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MDPI

Supplementary Materials

Environmental Background Values and Ecological Risk Assessment of Heavy Metals in Watershed Sediments: A Comparison of Assessment Methods

Jianbo Liao *, Xinyue Cui, Hai Feng and Shangkun Yan

Center for Eco-Environmental Engineering, Dongguan University of Technology, Dongguan 523808, China; cxy_xinyue@163.com (X.C.); 13475681739@163.com (H.F.); kun18127272848@163.com (S.Y.)
* Correspondence: author: liaojb@dgut.edu.cn

Tables

Table S1. Classifications for index of geoaccumulation (I_{geo}).

Class	I_{geo} Value	Pollution Level
1	$I_{geo} \leq 0$	unpolluted
2	$0 < I_{geo} \leq 1$	unpolluted to moderately polluted
3	$1 < I_{geo} \leq 2$	moderately polluted
4	$2 < I_{geo} \leq 3$	moderately to heavily polluted
5	$3 < I_{geo} \leq 4$	heavily polluted
6	$4 < I_{geo} \leq 5$	heavily to extremely polluted
7	$I_{geo} > 5$	extremely polluted

Table S2. Classifications for enrichment factor (*EF*).

Class	*EF* Value	Enrichment Level
1	$EF \leq 1$	no enrichment
2	$1 < EF \leq 3$	minor enrichment
3	$3< EF \leq 5$	moderate enrichment
4	$5 < EF \leq 10$	moderately severe enrichment
5	$10 < EF \leq 25$	severe enrichment
6	$25 < EF \leq 50$	very severe enrichment
7	$EF > 50$	extremely severe enrichment

Table S3. Classifications for modified contamination degree (mC_d).

Class	mC_d Value	Contamination Level
1	$mC_d \leq 1.5$	non to very low degree
2	$1.5 < mC_d \leq 2$	low degree
3	$2 < mC_d \leq 4$	moderate degree
4	$4 < mC_d \leq 8$	high degree
5	$8 < mC_d \leq 16$	very high degree
6	$16 < mC_d \leq 32$	extremely high degree
7	$mC_d > 32$	ultra high degree

Table S4. Sediment quality guidelines for metals in freshwater ecosystems that reflect *TECs* (below which harmful effects are unlikely to be observed) and *PECs* (above which harmful effects are likely to be observed), and toxicity coefficients (T_r^i) of heavy metals.

Metals	Cr	Ni	Cu	Zn	As	Cd	Tl	Pb	Hg
TEL	37.3	18	35.7	123	5.9	0.596	-	35	0.174
PEL	90	36	197	315	17	3.53	-	91.3	0.486
ERL	80	30	70	120	33	5	-	35	0.15
ERM	145	50	390	270	85	9	-	110	1.3

SEL	110	75	110	820	33	10	-	250	2
T_r^i	2	5	5	1	10	30	-	5	40

TEL: Threshold effect level, dry weight; *ERL*: Effect range low, dry weight; *PEL*: Probable effect level, dry weight; *ERM*: Effect range median, dry weight; *SEL*: Severe effect level, dry weight.

Table S5. Classifications for potential ecological risk index (*RI*).

Class	***RI*** **Value**	Ecological Risk Level
1	$RI \leq 150$	low ecological risk
2	$150 < RI \leq 300$	moderate ecological risk
3	$300 < RI \leq 600$	considerable ecological risk
4	$RI > 600$	very high ecological risk

Table S6. Classifications for toxic risk index (*TRI*).

Class	***TRI*** **Value**	Toxic Risk Degree
1	$TRI \leq 5$	no toxic risk
2	$5 < TRI \leq 10$	low toxic risk
3	$10 < TRI \leq 15$	moderate toxic risk
4	$15 < TRI \leq 20$	considerable toxic risk
5	$TRI > 20$	very high toxic risk

Table S7. Classifications for modified hazard quotient (*mHQ*).

Class	***mHQ*** **Value**	Contamination Degree
1	$mHQ \leq 0.5$	nil to very low severity of contamination
2	$0.5 < mHQ \leq 1.0$	very low severity of contamination
3	$1.0 < mHQ \leq 1.5$	low severity of contamination
4	$1.5 < mHQ \leq 2.0$	moderate severity of contamination
5	$2.0 < mHQ \leq 2.5$	considerable severity of contamination
6	$2.5 < mHQ \leq 3.0$	high severity of contamination
7	$3.0 < mHQ \leq 3.5$	very high severity of contamination
8	$mHQ > 3.5$	extreme severity of contamination

Table S8. Classifications for mean ERM quotient (*mERMQ*).

