

Supplementary Material (SM)

Soil Contamination and Risk Assessments on Selected Dumpsites within the Basement Complex and Sedimentary Formations of Ogun State, South-western Nigeria

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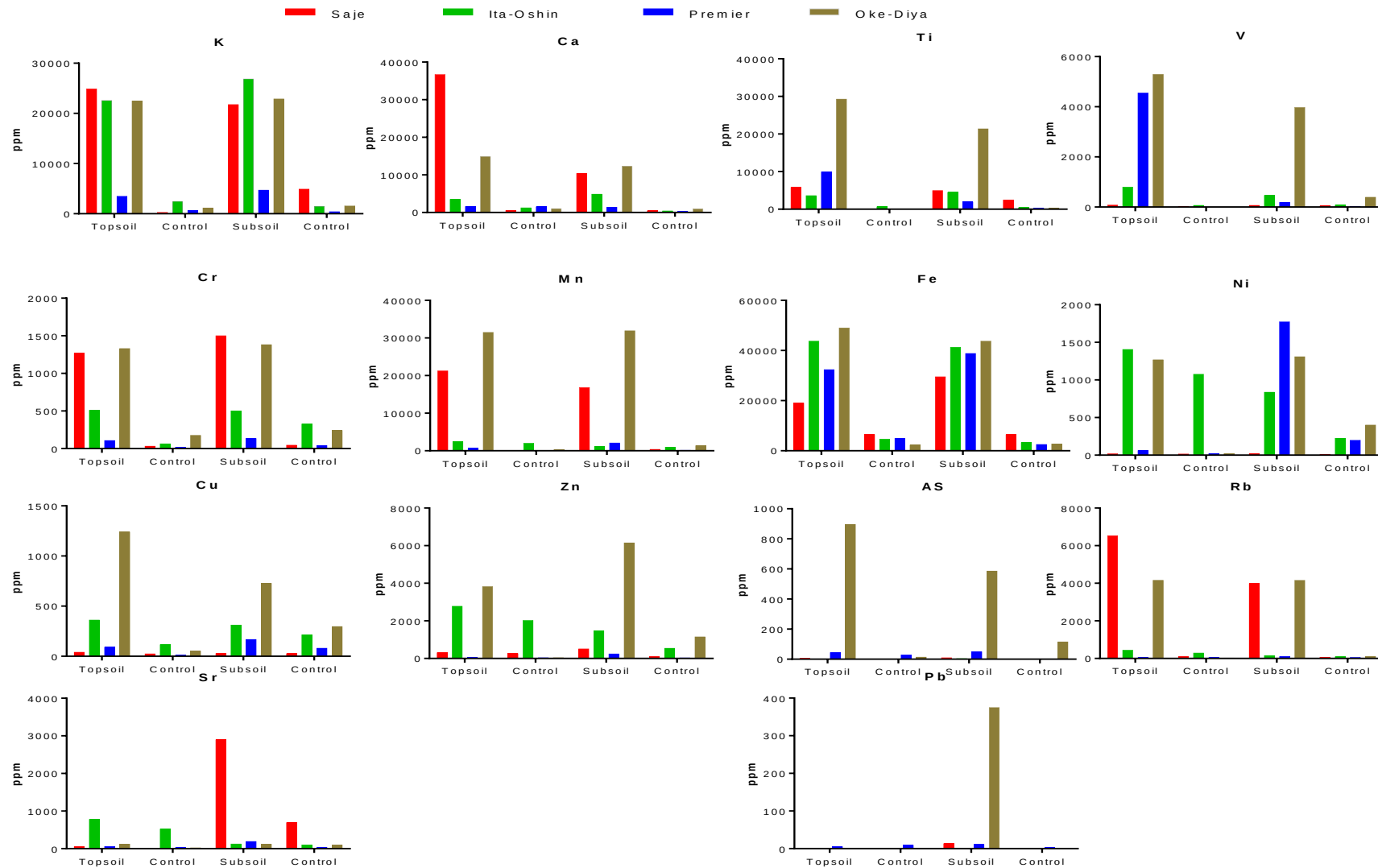
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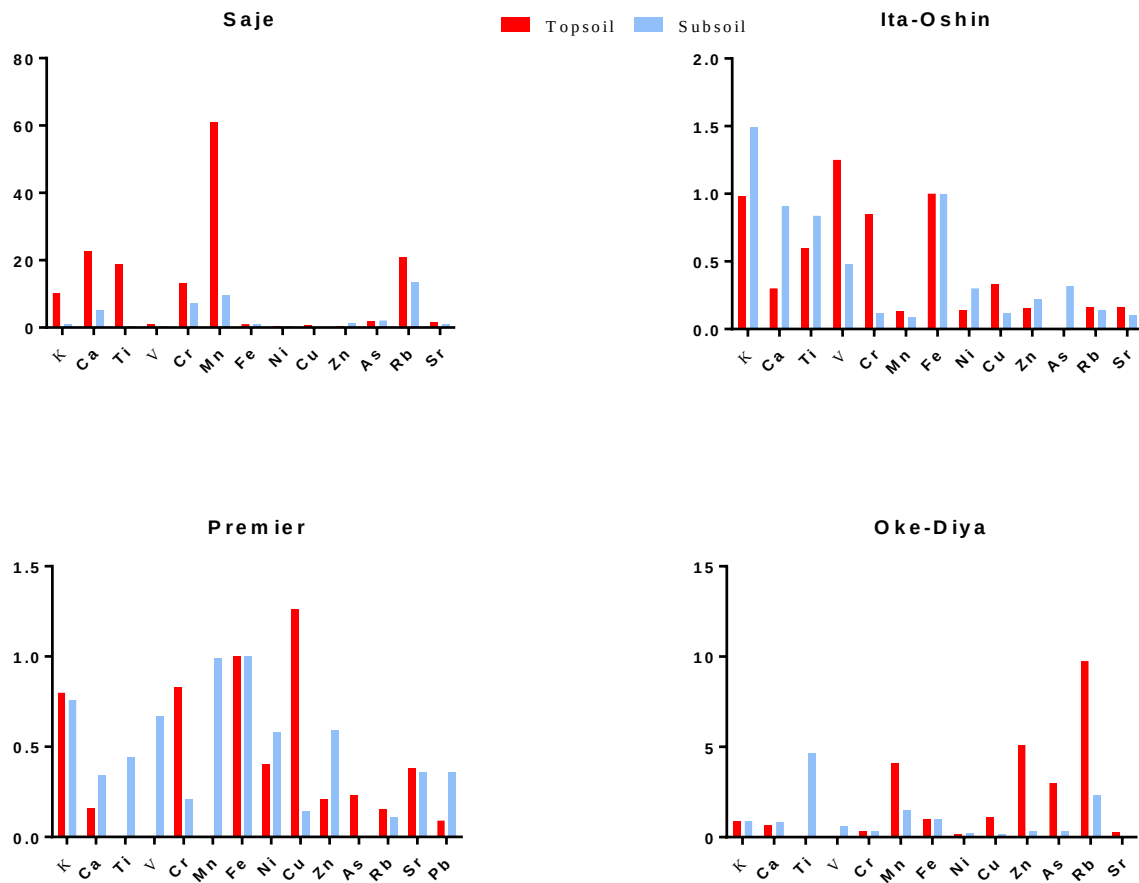
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SM 1 Geo-coordinates of the study areas and sampling points

