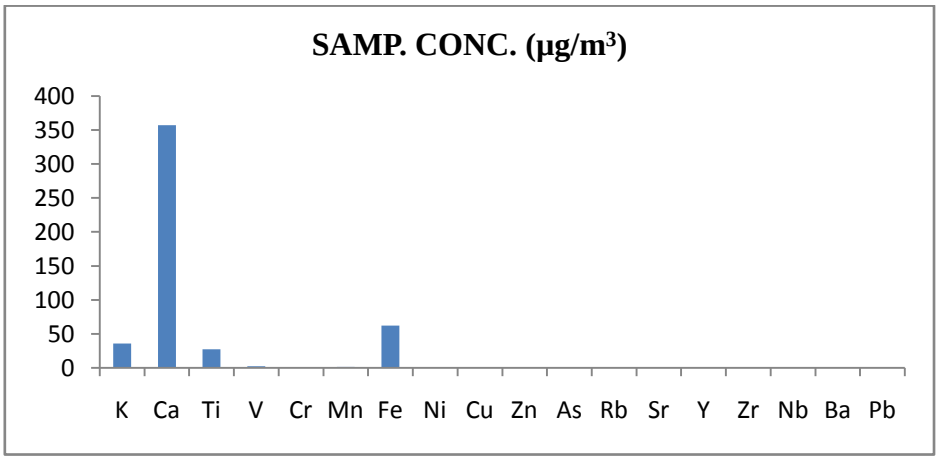

Figure 6: Characterized element of Dry Spot 4

Enrichment Factor

The Enrichment Factor (EF) is traditionally used to identify whether the elements are crustal derived or anthropogenic derived [3]. In this study, Ca was used as the reference element to determine the EF because it has the concentration among the characterized elements. It is customary that when EF <10, this indicate that a large fraction of the element can be attributed to crustal derived trace metal sources in the atmosphere and when EF >10, it indicate that a large fraction of the element can be attributed to non-crustal or anthropogenic sources trace metal in the atmosphere [3]. The EFs for this study is as presented in the Table 1 below. The EFs shows that all the elements are of crustal origin.

Table 1: Enrichment Factors for the Characterized Elements in the Dry seasons

Trace Elements	SP 1	SP 2	SP 3	SP 4
K	1.30	3.53	1.65	2.05
Ca	10.00	10.00	10.00	10.00
Ti	6.40	4.44	8.43	4.63
V	7.80	3.91	7.66	15.12
Cr	15.27	6.23	6.22	3.24
Mn	1.56	2.06	1.34	1.36
Fe	1.09	0.90	1.19	0.92
Ni	2.62	2.14	0.89	1.63
Cu	3.28	4.16	6.25	4.04

Zn	6.63	7.49	7.18	4.85
As	10.79	12.02	25.58	14.43
Rb	0.65	0.48	0.40	0.13
Sr	0.30	0.44	0.54	0.06
Y	1.32	1.64	1.19	1.00
Zr	5.19	3.79	9.29	0.61
Nb	7.38	9.53	18.22	5.70
Ba	0.73	0.60	0.94	0.62
Pb	9.09	8.28	10.96	12.23

Note: The figures in the above tables are multiplied by 10

Conclusion

The measurement of the dry deposition samples concentration elements were conducted at four selected spots of Isheri metropolis, Lagos, Nigeria. The results showed that the heavy metals concentrations of the studied areas in the dry season were high which may not be unconnected with the anthropogenic activities around the studied areas. The EFs are all less than 10 indicating a crustal origin or non-enriched elements (NEEs) for all characterized elements.

Acknowledgments

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