Supplementary Material

Risk Assessment and Source Apportionment of Heavy Metals in Soils from Handan City

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Table S1 Classification standard of *PI*, I_{geo}, *NIPI*, *PLI* and *PERI*

Class	*PI*	*Igeo*	*NIPI*	*PLI*	*PERI*	
					E_i	*RI*
Class I	0-1: No pollution	<0: Uncontaminated	≤0.7 : Safety	≤1: Low level	E_i < 40: Low risk	*RI* ≤ 150: Low risk
Class II	1-2: low pollution	0-1: Uncontaminated to moderately contaminated	0.7–1.0 : Precaution	1.-2: Moderate level	40 ≤ E_i < 80: Moderate risk	150 < *RI* ≤ 300: Moderate risk
Class III	2-3: Moderate pollution	1-2: Moderately contaminated	1.0-2.0 : Slightly pollution	2-5: High level	80 ≤ E_i < 160: Considerable risk	300 < *RI* ≤ 600: Considerable risk
Class IV	>3: Heavy Contamination	2-3: Moderately to heavily contaminated	2.0-3.0 : Moderately polluted	>5: Extremely high level	160 ≤ E_i < 320: High risk	*RI* > 600: high risk
Class V		3-4: Heavily contaminated	>3 : Severely polluted		E_i ≥ 320: Very high risk	
Class VI		4-5: Heavily to extremely contaminated				
Class VII		>5: Extremely contaminated				

Table S2 Abbreviation and reference values for health risk assessment parameters

Parameter	Abbreviation	Unit		value	References
Soil ingestion rate	IngR	mg/day	children	200	(MEPPRC, 2014)
			adult	100	
Exposure frequency	EF	day/year		350	
Exposure duration	ED	year	children	6	(MEPPRC, 2014)
			adult	24	
Exposure body weight	EBW	kg	children	15.9	(MEPPRC, 2014)
			adult	56.8	
Carcinogens average time	AT	day		25550	(US EPA, 2011)
non-carcinogens average time				*ED*×365	
Exposed skin surface area	SA	cm^2	children	2448	(MEPPRC, 2014)
			adult	5075	
Adherence factor	AF	$mg/cm^2 \cdot day$	children	0.2	(MEPPRC, 2014)
			adult	0.07	
Dermal absorption factor	ABS	unitless		0.001	(US EPA, 2011)
Soil inhalation rate	InhR	m^3/day	children	7.5	(MEPPRC, 2014)
			adult	14.5	
Particle emission factor	PEF	$10^9\ m^3/kg$		1.36	(US EPA, 2002)

MEPPRC, Technical Guidelines for Risk Assessment of Contaminated Sites, HJ 25.3-2014, 2014,

US EPA, 2011. Exposure Factors Handbook, final ed. US Environmental Protection Agency, Washington, DC [EPA/600/R-09/052F].

US EPA, 2002. Risk-based Concentration Table. United States Environmental Protection Agency, Washington DC.

Table S3 Reference dose (RfD) and slope factor (SF) of each heavy metal

	Cd	Cr	Cu	Mn	Ni	Pb	Zn
RfD for ingestion	1.00E-03[a]	3.00E-03[a]	4.00E-02[a]	4.60E-02[e]	2.00E-02[a]	3.50E-03[a]	3.00E-01[a]
RfD for dermal absorption	1.00E-05[a]	6.00E-05[a]	1.20E−02[a]	1.84E-03[e]	5.40E−03[a]	5.25E−04[a]	6.00E-02[a]
RfD for inhalation	1.00E-05[a]	2.86E-05[a]	4.02E-02[b]	1.43E-05[e]	9.00E-05[a]	3.52E−03[b]	3.00E-01[c]
SF for ingestion	6.10E+00[d]	5.00E-01[a]	-		1.70E+00[c]	8.50E-03[a]	-
SF for dermal absorption	-	2.00E+01[c]	-		4.25E+01[c]	-	-
SF for inhalation	6.30E+00[a]	4.20E+01[a]	-		8.40E-01[a]	-	-

Note: -: not applicable.

[a] Chen, H., Teng, Y., Lu, S., Wang, Y., Wu, J., Wang, J. 2016. Source apportionment and health risk assessment of trace metals in surface soils of Beijing metropolitan, China. Chemosphere 144, 1002-1011.

[b] Li, H., Chen, L., Yu, L., Guo, Z., Shan, C., Lin, J., Gu, Y., Yang, Z., Yang, Y., Shao, J., Zhu, X., Chen, Z. 2017. Pollution characteristics and risk assessment of human exposure to oral bioaccessibility of heavy metals via urban street dusts from different functional areas in Chengdu, China. Sci. Total Environ 586, 1076-1084.