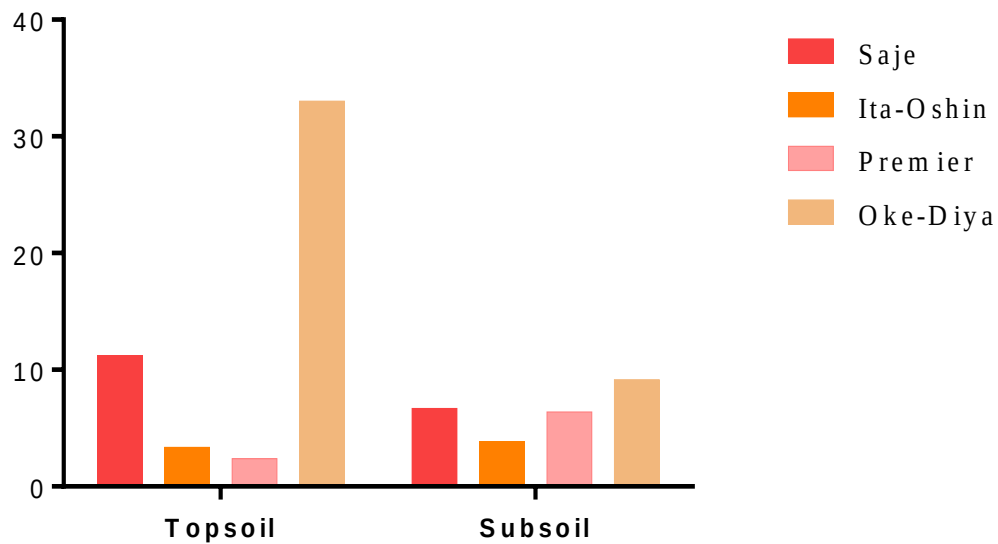
Dumpsite	Sampling Points	Latitude (°N)	Longitude (°E)
Saje		07°11'12"-07°11'28"	03°21'00"-03°22'15"
	Point 1	07°11'14"	03°21'01"
	Point 2	07°11'18"	03°22'10"
	Point 3	07°11'20"	03°21'15"
	Control	07°11'00"	03°23'57"
Ita-Oshin		07°08'05"-07°08'13"	03°18'21"-03°18'33"
	Point 1	07°08'05"	03°18'27"
	Point 2	07°08'12"	03°18'32"
	Control	07°08'49"	03°19'01"
Premier		07°09'36"-07°09'59"	03°18'12"-03°18'35"
	Point 1	07°09'36"	03°18'06"
	Point 2	07°09'54"	03°18'20"
	Control	07°10'14"	03°20'01"
Oke-Diya		06°48'06"-06°48'54"	03°35'31"-03°36'39"
	Point 1	06°48'08"	03°36'12"
	Point 2	06°48'37"	03°35'33"
	Point 3	06°48'48"	03°36'28"
	Control	06°46'50"	03°37'20"



