

## Supporting Information (SI)

### Text 1 PAH standards

A PAHs standard mixture, called PAH-Mix 16, included 16 targeted analytes: phenanthrene (PHE), Anthracene (AN), fluoranthene (FLA), pyrene (PY), benzo[a]anthracene (BaA), chrysene (CHR), benzo[b]fluoranthene (BbF), benzo[k]fluoranthene (BkF), benzo[a]pyrene (BaP), dibenzo[a,h]anthracene (DBA), indeno[1,2,3-cd]pyrene (IDP), benzo [g,h,i]perylene (BghiP), in hexane (200 µg/mL), and five internal standards of d<sub>8</sub>-naphthalene, d<sub>10</sub>-acenaphthene, d<sub>10</sub>-phenanthrene, d<sub>12</sub>-chrysene, and d<sub>12</sub>-perylene in dichloromethane (1000 µg/mL) were provided by TanMo Quality Testing Technology Co.,Ltd., USA. All standards were obtained with declared purity of > 98%. Working solutions were prepared in isooctane at concentrations of 1, 2, 5, 10, 20, 50, and 100 ng/mL and stored at -10°C in the refrigerator. Each calibration level contained relevant internal standards at 1 µg/mL.

### Text 2 Sample pretreatment

The Dionex ASE 350 Accelerated Solvent Extractor system (Thermo Fisher; USA) was used for the extraction of PAHs from soils and dust aerosols. Clean each extraction cell with soap and distilled de-ionized water (DDW, the conductivity of 18.25 MΩ) with agitation on a mechanical shaker (Model IKA Labor Technik KS 250 basic; Germany) set at 240 r/min for 10 min. Attach the bottom cell cap and then add a glass fiber filter, followed by 5 g of acidic alumina (Analytical purity; Sinopharm; China) and another filter. Before use, bake the alumina overnight at 350°C. When determining the concentrations of PAHs, aerosol filters were cut into small pieces, then mixed well with the appropriate amount of diatomaceous earth (DE; 98%; Thermo Fisher; USA), which were all filled into the 34 mL extraction cell. Load the extraction cells onto the Dionex ASE 350, four cycles of dichloromethane (DCM; HPLC; Thermo Fisher; USA) used in 100% volume with oven temperature set to 125°C and nitrogen pressure up to 1600 psi.

The purified extract was evaporated by rotary evaporation (IKA RV 10 digital; Germany) near to dryness and solvent was exchanged for n-hexane; the remaining solvent was removed with a gentle stream of nitrogen and the residue was re-dissolved in 1 mL, enriched with syringe standards at a concentration of 1 µg/mL.

### Text 3 Temperature programmed method of PAHs

The oven temperature of the GCMS (ISQ 7000; Thermo Fisher; USA) was programmed as follows: initial temperature of 40°C (hold for 4 min), first ramped to 160°C at 10°C/min and held for 1 min, then ramped to 280°C at 10°C/min and held for 4 min, and finally at 10°C/min. The temperature was raised to 300°C/min and held for 10 min. Analysis lasts 45 minutes. Sample injection was performed in splitless mode with helium carrier gas at a constant flow rate (1 mL/min). Five internal standards were spiked into each sample prior to analysis. The retention times for PAHs are assigned after each compound is identified in scan mode.

### Text 4 Soil particle size

To measure the particle size distribution of the soil, first, approximately 0.03–0.5 g of air-dried soil samples were filtered by a 2 mm sieve. Then, 10 mL of distilled water was added to soil samples and let the mixture soak overnight with different dispersants to adjust pH. For example, 1–1.5 mL 0.5 mol/L  $1/6$  ( $\text{NaPO}_3$ )<sub>6</sub> or 0.5 mol/L NaOH were added to alkaline or acidic soil samples, respectively. Finally, after ultrasonic vibration for 2 min, Laser Scattering Particle Size Distribution Analyzer (LA-960; HORIBA, Ltd.; Japan) was used to measure S1–S5 soil samples. The results were shown in Fig. S1.

### Text 5 OC/EC method

To measure the OC/EC of dust, a thermal–optical transmittance (TOT) protocol was used. When analyzed by the OC/EC analyzer (Model 4; Sunset Lab Inc; USA), the National Institute of Occupational Safety and Health (NIOSH, USA) method was implemented. Briefly, a small standard size punch (0.636 cm<sup>2</sup>) from a quartz fiber filter is placed in the main quartz oven, where the transmittance of red light ( $\lambda=632$  nm) through the filter can be monitored during the combustion. First, gradually heat the filter to a maximum temperature of 870°C under pure helium. The emitted gas passes through an oxidizer catalyst, in which all carbon compounds are converted to carbon dioxide. The carbon dioxide is then reduced to methane in a methanation furnace, which is then detected by a flame ionization detector (FID). In the next step, cool the oven to 550°C and reheat it in a mixture of He (98%) and oxygen (2%) to a final temperature of 870°C. EC is oxidized and converted to methane and tested by FID.