[c] Cao S., Duan X., Zhao X., Ma J., Dong T., Huang N., et al. Health risks from the exposure of children to As, Se, Pb and other heavy metals near the largest coking plant in China. Sci. Total Environ. 2014; 472: 1001-9.

[d] Yang, S., He, M., Zhi, Y., Chang, S., Gu, B., L, X. 2019. An integrated analysis on source-exposure risk of heavy metals in soils near intense electronic waste recycling activities. Environ Pollut 133, 105239.

[e] Teng, Y., Li, J., Wu, J., Lu, S., Wang, Y., Chen, H., 2015. Environmental distribution and associated human health risk due to trace elements and organic compounds in soil in Jiangxi province, China. Ecotox. Environ. Safe. 122, 406-416.

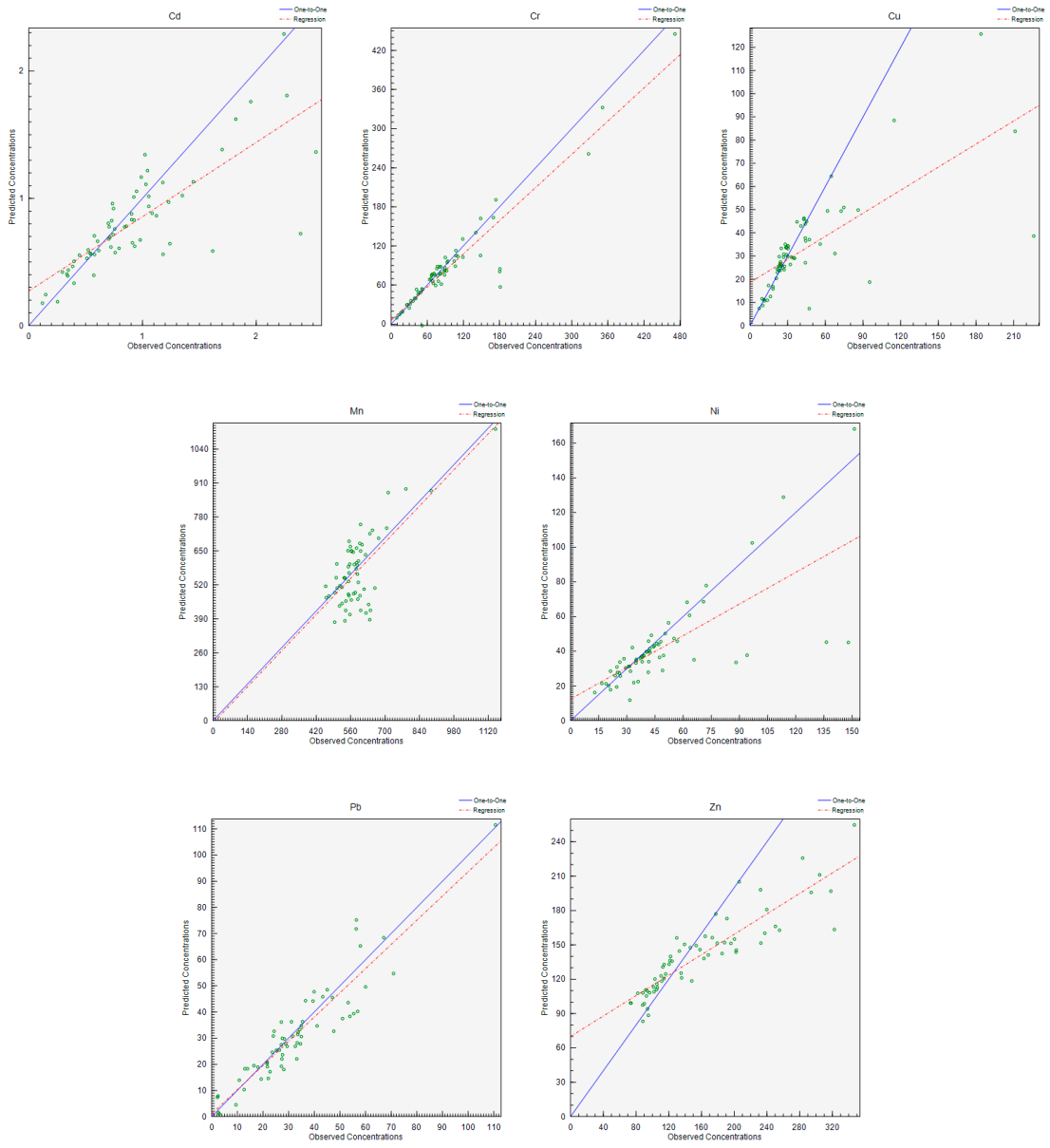

Figure. S1. Scatter plots of predicted and observed concentrations of species using the PMF model.