Class	***mERMQ*** **Value**	Toxicity Degree
1	$mERMQ \leq 0.1$	9% probability of toxicity
2	$0.1 < mERMQ \leq 0.5$	21% probability of toxicity
3	$0.5 < mERMQ \leq 1.5$	49% probability of toxicity
4	$mERMQ > 1.5$	76% probability of toxicity

Table S9. Classifications for contamination severity index (*CSI*).

Class	***CSI*** **Value**	Severity Degree
1	$CSI \leq 0.5$	uncontaminated
2	$0.5 < CSI \leq 1$	very low severity
3	$1 < CSI \leq 1.5$	low severity
4	$1.5 < CSI \leq 2$	low to moderate severity
5	$2 < CSI \leq 2.5$	moderate severity
6	$2.5 < CSI \leq 3$	moderate to high severity
7	$3 < CSI \leq 4$	high severity
8	$4 < CSI \leq 5$	very high severity
9	$CSI > 5$	ultra high severity

Table S10. The loading value, eigen value and w_i based on principal component analysis and factor analysis.

Heavy Metals	Loading Value	Eigen Value	Loading Value × Eigen Value	w_i
Cr	0.824	5.773	4.757	0.11
Ni	0.475		2.742	0.064
Cu	0.879		5.074	0.118
Zn	0.916		5.288	0.123
As	0.947		5.467	0.127
Cd	0.911		5.259	0.122
Tl	0.817		4.716	0.11
Pb	0.951		5.49	0.128
Hg	0.731		4.22	0.098
Sum	-		43.014	-

Table S11. Heavy metal concentrations in surface sediments used as control values, all data in mean concentrations, dry weight, mg/kg.

Metals	Cr	Ni	Cu	Zn	As	Cd	Tl	Pb	Hg	Fe
K1	25.39	7.64	16.19	36.47	5.02	0.24	0.56	20.48	0.25	25500
K2	39.42	7.34	12.25	29.51	6.78	0.18	0.65	25.43	0.16	54470
K3	28.68	11.12	11.21	27.46	4.89	0.23	0.48	19.46	0.34	21570
Mean	31.16	8.7	13.22	31.15	5.56	0.22	0.56	21.79	0.25	33846

Figures

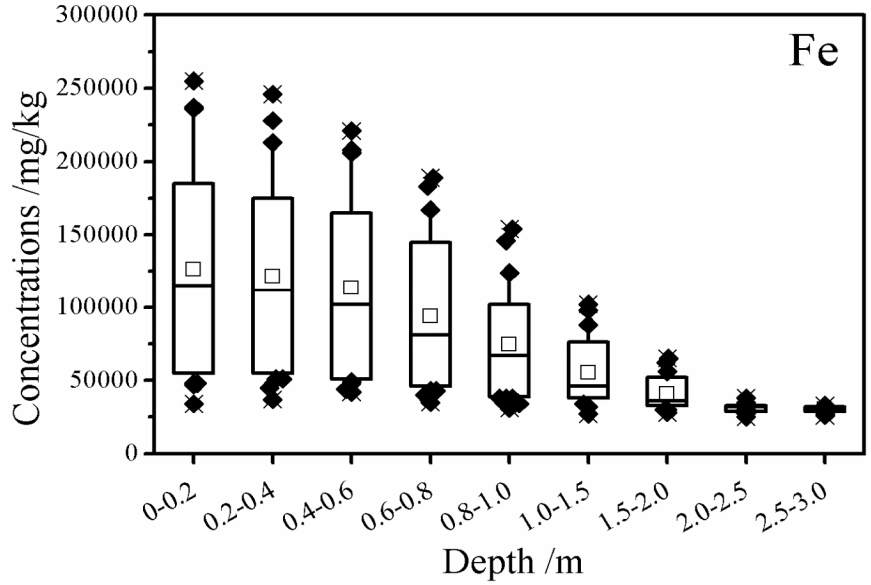

Figure S1. Vertical variations of Fe in sediments, all data in mean concentrations, dry weight, mg/kg. The boxes represent 25th and 75th percentiles, the middle horizontal lines represent the 50th percentile, the vertical line ends represent 1th and 99th percentiles, the small squares in the middle represent the mean value, and the diamond black dots represent outliers.

