

Supplementary Material for Rapljenović et al. 2024: Influence of the organic matter and speciation on the dynamics of trace metal adsorption on microplastics in marine conditions

Table S1. Basic statistical parameters (N, Mean, Median, Sum, Minimum, Maximum, Range and Std. Deviation) for: A) PE pellet dataset, B) PP pellet dataset, C) Fibers dataset.

A)

	Valid N	Mean	Median	Sum	Minimum	Maximum	Range	Std.Dev.
Zn (ng/g)	32	71.16531	33.84500	2277.290	0.000000	321.7400	321.7400	78.44128
Cd (ng/g)	32	3.33344	3.50500	106.670	0.270000	8.0500	7.7800	2.06947
Pb (ng/g)	32	19.48406	19.89500	623.490	5.500000	35.4300	29.9300	9.02819
Cu (ng/g)	32	43.17125	41.81500	1381.480	7.350000	98.6600	91.3100	29.14457
Ni (ng/g)	32	31.70375	30.56500	1014.520	4.110000	104.1100	100.0000	19.47347
Co (ng/g)	32	7.95875	7.93000	254.680	0.000000	22.1800	22.1800	4.48879

B)

	Valid N	Mean	Median	Sum	Minimum	Maximum	Range	Std.Dev.
Zn (ng/g)	32	133.0931	129.7850	4258.980	33.01000	276.6000	243.5900	69.81960
Cd (ng/g)	32	5.6288	6.2350	180.120	0.00000	10.3400	10.3400	2.83973
Pb (ng/g)	32	27.9684	27.9750	894.990	10.70000	44.4700	33.7700	9.56662
Cu (ng/g)	32	49.0275	49.1950	1568.880	10.52000	105.8000	95.2800	29.28218
Ni (ng/g)	32	27.3638	25.6050	875.640	7.89000	51.9200	44.0300	11.64346
Co (ng/g)	32	9.6650	9.7800	309.280	0.92000	19.7800	18.8600	5.39426

C)

	Valid N	Mean	Median	Sum	Minimum	Maximum	Range	Std.Dev.
Zn (ng/g)	32	337.1109	317.2050	10787.55	48.52000	785.7100	737.1900	193.5459
Cd (ng/g)	32	40.8947	40.5500	1308.63	9.63000	93.3900	83.7600	23.1508
Pb (ng/g)	32	125.4581	106.9550	4014.66	30.00000	293.5700	263.5700	79.3621
Cu (ng/g)	32	214.7725	126.3700	6872.72	29.89000	703.0400	673.1500	177.7490
Ni (ng/g)	32	76.1800	66.9750	2437.76	17.07000	233.1000	216.0300	47.5551
Co (ng/g)	32	91.9625	82.6650	2942.80	24.59000	226.5000	201.9100	57.5910

Table S2. Correlation matrix for all three types of samples: A) PE pellets. Correlations (Statistika_PE-pelet.sta) Marked correlations are significant at $p < .05000$ N=32 (Casewise deletion of missing data); B) PP pellets. Correlations (Statistika_PP-pelet.sta) Marked correlations are significant at $p < .05000$ N=32 (Casewise deletion of missing data); C) Fibers. Correlations (Statistika_Fibers.sta) Marked correlations are significant at $p < .05000$ N=32 (Casewise deletion of missing data).

A)

	HA concentration (mg/L)	Time/day	Zn (ng/g)	Cd (ng/g)	Pb (ng/g)	Cu (ng/g)	Ni (ng/g)	Co (ng/g)
HA concentration (mg/L)	1.00	-0.00	0.03	0.37	0.36	0.13	0.23	0.09
Time/day	-0.00	1.00	0.62	0.36	0.10	0.49	0.17	0.19
Zn (ng/g)	0.03	0.62	1.00	0.21	0.10	0.31	0.57	0.27
Cd (ng/g)	0.37	0.36	0.21	1.00	0.61	0.71	0.42	0.46
Pb (ng/g)	0.36	0.10	0.10	0.61	1.00	0.50	0.40	0.47
Cu (ng/g)	0.13	0.49	0.31	0.71	0.50	1.00	0.34	0.58
Ni (ng/g)	0.23	0.17	0.57	0.42	0.40	0.34	1.00	0.54
Co (ng/g)	0.09	0.19	0.27	0.46	0.47	0.58	0.54	1.00