SM 2 Mean elemental concentrations (ppm) in the topsoil (depths <20 cm) and subsoil (depths >20 cm) of the study and control samples.



SM 3 Contamination factors of the topsoil and subsoil of the study area.



SM 4 The pollution load index of the topsoil and subsoil for each study area.

SM 5 Pearson's correlation elemental analysis of Saje

Element	K	Ca	Ti	V	Cr	Mn	Fe	Ni	Cu	Zn
K	1									
Ca	0.04	1								
Ti	-0.19	-0.09	1							
V	0.71**	0.05	0.08	1						
Cr	-0.46	-0.14	0.28	-0.13	1					
Mn	0.26	-0.12	-0.11	0.22	-0.13	1				
Fe	-0.03	-0.15	0.37	0.14	-0.24	-0.18	1			
Ni	-0.20	0.11	-0.13	0.24	-0.09	-0.02	-0.09	1		
Cu	0.09	-0.40	0.17	0.04	0.04	0.07	-0.26	0.37	1	
Zn	0.60*	0.09	0.16	0.57	-0.36	0.30	0.12	0.05	-0.04	1

Remark: ** $\rho=0.01$ (2-tailed), * $\rho=0.05$ (2-tailed)

SM 6 Pearson's correlation elemental analysis of Ita-Oshin

Element	K	Ca	Ti	V	Cr	Mn	Fe	Ni	Cu	Zn
K	1									
Ca	0.16	1								
Ti	-0.34	-0.37	1							
V	-0.39	-0.34	0.99**	1						
Cr	-0.64*	0.02	0.24	0.27	1					
Mn	-0.42	0.048	-0.23	-0.22	0.44	1				
Fe	-0.36	-0.33	-0.17	-0.17	0.14	0.73**	1			
Ni	0.09	0.03	-0.15	-0.16	-0.01	0.38	0.29	1		
Cu	-0.27	-0.01	-0.32	-0.32	0.29	0.16	0.14	0.11	1	
Zn	-0.31	-0.24	-0.07	0.04	0.10	0.12	0.23	0.05	0.85**	1

Remark: ** $\rho=0.01$ (2-tailed), * $\rho=0.05$ (2-tailed)