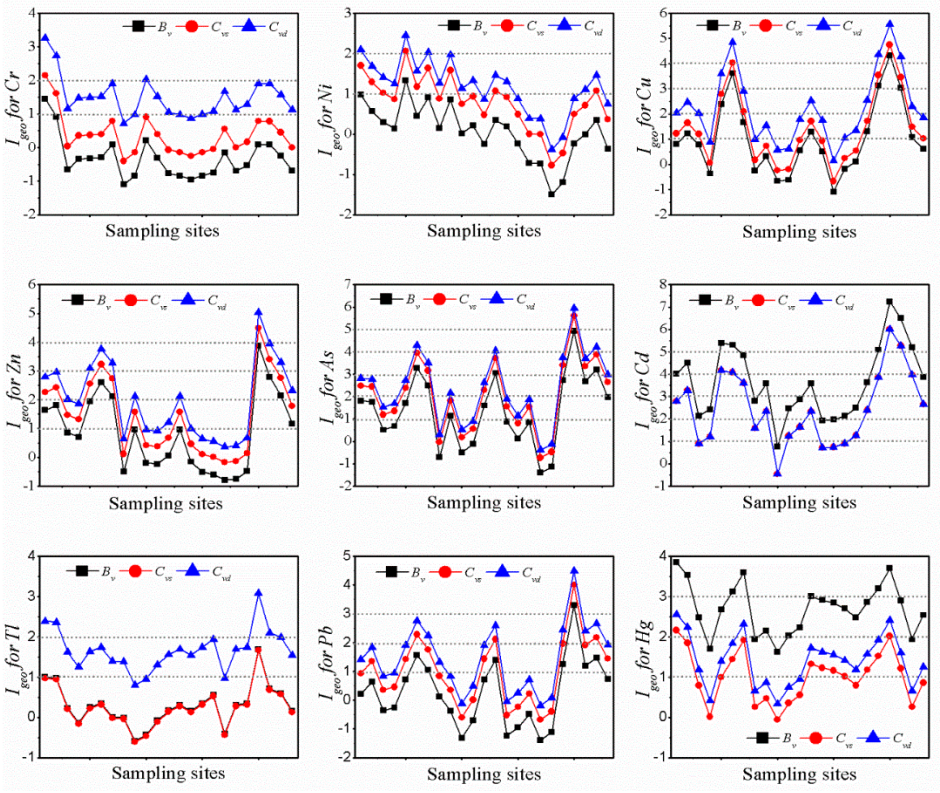

Figure S2. The distribution of I_{geo} values for Cr, Ni, Cu, Zn, As, Cd, Tl, Pb and Hg in the whole investigated region based on different types of background values.