B)

	HA concentration (mg/L)	Time/day	Zn (ng/g)	Cd (ng/g)	Pb (ng/g)	Cu (ng/g)	Ni (ng/g)	Co (ng/g)
HA concentration (mg/L)	1.00	-0.00	-0.03	0.01	0.48	0.18	0.06	0.03
Time/day	-0.00	1.00	0.19	0.12	-0.35	0.33	-0.12	-0.15
Zn (ng/g)	-0.03	0.19	1.00	0.51	0.36	0.31	0.43	0.44
Cd (ng/g)	0.01	0.12	0.51	1.00	0.41	0.74	0.50	0.60
Pb (ng/g)	0.48	-0.35	0.36	0.41	1.00	0.24	0.60	0.52
Cu (ng/g)	0.18	0.33	0.31	0.74	0.24	1.00	0.33	0.36
Ni (ng/g)	0.06	-0.12	0.43	0.50	0.60	0.33	1.00	0.36
Co (ng/g)	0.03	-0.15	0.44	0.60	0.52	0.36	0.36	1.00

C)

	HA concentration (mg/L)	Time/day	Zn (ng/g)	Cd (ng/g)	Pb (ng/g)	Cu (ng/g)	Ni (ng/g)	Co (ng/g)
HA concentration (mg/L)	1.00	-0.00	0.10	0.11	0.72	0.67	0.40	0.16
Time/day	-0.00	1.00	-0.54	-0.45	-0.07	0.10	-0.42	-0.46
Zn (ng/g)	0.10	-0.54	1.00	0.74	0.49	0.46	0.64	0.91
Cd (ng/g)	0.11	-0.45	0.74	1.00	0.46	0.48	0.69	0.87
Pb (ng/g)	0.72	-0.07	0.49	0.46	1.00	0.83	0.64	0.56
Cu (ng/g)	0.67	0.10	0.46	0.48	0.83	1.00	0.56	0.57
Ni (ng/g)	0.40	-0.42	0.64	0.69	0.64	0.56	1.00	0.69
Co (ng/g)	0.16	-0.46	0.91	0.87	0.56	0.57	0.69	1.00

Chapter S1. Boxplot method

Scatterbox with boxplots were constructed for each of three datasets (PE pellets, PP pellets and Fibers) separately, to get insight into statistical anomalies and distribution.

In PE pellets dataset there are several anomalies (Figure S1). Zn distribution in PE pellet dataset is not very regular, despite that all samples except PE pellets with 5 mg/L HA present in the seawater solution, sampled after 21 days, are in the range which does not present anomalies. Mentioned sample is outlier (anomaly of lower degree). Cd, Pb and Cu does not show any anomaly in PE pellet dataset and show rather normal distribution, especially Pb, which distribution is like an example of statistical normal distribution. Ni shows two anomalous values. One of them (PE pellets with 5 mg/L HA present in the seawater solution, sampled after 21 days) is extreme (anomaly of higher degree), while the other anomalous value (PE pellets with 0.1 mg/L HA present in the seawater solution, sampled after 3 hours) is an outlier. The extreme value of Ni is in the same sample in which is outlier for Zn. Co in PE pellet dataset has several negative outliers, but they will not be discussed due to the fact that they are values equal to 0, i.e. values under the detection limit or which were not analyzed, so they can be ignored. Co also has one positive extreme value in the sample PE pellets with 1 mg/L HA present in the seawater solution, sampled after 21 days.

All samples from the PP pellet group do not show any anomalous values and all elements within this dataset have normal distribution, which is for majority of elements perfectly regular (Figure S2).