SM 7 Pearson's correlation elemental analysis of Premier

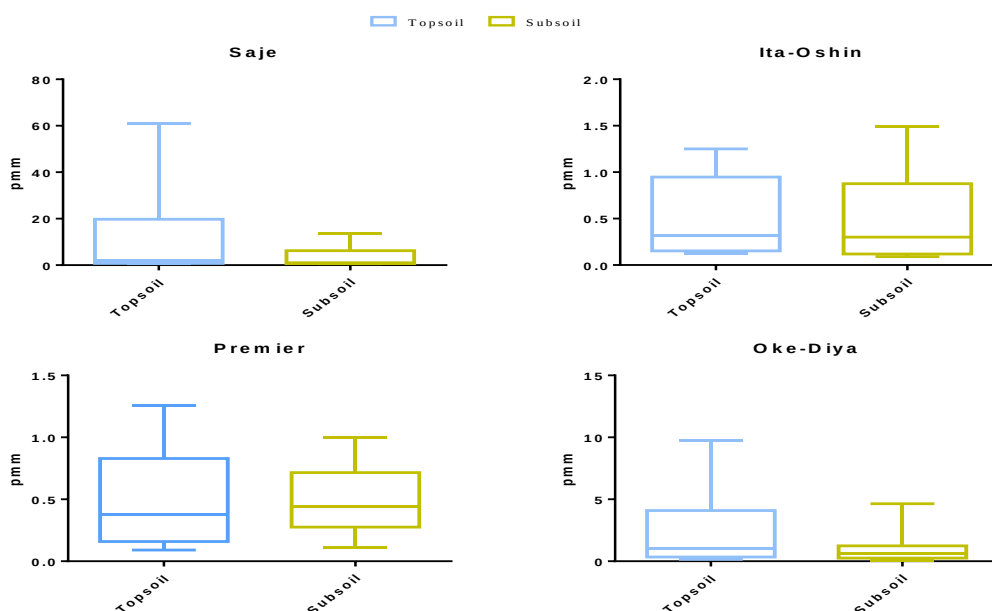
Element	K	Ca	Ti	V	Cr	Mn	Fe	Ni	Cu	Zn
K	1									
Ca	0.16	1								
Ti	-0.38	-0.37	1							
V	-0.39	-0.34	0.99**	1						
Cr	-0.64*	0.02	0.25	0.27	1					
Mn	-0.36	0.03	-0.17	-0.17	0.19	1				
Fe	-0.11	0.43	-0.13	-0.13	0.26	0.33	1			
Ni	0.56	-0.35	-0.12	-0.16	-0.45	-0.05	0.07	1		
Cu	0.23	0.02	-0.18	-0.19	-0.05	0.39	0.05	0.40	1	
Zn	0.13	-0.05	0.24	0.45	0.03	0.37	0.01	0.32	0.99**	1

Remark: ** $\rho=0.01$ (2-tailed), * $\rho=0.05$ (2-tailed)

SM 8 Pearson's correlation elemental analysis of Oke-Diya

Element	K	Ca	Ti	V	Cr	Mn	Fe	Ni	Cu	Zn
K	1									
Ca	-0.58	1								
Ti	-0.10	0.46	1							
V	-0.53	0.88**	0.50	1						
Cr	-0.12	0.65	0.14	0.70	1					
Mn	-0.30	0.71*	0.76*	0.87**	0.41	1				
Fe	-0.38	0.64	0.91**	0.76*	0.27	0.92**	1			
Ni	-0.49	0.88**	0.59	0.98**	0.64	0.93**	0.82*	1		
Cu	-0.01	-0.17	0.06	-0.09	-0.44	-0.04	0.06	-0.17	1	
Zn	-0.25	0.59	0.60	0.73*	0.29	0.93**	0.78*	0.84**	-0.25	1

Remark: ** $\rho=0.01$ (2-tailed), * $\rho=0.05$ (2-tailed)

**SM 9** Enrichment factors of the topsoil and subsoil of each of the study area.**SM 10** Kolmogorov-Smirnov and Shapiro-Wilk normality tests

Elements	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
K	0.231	14	0.022	0.871	14	0.028
Ca	0.190	14	0.126	0.779	14	0.001
Ti	0.329	14	0.000	0.779	14	0.001
V	0.352	14	0.000	0.671	14	0.000
Cr	0.173	14	0.200*	0.892	14	0.059
Mn	0.315	14	0.000	0.746	14	0.001
Fe	0.224	14	0.032	0.886	14	0.048
Ni	0.193	14	0.113	0.834	14	0.008
Cu	0.204	14	0.074	0.843	14	0.011
Zn	0.278	14	0.002	0.792	14	0.002

SM 10 Kolmogorov-Smirnov and Shapiro-Wilk normality tests (*continued*)

Elements	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
As	0.344	14	0.000	0.606	14	0.000
Rb	0.313	14	0.000	0.781	14	0.002
Sr	0.501	14	0.000	0.422	14	0.000
Pb	0.438	14	0.000	0.541	14	0.000

Remark: H0: Elements are normally distributed, H1: Elements are not normally distributed