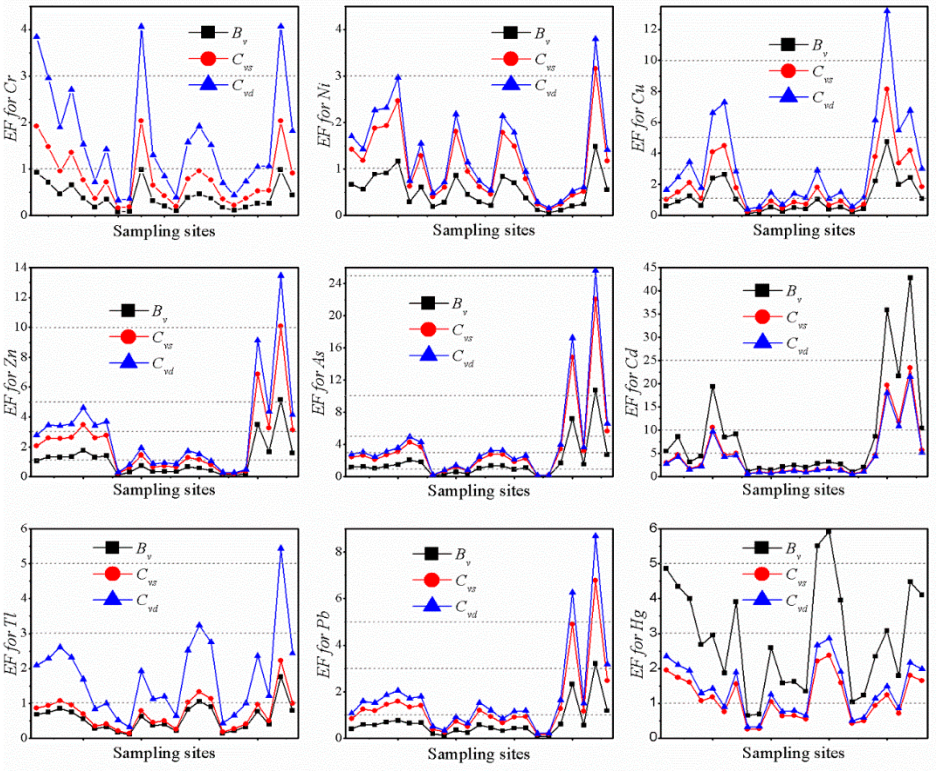

Figure S3. The distribution of *EF* values for Cr, Ni, Cu, Zn, As, Cd, Tl, Pb and Hg in the whole investigated region based on different types of background values.

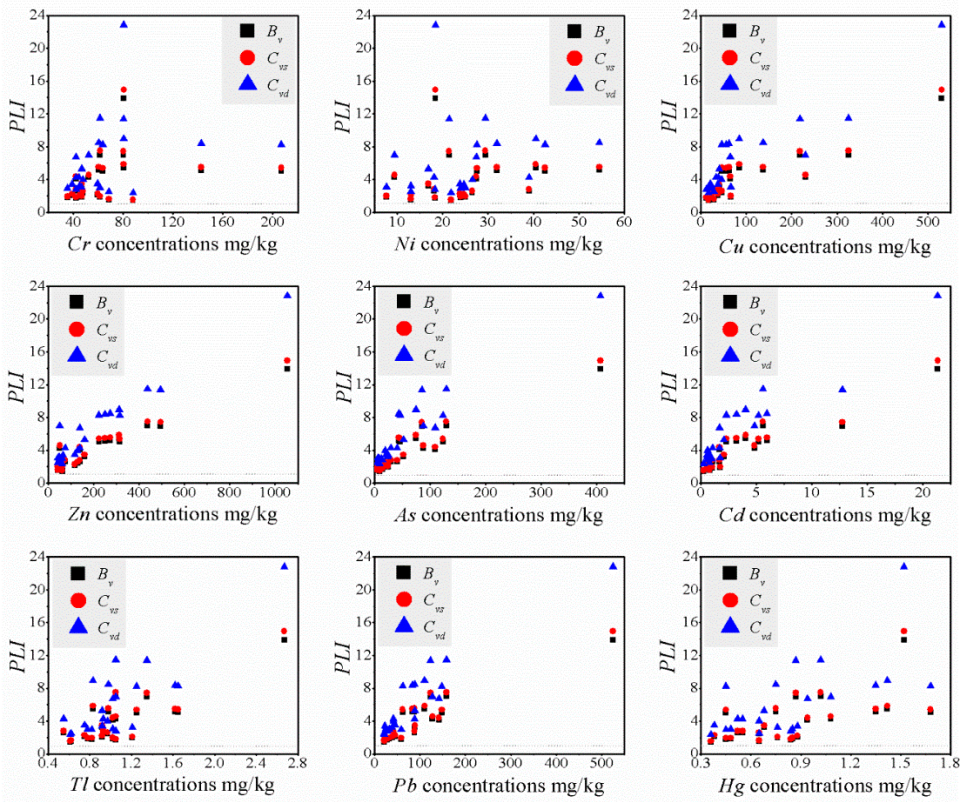

Figure S4. The *PLI* values of Cr, Ni, Cu, Zn, As, Cd, Tl, Pb and Hg in sediments were calculated based on different types of background values and total concentrations.