In Fibers dataset only Zn and Ni show outliers (anomalies of lower degree) (Figure S3). No other element shows any anomaly. Zn shows 2 outliers, and these samples are fibers with 1 mg/L HA present in the seawater solution, sampled after 24 hours and fibers with 1 mg/L HA present in the seawater solution, sampled after 2 days. Ni shows 1 outlier in sample fibers with 5 mg/L HA present in the seawater solution, sampled after 3 hours.

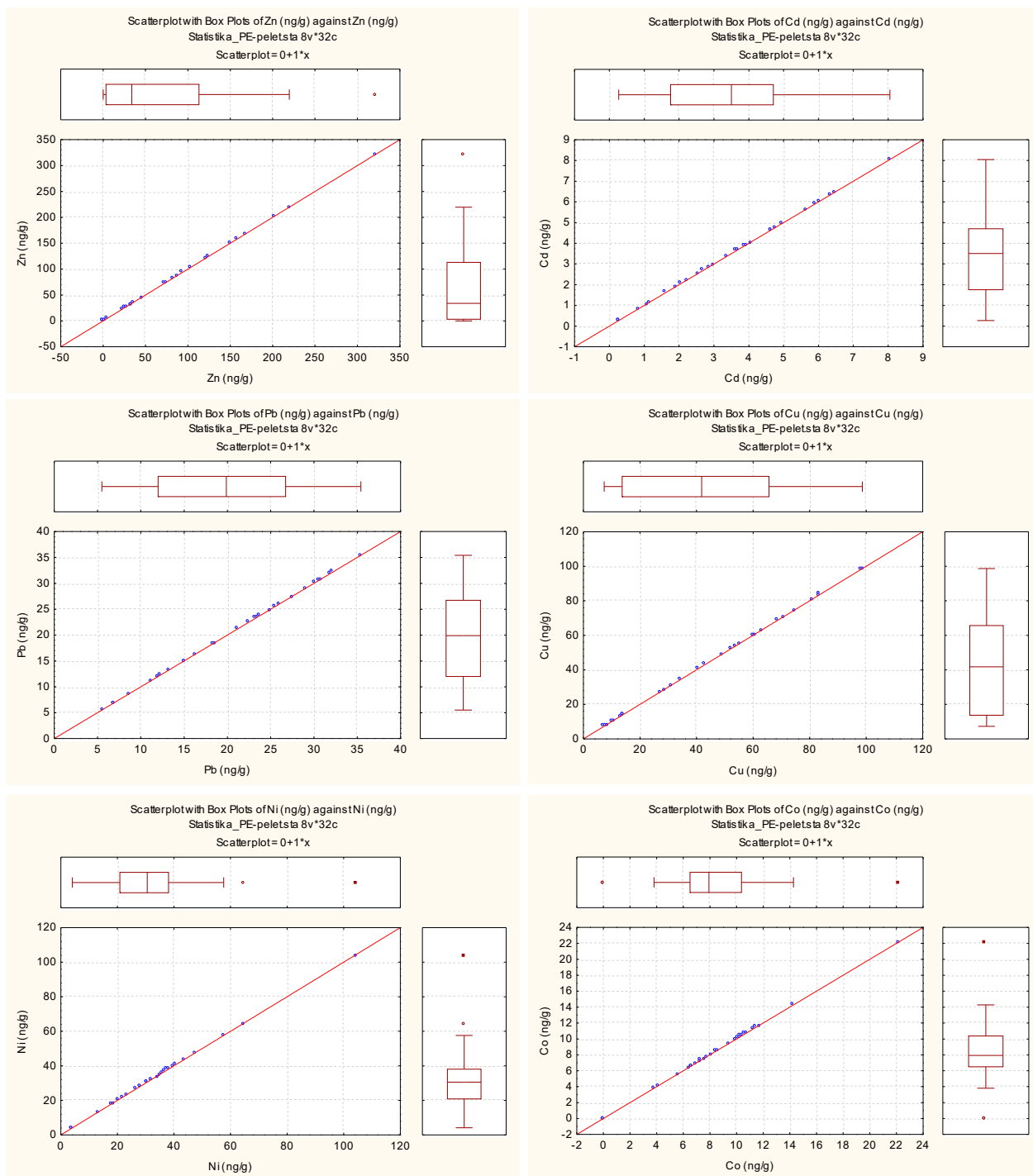


Figure S1. Scatterbox with boxplot for PE pellets samples.