SM 11 Kruskal-Wallis test showing the mean ranks for each location and depth

Elements	Saje	Ita-Oshin	Premier	Oke-Diya	20 cm	40 cm	60 cm	80 cm
K	11.00	10.75	3.25	9.00	8.25	4.00	10.50	11.25
Ca	12.00	6.00	3.00	13.00	10.25	7.25	7.50	9.00
Ti	8.25	6.00	5.25	14.50	10.75	6.63	8.00	8.63
V	2.50	9.50	7.50	14.50	10.00	8.25	7.00	8.75
Cr	11.25	6.75	2.50	13.50	8.13	7.63	9.50	8.75
Mn	8.50	5.25	5.75	14.50	8.75	9.00	9.75	6.50
Fe	3.75	10.25	7.50	12.50	8.25	9.75	6.25	9.75
Ni	2.50	9.50	10.50	11.50	7.75	9.00	7.25	10.00
Cu	2.50	10.25	6.75	14.50	9.25	8.75	7.75	8.25
Zn	6.00	10.50	3.00	14.50	7.50	9.75	8.00	8.75
As	6.25	3.13	10.13	14.50	8.63	9.88	7.88	7.63
Rb	11.00	6.75	3.75	12.50	9.75	9.75	8.50	6.00
Sr	8.75	10.25	7.75	7.25	7.00	8.25	8.25	10.50
Pb	8.00	4.00	9.75	12.25	5.13	10.25	8.50	10.13

SM 12 One way ANOVA test across the study locations and soil profile depths

Elements	Study locations			Depths		
	Chi-Square	Df	Asmp. Sig.	Chi-Square	Df	Asmp. Sig.
K	6.904	3	0.075	5.625	3	0.131
Ca	12.176	3	0.007	1.037	3	0.792
Ti	9.345	3	0.025	1.563	3	0.668
V	13.059	3	0.005	0.816	3	0.846
Cr	12.658	3	0.005	0.348	3	0.951
Mn	9.551	3	0.023	1.037	3	0.792
Fe	7.522	3	0.057	1.456	3	0.692
Ni	8.824	3	0.032	0.816	3	0.846
Cu	13.787	3	0.003	0.221	3	0.974
Zn	13.500	3	0.004	0.507	3	0.917
As	13.021	3	0.005	0.549	3	0.908
Rb	8.449	3	0.038	1.654	3	0.647
Sr	0.926	3	0.819	1.125	3	0.771
Pb	6.958	3	0.073	3.293	3	0.349

SM 13 ADDI for Saje samples

Elements	20 cm	40 cm	60 cm	80 cm	Mean
Children					
K	2.73E-02	2.13E-03	3.19E-02	3.75E-02	2.47E-02
Ca	4.03E-02	1.06E-02	1.45E-02	9.06E-03	1.86E-02
Ti	6.35E-03	5.99E-03	3.83E-03	6.46E-03	5.66E-03
V	8.49E-05	7.73E-05	5.88E-05	8.55E-05	7.66E-05
Cr	1.39E-03	1.02E-03	2.64E-03	1.27E-03	1.58E-03
Mn	2.33E-02	3.32E-02	2.18E-02	3.72E-04	1.97E-02
Fe	2.08E-02	2.57E-02	2.66E-02	4.48E-02	2.95E-02
Ni	2.08E-05	1.43E-05	2.74E-05	2.85E-05	2.27E-05
Cu	4.38E-05	4.16E-05	1.83E-05	2.96E-05	2.65E-05
Zn	3.32E-04	6.52E-04	4.19E-04	6.07E-04	5.02E-04
As	6.14E-06	1.43E-05	-	6.58E-06	8.99E-06
Rb	7.15E-03	4.08E-02	8.91E-03	1.03E-04	1.42E-02
Sr	5.66E-05	1.60E-05	5.46E-02	4.05E-02	2.38E-02
Pb	-	1.32E-05	-	2.96E-05	4.27E-05
Adults					
K	1.46E-02	1.14E-03	1.71E-02	2.10E-02	1.32E-02
Ca	2.16E-02	5.70E-03	7.76E-03	4.85E-03	9.97E-03
Ti	3.40E-03	3.21E-03	2.05E-03	3.46E-03	3.03E-03
V	4.55E-05	4.14E-05	3.15E-05	4.58E-05	1.64E-04
Cr	7.44E-04	5.48E-04	1.42E-03	6.80E-04	8.47E-04
Mn	1.25E-02	1.78E-02	1.17E-02	1.99E-04	1.05E-02
Fe	1.12E-02	1.38E-02	1.43E-02	2.40E-02	1.58E-02
Ni	1.12E-05	7.63E-06	1.47E-05	1.53E-05	1.22E-05
Cu	2.35E-05	2.23E-05	9.79E-06	1.59E-05	1.79E-05
Zn	1.78E-04	3.49E-04	2.24E-04	3.25E-04	2.69E-04
As	3.29E-06	7.63E-06	-	3.52E-06	3.61E-06
Rb	3.83E-03	2.19E-02	4.77E-05	5.45E-05	7.63E-03
Sr	3.03E-05	8.57E-06	2.92E-02	2.17E-02	1.28E-02
Ba	7.63E-05	-	-	7.63E-05	7.63E-05
Pb	-	7.05E-06	-	1.59E-05	1.15E-05