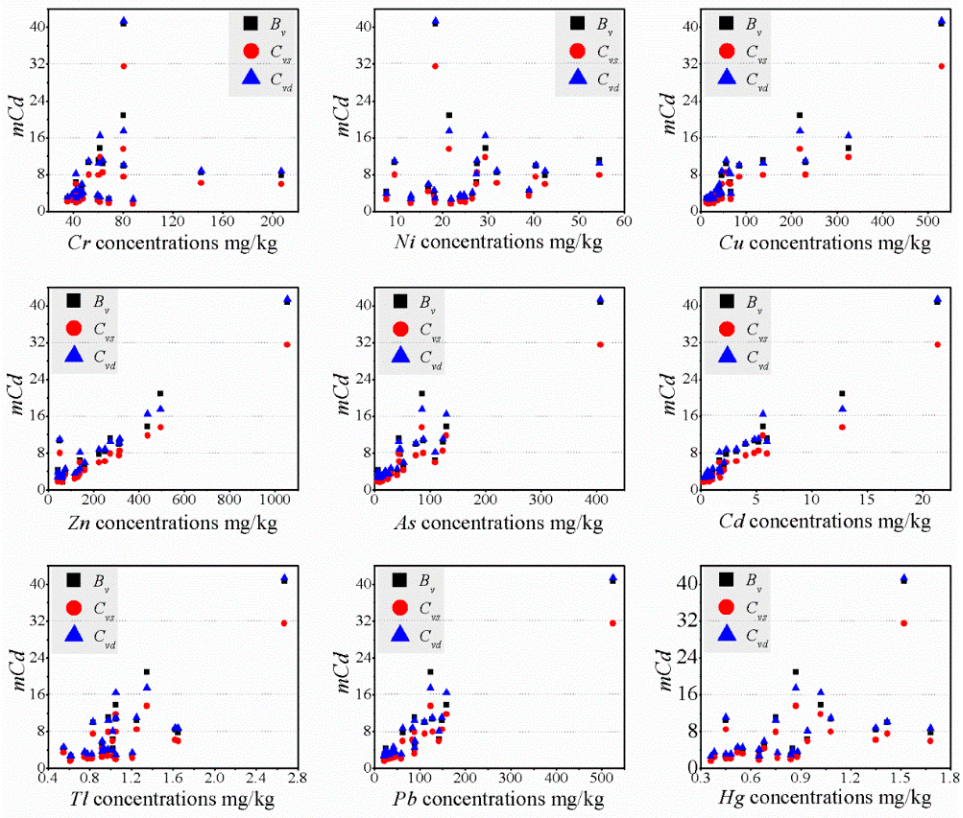

Figure S5. The *mCd* values of Cr, Ni, Cu, Zn, As, Cd, Tl, Pb and Hg in sediments were calculated based on different types of background values and total concentrations.

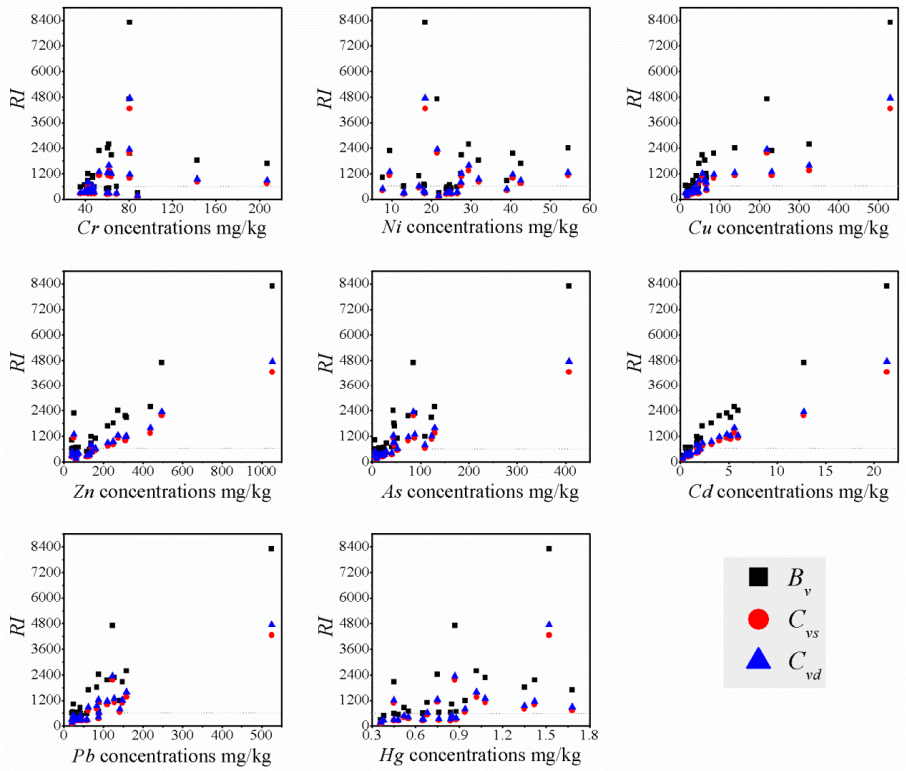

Figure S6. The *RI* values of Cr, Ni, Cu, Zn, As, Cd, Pb and Hg in sediments were calculated based on different types of background values and total concentrations.

