Supporting Information

Spatial distribution, migration and ecological risk of heavy metals of sediments and soils surrounding sulfide mines - A case study of the Dabaoshan mine of Guangdong, China

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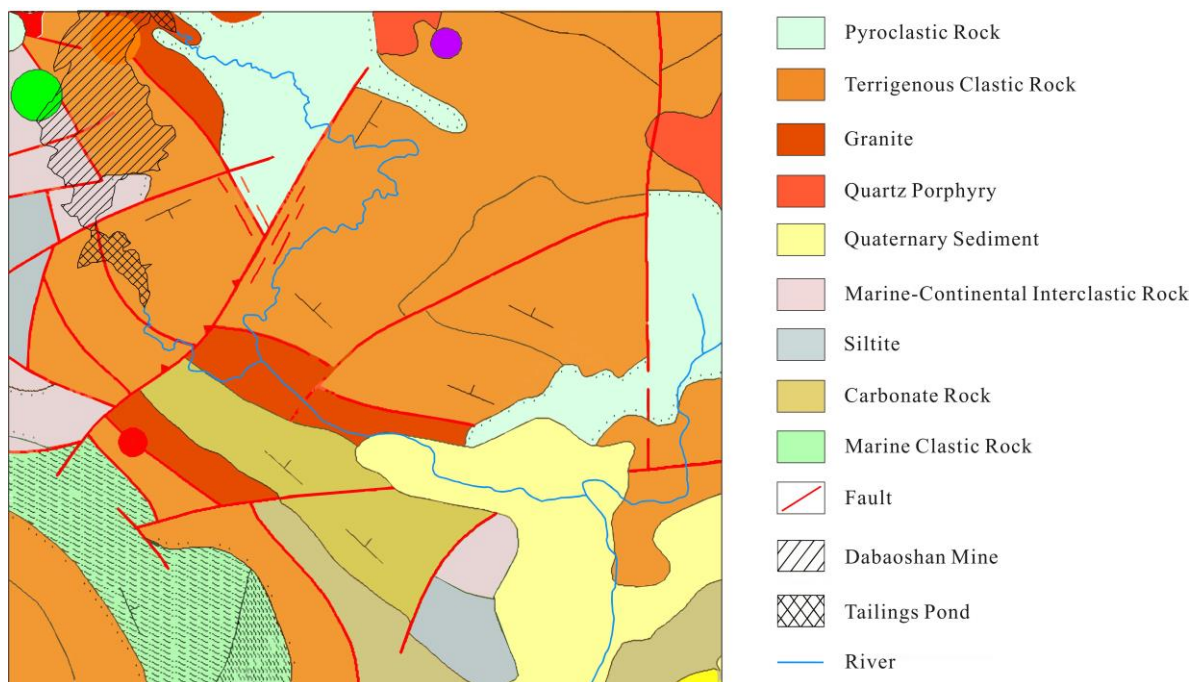
Figure S1 The geological map of study area (modified by National Geological Archive)

The quality control analysis of data

The national standard materials (GBW) were used for controlling the accuracy and precision of the analytical methods. Accuracy and Precision are shown by calculating the logarithm deviation ($\overline{\Delta \lg C}$) and relative standard deviation (RSD) between measurements and standard valuesand, respectively, and are calculated using followed formula:

$$\overline{\Delta \lg C}\ (GBW) = |lg\overline{C_\iota} - lgC_s|$$

$$\text{RSD (\%)} = 100\% \times \sqrt{\sum\nolimits_{i=1}^{n}(C_i - C_s)^2/(n-1)}\ /C_s$$

Where C_i is the single measure value for each GBW standard material, $\overline{C_\iota}$ is the average of 12 measured values for each GBW standard material, C_s is the standard value of GBW standard materials and n is the number of measurements for each GBW standard material.

The accuracy and precision of tests for elements concentration in soil, sediments and rice grains all meet the requirements of Specification of Multi-Purpose Regional Geochemical Survey (DZ/T 0258-2014).