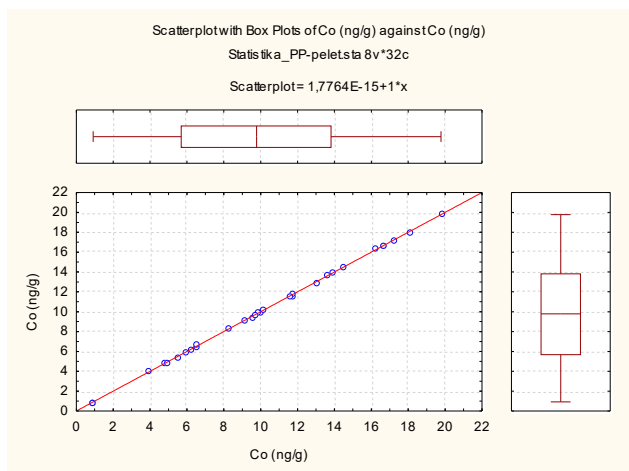
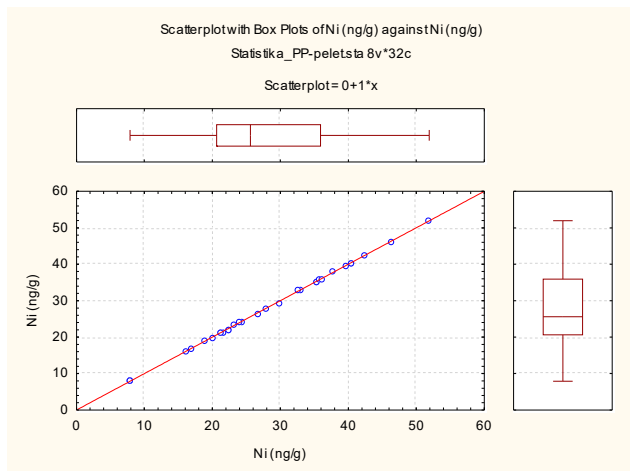
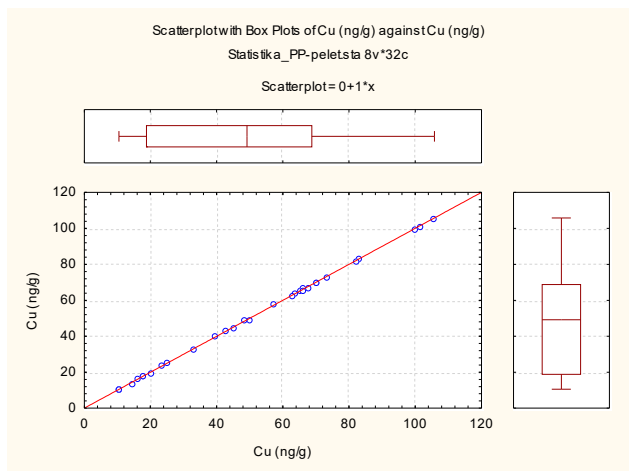
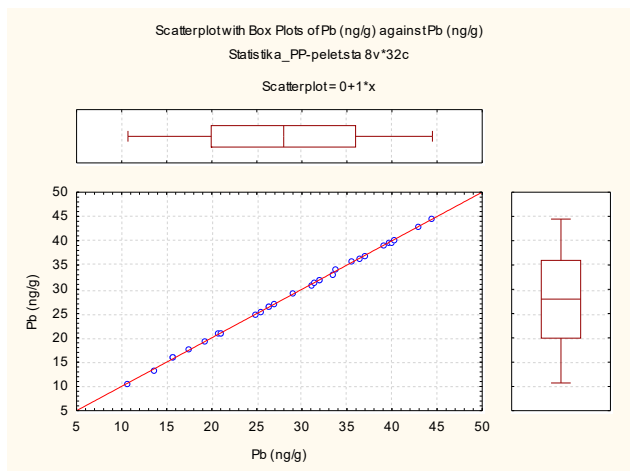
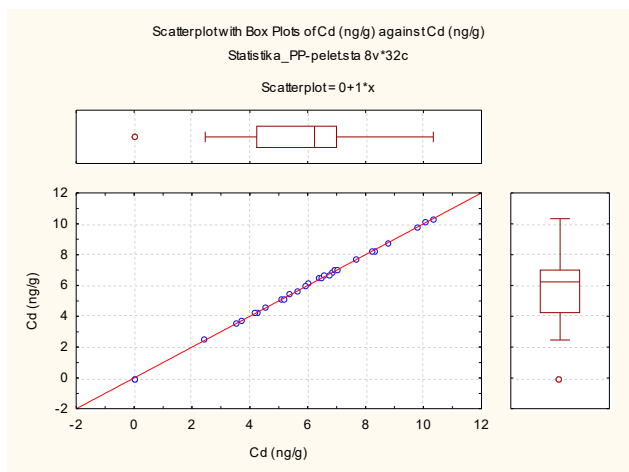