SM 14 ADDI for Premier samples

Elements	20 cm	40 cm	60 cm	80 cm	Mean
Children					
K	3.84E-03	1.91E-03	1.08E-02	2.80E-03	4.84E-03
Ca	1.73E-03	1.10E-03	1.08E-03	2.43E-06	9.79E-04
Ti	1.09E-02	9.29E-04	4.46E-03	9.29E-04	4.29E-03
V	4.99E-03	1.72E-04	1.21E-04	3.16E-04	1.40E-03
Cr	1.17E-04	1.17E-04	1.20E-04	2.04E-04	1.40E-04
Mn	6.97E-04	1.05E-03	3.87E-03	1.94E-03	1.89E-03

SM 14 ADDI for Premier samples (*continued*)

Elements	20 cm	40 cm	60 cm	80 cm	Mean
Children (<i>continued</i>)					
Fe	3.55E-02	4.47E-02	3.40E-02	4.90E-02	4.08E-02
Ni	6.63E-05	1.95E-03	7.89E-05	3.81E-03	1.48E-03
Cu	9.86E-06	1.96E-04	6.58E-06	2.84E-04	1.24E-04
Zn	5.48E-05	3.72E-04	4.16E-05	3.92E-04	2.15E-04
As	4.82E-05	1.36E-04	2.08E-05	6.58E-06	5.29E-05
Rb	4.38E-05	1.44E-04	3.29E-05	1.36E-04	8.92E-05
Sr	6.52E-05	2.21E-04	2.85E-05	3.85E-04	1.75E-04
Pb	5.48E-06	2.08E-05	1.10E-05	5.48E-6	1.07E05
Adults					
K	2.06E-03	1.07E-03	6.05E-03	1.56E-03	2.68E-03
Ca	9.29E-04	6.12E-04	6.05E-04	1.36E-03	8.76E-04
Ti	5.82E-03	5.19E-04	2.49E-03	5.19E-04	2.34E-03
V	2.67E-03	9.61E-05	6.70E-05	1.76E-04	7.53E-04
Cr	6.28E-05	6.55E-05	6.64E-05	1.14E-04	7.71E-05
Mn	3.73E-04	5.87E-04	2.16E-03	1.08E-03	1.05E-03
Fe	1.98E-02	2.50E-02	1.90E-02	2.74E-02	2.28E-02
Ni	3.70E-05	1.09E-03	4.41E-05	2.13E-03	8.24E-04
Cu	5.51E-06	1.10E-04	3.67E-06	1.57E-04	6.90E-05
Zn	3.06E-05	2.08E-04	2.33E-05	2.19E-04	1.20E-04
As	2.69E-05	7.59E-05	1.16E-05	3.67E-06	2.95E-05
Rb	2.45E-05	8.05E-05	1.84E-05	7.59E-05	4.98E-05
Sr	3.64E-05	1.24E-04	1.59E-05	2.15E-04	9.77E-05
Pb	3.06E-06	1.16E-05	5.82E-06	3.06E-06	5.89E-06

SM 15 ADDI for Ita-Oshin samples

Elements	20 cm	40 cm	60 cm	80 cm	Mean
Children					
K	2.48E-02	2.19E-02	3.05E-02	3.59E-02	2.83E-02
Ca	3.81E-03	1.73E-03	6.51E-03	7.79E-03	4.96E-03
Ti	3.96E-03	3.69E-03	6.01E-03	4.99E-03	4.66E-03
V	8.76E-04	6.44E-04	4.58E-04	4.14E-04	5.98E-04
Cr	5.57E-04	1.05E-03	2.76E-04	3.32E-04	7.38E-04
Mn	2.69E-03	1.84E-03	9.82E-04	9.80E-04	1.62E-03
Fe	4.79E-02	4.92E-02	4.14E-02	4.52E-02	4.59E-02
Ni	1.54E-03	1.09E-03	8.37E-04	8.30E-04	1.07E-03
Cu	3.97E-04	3.68E-04	4.17E-04	2.41E-04	3.56E-04
Zn	3.04E-03	2.76E-03	1.35E-03	7.28E-04	1.97E-03
As	-	-	4.38E-06	-	4.38E-06
Rb	4.83E-04	2.66E-04	1.38E-04	1.10E-04	2.49E-04
Sr	8.54E-04	1.46E-04	1.46E-04	1.18E-04	3.16E-04