Table S1. The Risk Screening Values (RSVs) and Risk Intervention Values (RIVs) for Cd, Pb and Zn in "Soil Environment Quality: Risk Control Standard for Soil Contamination of Agricultural Land" (GB15618-2018)

	Cd	Pb	Zn
RSV (mg/kg)	0.4	100	200
RIV (mg/kg)	2	500	-

Table S2. The Threshold Effect Level (TEL) and Probable Effect Level (PEL) of Cd, Pb, and Zn in Sediment Quality Guidelines (SQGs)

	Cd	Pb	Zn
TEL (mg/kg)	0.68	30.2	124
PEL (mg/kg)	4.21	112	271

Table S3. The concentrations of Cd, Pb, Zn, oxides and physicochemical properties of natural forest soil sampled in study area

	Al_2O_3	CaO	K_2O	MgO	Mn	Na_2O	SiO_2	TFe_2O_3	Cd	Pb	Zn	CEC	pH	SOM	$CaCl_2$-extracted Cd
NFS01	11.22	0.23	1.92	0.52	386	0.11	75.04	4.46	1.02	57.6	161.3	6.51	5.67	0.81	0.13
NFS02	10.46	0.68	2.20	0.85	951	0.13	65.87	14.55	1.62	356.4	522.6	3.72	4.18	0.51	0.02
NFS03	13.12	0.25	2.87	0.92	444	0.14	63.66	14.18	0.66	1118.1	446.6	4.78	4.22	0.47	0.04
NFS04	8.08	0.19	1.33	0.35	546	0.13	82.04	4.07	0.36	46.1	73.9	3.99	5.81	0.51	0.05
NFS05	12.65	0.25	2.35	0.63	699	0.19	70.55	6.44	0.51	125.6	166.3	4.38	5.24	0.53	0.06
NFS06	8.81	0.26	2.88	0.51	383	0.26	81.15	3.43	0.22	55.0	80.7	4.25	6.09	0.51	0.03

Cd, Pb, Zn and Mn: mg/kg; CEC: cmol/kg; others: %

Table S4. The concentrations of Rice grain and concentrations of Cd, Pb, Zn, oxides and physicochemical properties of corresponding agricultural soils sampled in study area