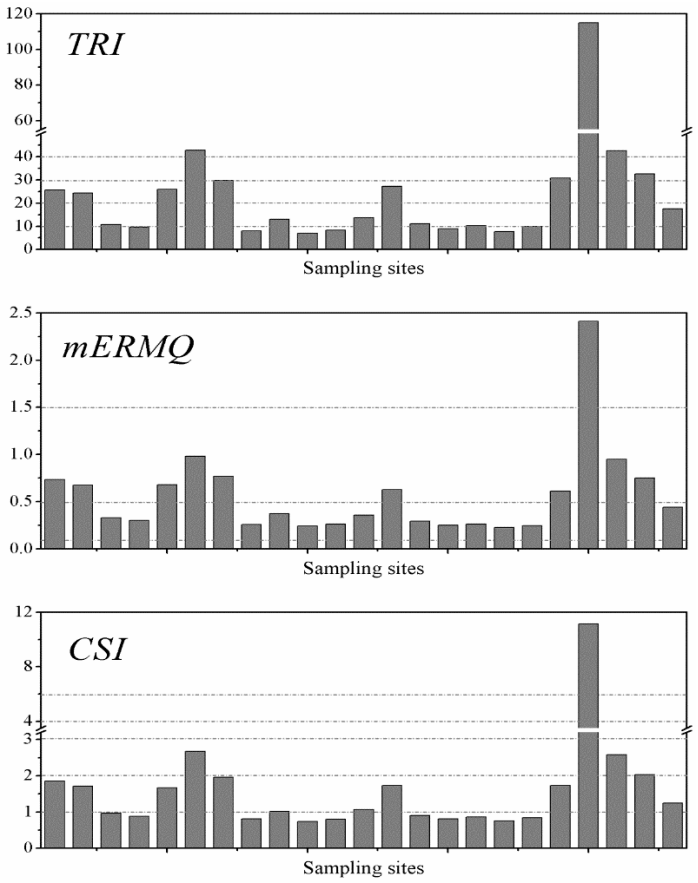

Figure S7. The distribution of the *TRI, mERMQ and CSI* values for Cr, Ni, Cu, Zn, As, Cd, Pb and Hg in sediments in the whole investigated region based on different types of SQG values.

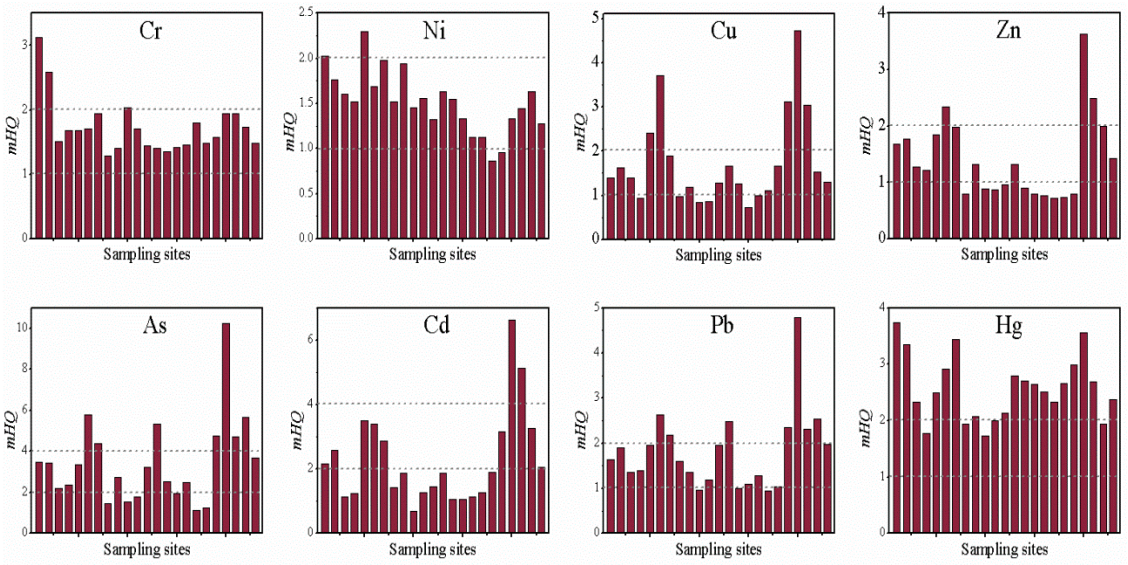

Figure S8. The distribution of the *mHQ* values for Cr, Ni, Cu, Zn, As, Cd, Pb and Hg in sediments in the whole investigated region based on different types of SQG values.