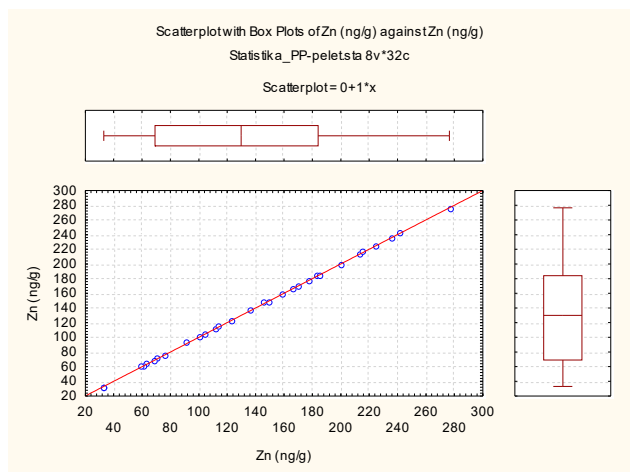
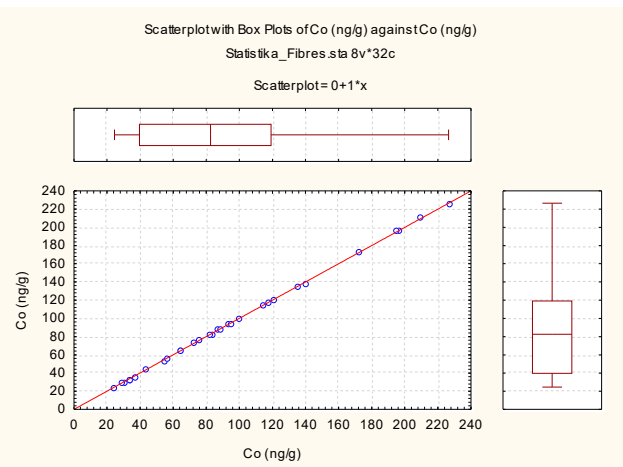
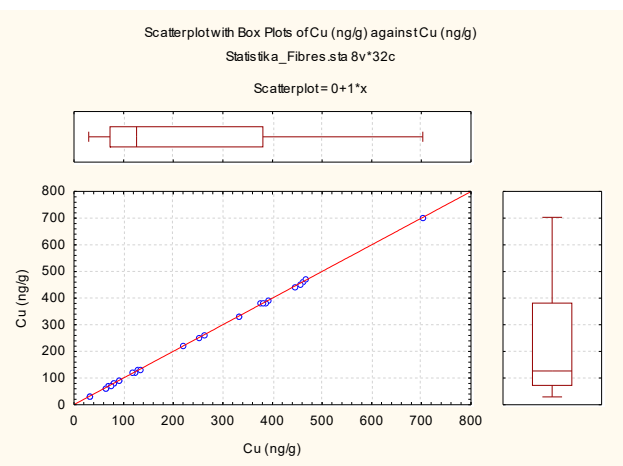
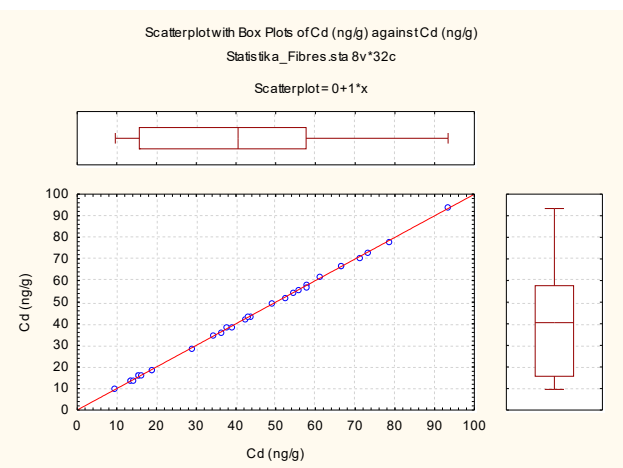