| | Agriculture Soils | | | | | | | | | | | | | | Rice Grain | | |
	Al_2O_3/SiO_2	CaO	K_2O	MgO	Mn	Na_2O	TFe_2O_3	Cd	Pb	Zn	CEC	pH	SOM	$CaCl_2$-extracted Cd	Cd	Pb	Zn
FLS01	0.23	1.41	1.64	0.81	5069	0.12	8.83	0.56	38.7	259.0	7.84	6.60	0.28	0.01	0.70	0.06	18.2
FLS02	0.13	0.27	2.65	0.79	463	0.19	6.69	1.08	153.4	333.3	8.90	5.72	1.26	0.11	0.70	0.06	18.1
FLS03	0.16	0.80	2.17	0.79	2593	0.15	7.62	0.82	99.4	293.2	8.28	6.12	0.80	0.06	0.71	0.06	17.7
FLS04	0.13	0.48	2.34	0.69	1317	0.15	6.63	0.63	126.7	238.2	6.65	5.79	0.97	0.08	0.52	0.06	23.9
FLS05	0.13	0.19	2.89	0.69	203	0.16	7.12	0.66	194.4	251.8	5.18	5.53	1.17	0.10	0.63	0.07	21.2
FLS06	0.11	0.22	2.64	0.69	178	0.15	6.03	0.44	157.8	196.9	5.32	5.74	1.17	0.06	0.65	0.08	20.0
FLS07	0.07	0.15	1.70	0.40	103	0.12	2.92	0.20	57.1	80.5	5.04	5.46	0.94	0.14	0.78	0.12	22.4
FLS08	0.07	0.14	1.66	0.39	100	0.12	2.83	0.19	53.9	75.8	4.96	5.41	0.92	0.14	0.01	0.02	15.6
FLS09	0.07	0.14	1.31	0.37	149	0.12	2.58	0.18	60.7	90.4	5.85	5.20	1.20	0.19	1.37	0.17	18.2
FLS10	0.08	0.17	1.95	0.49	149	0.14	6.03	0.35	146.8	150.2	5.45	4.87	1.15	0.16	2.12	0.27	17.8
FLS11	0.09	0.23	1.92	0.51	182	0.15	4.83	0.41	117.6	164.8	6.58	5.00	1.14	0.13	2.69	0.39	16.9
FLS12	0.09	0.30	1.98	0.55	223	0.17	4.61	0.54	120.5	210.1	7.63	4.95	1.12	0.09	1.31	0.02	19.9
FLS13	0.10	0.37	1.99	0.58	257	0.19	4.82	0.64	146.3	259.5	8.50	4.66	1.05	0.04	1.59	0.12	19.1
FLS14	0.10	0.52	2.17	0.77	284	0.20	4.47	0.95	117.2	300.0	7.71	5.13	1.15	0.04	1.46	0.13	18.9
FLS15	0.11	0.23	2.12	0.51	197	0.20	4.19	0.32	85.5	174.3	7.71	5.68	1.07	0.09	1.33	0.13	18.9
FLS16	0.11	0.28	2.20	0.54	271	0.19	3.64	1.09	97.0	270.0	9.30	5.13	1.62	0.19	1.08	0.11	18.9
FLS17	0.11	0.38	2.30	0.55	267	0.21	4.57	0.69	109.3	214.4	10.10	5.70	1.39	0.10	0.76	0.07	18.6
FLS18	0.12	0.27	2.31	0.44	328	0.33	3.57	0.24	51.7	82.6	7.18	5.79	1.64	0.09	0.72	0.07	18.5

Cd, Pb, Zn and Mn: mg/kg; CEC: cmol/kg; others: %

Table S5. The concentrations of Cd, Pb, Zn, oxides and physicochemical properties of sediments sampled in study area

	Al_2O_3	CaO	K_2O	MgO	Mn	Na_2O	SiO_2	TFe_2O_3	Cd	Pb	Zn	CEC	pH	SOM	$CaCl_2$-extracted Cd
SST01	5.91	16.32	0.99	10.64	1228.5	0.15	23.44	4.38	5.29	547.5	1238.5	22.59	9.10	3.41	0.004
SST02	9.47	0.61	2.28	0.71	11104.2	0.14	66.57	13.49	2.65	200.5	573.1	9.57	7.50	1.22	0.010
SST03	13.31	4.19	2.21	2.96	2384.5	0.14	45.10	17.28	10.78	868.7	2597.0	7.44	8.34	1.33	0.004
SST04	8.73	7.58	1.76	6.48	2468.2	0.15	46.19	10.03	13.46	334.5	2780.5	3.45	9.09	0.79	0.003
SST05	6.60	10.36	1.16	3.86	7214.0	0.12	52.14	9.16	20.22	584.9	2497.9	1.33	9.12	0.60	0.005
SST06	13.34	1.59	3.10	0.82	2035.8	0.26	65.45	7.72	4.28	196.3	644.7	5.58	7.94	0.49	0.015
SST07	11.12	8.24	2.07	3.78	6416.1	0.15	45.16	9.85	15.46	452.7	3276.1	6.64	8.22	0.77	0.004

Cd, Pb, Zn and Mn: mg/kg; CEC: cmol/kg; others: %

Table S6. Pearson correlation coefficients between the bioconcentration factor of Cd (BCF_{Cd}) and soil properties in agricultural soils from the study area

	S	Na_2O	MgO	K_2O	CaO	TFe_2O_3	Corg	pH	Al_2O_3/SiO_2	Mn
BCF_{Cd}	-0.26	-0.50	-0.74**	-0.62*	-0.60*	-0.59*	-0.05	-0.38	-0.79**	-0.53*

*：Significant at p<0.05
**: Significant at p<0.01