SM 15 ADDI for Ita-Oshin samples (*continued*)

Elements	20 cm	40 cm	60 cm	80 cm	Mean
Adults					
K	1.33E-02	1.17E-02	2.78E-02	2.10E-02	1.82E-02
Ca	2.04E-03	3.93E-04	3.64E-03	4.35E-03	2.61E-03
Ti	2.12E-03	1.98E-03	3.36E-03	2.79E-03	2.56E-03
V	4.69E-04	3.46E-04	2.56E-04	2.31E-04	3.26E-04
Cr	2.99E-04	5.61E-04	1.54E-04	1.86E-04	3.00E-04
Mn	1.44E-03	9.84E-04	5.49E-04	5.47E-04	8.81E-04
Fe	2.57E-02	2.64E-02	3.31E-02	2.53E-02	2.51E-02
Ni	8.25E-04	5.82E-04	4.68E-04	4.64E-04	5.85E-04
Cu	2.13E-04	1.97E-04	2.33E-04	1.35E-04	1.94E-04
Zn	1.63E-03	1.48E-03	7.53E-04	4.07E-04	1.07E-03
As	-	-	2.45E-06	-	2.45E-06
Rb	2.59E-04	1.43E-04	7.68E-05	6.12E-05	1.35E-04
Sr	4.58E-04	7.87E-05	8.14E-05	6.58E-05	1.71E-04

SM 16 ADDI for Oke-Diya samples

Elements	20 cm	40 cm	60 cm	80 cm	Mean
Children					
K	2.46E-02	2.40E-02	2.54E-02	2.58E-02	2.50E-02
Ca	1.64E-02	1.45E-02	1.05E-02	1.53E-02	1.42E-02
Ti	3.21E-02	2.46E-02	1.79E-02	2.78E-02	2.56E-02
V	5.80E-03	5.81E-03	5.73E-03	5.91E-03	5.81E-03
Cr	1.46E-03	1.44E-03	1.49E-03	1.61E-03	1.50E-03
Mn	3.45E-02	3.41E-02	3.61E-02	3.48E-02	3.49E-02
Fe	5.37E-02	5.11E-02	4.90E-02	4.39E-02	4.94E-02
Ni	1.39E-03	1.40E-03	1.42E-03	1.49E-03	1.42E-03
Cu	1.36E-03	1.00E-03	6.50E-04	7.35E-04	9.37E-04
Zn	4.19E-03	7.87E-03	6.85E-03	5.51E-03	6.10E-03
As	9.83E-04	1.19E-03	3.97E-04	3.46E-04	7.28E-04
Rb	4.56E-03	4.57E-03	4.54E-03	4.55E-03	4.56E-03
Sr	1.35E-04	1.35E-04	1.16E-04	1.35E-04	1.30E-04
Pb	-	3.36E-04	4.50E-04	4.45E-04	3.08E-04
Adults					
K	1.38E-02	1.34E-02	1.42E-02	1.44E-03	1.40E-02
Ca	9.13E-03	8.12E-03	5.88E-03	8.55E-03	7.92E-03
Ti	1.79E-02	1.37E-02	9.99E-03	1.56E-02	1.43E-02
V	3.24E-03	3.25E-03	3.20E-03	3.30E-03	3.25E-03
Cr	8.14E-04	8.03E-04	8.34E-04	9.01E-04	8.38E-04
Mn	1.93E-02	1.90E-02	2.01E-02	1.94E-02	1.95E-02
Fe	3.00E-02	2.85E-02	2.74E-02	2.45E-02	2.76E-02
Ni	7.76E-04	7.83E-04	7.94E-04	8.30E-04	7.96E-04