Figure S2. Scatterbox with boxplot for PP pellets samples.



Dependent: Zn (ng/g) Multiple R = .03298331 F = .0326725
R2= .00108790 df = 1.30
No. of cases: 32 adjusted R2= -.03220917 p = .857775
Standard error of estimate: 79.694534346
Intercept: 69.265158050 Std. Error: 17.57794 t(30) = 3.9405 p = .0004

HA concentrat beta=.033

Multiple Regression Results

Dependent: Cd (ng/g) Multiple R = .37099947 F = 4.788280
R2= .13764061 df = 1.30
No. of cases: 32 adjusted R2= .10889529 p = .036577
Standard error of estimate: 1.953544153
Intercept: 2.769563445 Std.Error: .4308863 t(30) = 6.4276 p = .0000

HA concentrat beta=.371

Multiple Regression Results

Dependent: Pb (ng/g) Multiple R = .36185089 F = 4.519900
R2= .13093607 df = 1.30
No. of cases: 32 adjusted R2= .10196727 p = .041846
Standard error of estimate: 8.555526983
Intercept: 17.084786024 Std.Error: 1.887062 t(30) = 9.0536 p = .0000

HA concentrat beta=.362

Multiple Regression Results

Dependent: Cu (ng/g) Multiple R = .13104980 F = .5242245
R2= .01717405 df = 1.30
No. of cases: 32 adjusted R2= -.01558682 p = .474654
Standard error of estimate: 29.370822458
Intercept: 40.366178737 Std.Error: 6.478218 t(30) = 6.2311 p = .0000

HA concentrat beta=.131

Multiple Regression Results

Dependent: Ni (ng/g) Multiple R = .22837148 F = 1.650696
R2= .05215353 df = 1.30
No. of cases: 32 adjusted R2= .02055865 p = .208696
Standard error of estimate: 19.272253600
Intercept: 28.437607549 Std.Error: 4.250813 t(30) = 6.6899 p = .0000

HA concentrat beta=.228

Multiple Regression Results

Dependent: Co (ng/g) Multiple R = .08751572 F = .2315434
R2= .00765900 df = 1.30
No. of cases: 32 adjusted R2= -.02541903 p = .633873
Standard error of estimate: 4.545486142
Intercept: 7.670236795 Std.Error: 1.002582 t(30) = 7.6505 p = .0000

HA concentrat beta=.088

(significant betas are highlighted)

PP PELLET:

Multiple Regression Results

Dependent: Zn (ng/g) Multiple R = .03104432 F = .0289404
R2= .00096375 df = 1.30
No. of cases: 32 adjusted R2= -.03233746 p = .866059
Standard error of estimate: 70.939514339
Intercept: 134.68500206 Std.Error: 15.64688 t(30) = 8.6078 p = .0000
HA concentrat beta=-.03

Multiple Regression Results

Dependent: Cd (ng/g) Multiple R = .00748388 F = .0016803
R2= .00005601 df = 1.30
No. of cases: 32 adjusted R2= -.03327546 p = .967574
Standard error of estimate: 2.886592851
Intercept: 5.613141740 Std.Error: .6366856 t(30) = 8.8162 p = .0000
HA concentrat beta=.007

