Supplementary materials

Text S1

BCR method

Acid soluble fraction: 0.5 g dust sample after air drying and sieving was weighed in a 50 mL polyethylene centrifuge tube, and 20 mL CH_3COOH (0.11 mol/L, pH=2.85) was added to the centrifuge tube and placed in a thermostatic oscillator at 252 °C for 16 h. After standing, it was centrifuged at 3000 r/min for 10 min and filtered with a 0.45 μm microporous membrane. The concentrations of heavy metal(loid)s in the filtrate were determined by ICP-OES (Agilent 7500 Series, Thermo Scientific, USA). After adding 10 mL deionized water to the filter residue and washing twice, the washing liquid was discarded.

Reducible fraction: 20 mL $NH_2OH{\cdot}HCl$ (0.5 mol/L, pH=1.5) was added to the remaining solid filter residue in the acid extractable fraction, and placed in a thermostatic oscillator at 252 °C for 16 h. After standing, it was centrifuged at 3000 r/min for 10 min, and filtered with a 0.45 μm microporous membrane. The filtrate was determined by ICP-OES. After adding 10 mL deionized water to the filter residue and washing twice, the washing liquid was discarded.

Oxidizable fraction: 10 mL H_2O_2 (8.8 mol/L, adding a few drops of nitric acid to make pH of 2−3) was added to the remaining solid filter residue in the reducible fraction. It was placed in a thermostatic oscillator and shaken at 252 °C for 30 min. Then it was heated and evaporated in a 90 °C water bath. After cooling, 20 mL CH_3COONH_4 (l mol/L, adding a few drops of nitric acid to make pH=2) was added. It was placed in a thermostatic oscillator and shaken at (25±2) °C for 16 h. After standing, it was centrifuged at 3000 r/min for 10 min. The filtrate was filtered through a 0.45 μm microporous membrane, and the concentration of each heavy metal(loid) was determined by ICP-OES. The filter residue was washed twice with 10 mL deionized water, and then the washing liquid was discarded.

Residue fraction: The oxidizable residual fraction was transferred to the tetrafluoroethylene digestion tank after acid cleaning, and the digestion was carried out according to the experimental steps of heavy metal(loid) element analysis of solid samples, and the concentration of each heavy metal(loid) was determined by ICP-OES.

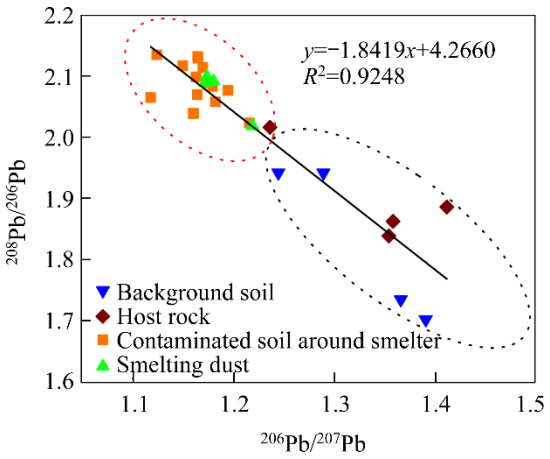

Figure S1 Correlation between $^{208}Pb/^{206}Pb$ and $^{206}Pb/^{207}Pb$ in different media

Table S1 Statistical table of Pb isotope ratio in soil near lead smelting plant

Sample	$^{208}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{206}Pb/^{204}Pb$	$^{206}Pb/^{207}Pb$	$^{208}Pb/^{206}Pb$	$^{208}Pb/^{207}Pb$
BD	38.694	15.681	18.503	1.180	2.091	2.467
BFD	38.612	15.675	18.394	1.173	2.099	2.463
SL-1	38.647	15.675	18.375	1.172	2.103	2.465
SL-2	38.600	15.671	18.378	1.173	2.100	2.463
SL-3	38.568	15.668	18.329	1.170	2.104	2.462

Table S2 Modal mineral phase composition of dust samples

Mineral species	Chemical formula	wt/%
Zinkosite	—	21.64
Rhodochrosite	$MnCO_3$	12.41
lead sulfate	$PbSO_4$	6.59
Hematite	Fe_2O_3	5.6
Calcium silica lead-zinc ore	$Zn_{1.74}Cd_{0.263}Fe_{0.216}Si_{0.983}Cl_{0.362}Mg_{0.258}S_{1.47}F_{0.44}O_4$	4.1
Psilomelane	mMnO·MnO_2·$n$$H_2O$	3.99
Anhydrite	$CaSO_4$	3.62
Galena	$Zn_{2.95}Cd_{0.292}Si_{0.127}Cl_{0.621}S_{1.3}O_{4.71}$	3.08
Paulmooreite	$Pb_5(AsO_4)_3Cl$	2.35
Pyrite	FeS_2	2.33
Others	—	34.29

Table S3 Modal mineral phase composition of topsoil samples

Mineral species	Chemical formula	wt/%
Quartz	SiO_2	25.61
Calcite	$CaCO_3$	18.96
Dolomite	$CaMg(CO_3)_2$	8.81
Muscovite	$Al_2K_2O_6Si$	8.68
Orthoclase	$KAlSi_3O_8$	5.70
Andesine	$(Na,Ca)[A1(A1,Si)Si_2O_8]$	5.06
Axinite	$(Ca,Fe,Mn,Mg)_3Al_2BSi$	4.36
Albite	$Na_2O·Al_2O_3·6SiO_2$	3.14
Hematite	Fe_2O_3	2.17
Pyrite	FeS_2	2.16
Fayalite	$(Mg,Fe)_2[SiO_4]$	1.54
Others	—	13.81