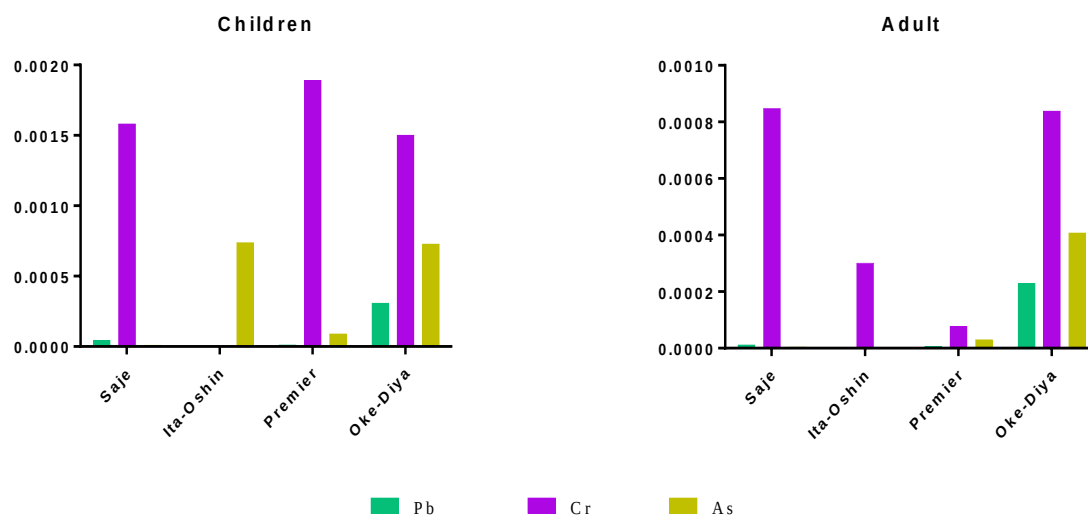
SM 16 ADDI for Oke-Diya samples (*continued*)

Elements	20 cm	40 cm	60 cm	80 cm	Mean
Adults (<i>continued</i>)					
Cu	7.59E-04	5.61E-04	3.63E-04	4.11E-04	5.23E-04
Zn	2.34E-03	4.39E-03	3.83E-03	3.08E-03	3.41E-03
As	5.49E-04	6.62E-04	2.22E-04	1.93E-04	4.07E-04
Rb	2.55E-03	2.55E-03	2.54E-03	2.54E-03	2.55E-03
Sr	7.51E-05	7.55E-05	6.47E-05	7.53E-05	7.27E-05
Pb	-	1.88E-04	2.52E-04	2.49E-04	2.29E-04

SM 17 HQ and HI for children and adults

	Saje		Ita-Oshin		Premier		Oke-Diya	
Element	Children	Adults	Children	Adults	Children	Adults	Children	Adults
Ti	1.89×10^{-3}	1.01×10^{-3}	1.55×10^{-3}	8.54×10^{-4}	1.43×10^{-3}	7.79×10^{-4}	8.53×10^{-3}	4.76×10^{-3}
V	1.52×10^{-2}	3.26×10^{-2}	0.119	6.46×10^{-2}	0.278	0.149	1.15	0.644
Cr	0.527	0.282	0.246	9.99×10^{-2}	4.65×10^{-2}	2.57×10^{-2}	0.5	0.279
Mn	1.40	0.752	0.116	6.29×10^{-2}	0.135	7.51×10^{-2}	2.49	1.39
Fe	4.2×10^{-2}	2.3×10^{-2}	6.56×10^{-2}	3.59×10^{-2}	5.83×10^{-2}	3.26×10^{-2}	7.06×10^{-2}	3.94×10^{-2}
Ni	1.14×10^{-3}	6.09×10^{-4}	5.37×10^{-2}	2.93×10^{-2}	7.38×10^{-2}	4.12×10^{-2}	7.12×10^{-2}	3.98×10^{-2}
Cu	6.62×10^{-4}	4.47×10^{-4}	8.89×10^{-3}	4.86×10^{-3}	3.11×10^{-3}	1.72×10^{-3}	2.34×10^{-2}	1.31×10^{-2}
Zn	1.68×10^{-3}	8.97×10^{-4}	6.56×10^{-3}	3.55×10^{-3}	7.17×10^{-4}	4.01×10^{-4}	2.03×10^{-2}	1.14×10^{-2}
As	3.0×10^{-2}	1.2×10^{-2}	1.46×10^{-2}	8.16×10^{-3}	0.176	9.83×10^{-2}	2.43	1.36
Sr	3.97×10^{-2}	2.13×10^{-2}	5.27×10^{-4}	2.85×10^{-4}	2.92×10^{-4}	1.63×10^{-4}	2.17×10^{-4}	1.21×10^{-4}
Pb	1.22×10^{-2}	3.27×10^{-3}	-	-	3.05×10^{-3}	1.68×10^{-2}	-	6.55×10^{-2}
HI	2.07	1.13	0.63	0.31	0.78	0.44	6.76	3.85

Remark: HI > 1: Unacceptable level of health risk, HI < 1: Acceptable level of health risk

**SM 18** Carcinogenic risks related to Pb, Cr and As for children and adult.