Multiple Regression Results

Dependent: Pb (ng/g) Multiple R = .48078913 F = 9.019730
R2= .23115818 df = 1.30
No. of cases: 32 adjusted R2= .20553012 p = .005346
Standard error of estimate: 8.527019891
Intercept: 24.590410183 Std.Error: 1.880774 t(30) = 13.075 p = .0000
HA concentrat beta=.481

Multiple Regression Results

Dependent: Cu (ng/g) Multiple R = .17525470 F = .9506239
R2= .03071421 df = 1.30
No. of cases: 32 adjusted R2= -.00159532 p = .337357
Standard error of estimate: 29.305524343
Intercept: 45.258527420 Std.Error: 6.463816 t(30) = 7.0018 p = .0000
HA concentrat beta=.175

Multiple Regression Results

Dependent: Ni (ng/g) Multiple R = .06454020 F = .1254858
R2= .00416544 df = 1.30
No. of cases: 32 adjusted R2= -.02902905 p = .725637
Standard error of estimate:11.811253619
Intercept: 26.811847411 Std.Error: 2.605166 t(30) = 10.292 p = .0000
HA concentrat beta=.065

Multiple Regression Results

Dependent: Co (ng/g) Multiple R = .03070324 F = .0283073
R2= .00094269 df = 1.30
No. of cases: 32 adjusted R2= -.03235922 p = .867517
Standard error of estimate: 5.480846213
Intercept: 9.543362824 Std.Error: 1.208891 t(30) = 7.8943 p = .0000
HA concentrat beta=.031

(significant betas are highlighted)

PP FIBERS:

Multiple Regression Results

Dependent: Zn (ng/g) Multiple R = .09883283 F = .2959284
R2= .00976793 df = 1.30
No. of cases: 32 adjusted R2= -.02323981 p = .590467
Standard error of estimate:195.78196965
Intercept: 323.06226863 Std.Error: 43.18293 t(30) = 7.4812 p = .0000
HA concentrat beta=.099

Multiple Regression Results

Dependent: Cd (ng/g) Multiple R = .11347336 F = .3913249
R2= .01287620 df = 1.30
No. of cases: 32 adjusted R2= -.02002792 p = .536334
Standard error of estimate:23.381492086
Intercept: 38.965341725 Std.Error: 5.157173 t(30) = 7.5556 p = .0000
HA concentrat beta=.113

Multiple Regression Results

Dependent: Pb (ng/g) Multiple R = .72106194 F = 32.49093

R2= .51993032 df = 1.30
No. of cases: 32 adjusted R2= .50392800 p = .000003
Standard error of estimate:55.896635250
Intercept: 83.430404010 Std.Error: 12.32892 t(30) = 6.7670 p = .0000
HA concentrat beta=.721

Multiple Regression Results

Dependent: Cu (ng/g) Multiple R = .67375554 F = 24.93967
R2= .45394653 df = 1.30
No. of cases: 32 adjusted R2= .43574475 p = .000024
Standard error of estimate:133.51959108
Intercept: 126.81770855 Std.Error: 29.44994 t(30) = 4.3062 p = .0002
HA concentrat beta=.674

Multiple Regression Results

Dependent: Ni (ng/g) Multiple R = .39506511 F = 5.548243
R2= .15607644 df = 1.30
No. of cases: 32 adjusted R2= .12794565 p = .025232
Standard error of estimate:44.408782404
Intercept: 62.382013130 Std.Error: 9.795088 t(30) = 6.3687 p = .0000
HA concentrat beta=.395

Multiple Regression Results

Dependent: Co (ng/g) Multiple R = .15549587 F = .7433422
R2= .02417897 df = 1.30
No. of cases: 32 adjusted R2= -.00834840 p = .395432
Standard error of estimate:57.830872004
Intercept: 85.385569542 Std.Error: 12.75555 t(30) = 6.6940 p = .0000
HA concentrat beta=.155

(significant betas are highlighted)