The analyzer utilized laser transmission to correct for OC charring. The EC was determined as the carbon evolved after the filter transmittance returned to its initial value. The detection limits of the OC and EC, which are defined as twice the average for field blanks, were 0.50 and 0.05 mg

C/cm, respectively. The precision of the OC and EC measurements was 6.5% and 9.6%, respectively.

Only one step is needed under pure him, and some organic compounds will be pyrolyzed and burned during the pyrolysis process to form pyrolytic carbon (PC). This PC may be due to both physical properties and EC (Birch and Cary, 1996).

#### Text 6 Scanning Electron Microscopy (SEM)

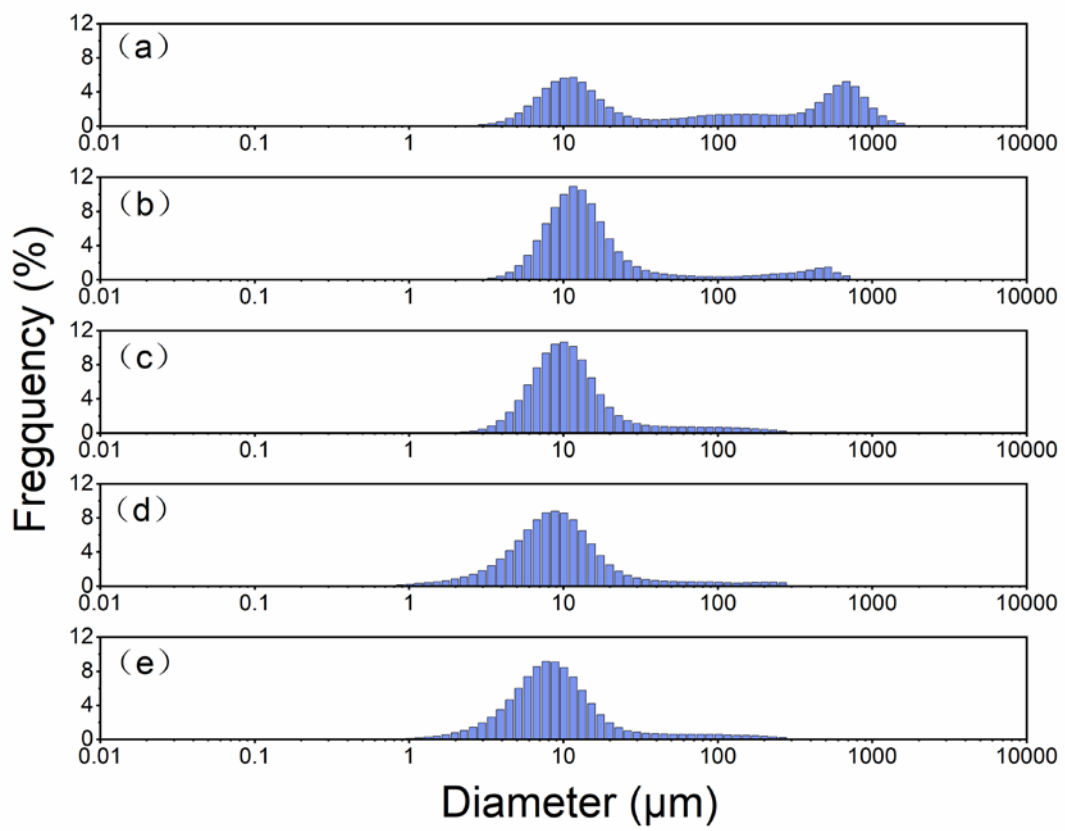
A TESCAN VEGA 3 SBU scanning electron microscope (TESCAN Ltd., Brno, Czech Republic) equipped with an energy-dispersive X-ray detector (XFlash detector 610 M, Bruker Nano GmbH, Germany) was used for morphological evaluation of particles. The images of soil and dust with particle sizes of 10  $\mu\text{m}$ , 5.6  $\mu\text{m}$ , 3.2  $\mu\text{m}$ , 1.8  $\mu\text{m}$ , 1  $\mu\text{m}$ , and 0.56  $\mu\text{m}$  were collected at the voltage of 15 kV or 10 kV.

#### Text 7 Qualitative analysis of the compounds in the soils

In addition to quantifying the PAHs in the soil and the content of dust produced, we also conducted a qualitative analysis of the soils by GCMS. The degree of EFs may be related to the soil properties PAHs will tend to bind organic matter (OM). The total ion chromatogram (TIC) was obtained by S1–S4 in scan mode.

**Table S1** The properties of different soils.

	Sampling site	Location	Soil texture	Color	pH	TOC (%)	Longitude (E)	Latitude(N)
S1	Beside the Pedestrian Road	Yueyang	Sandy loam	Black	8.22	3.451	113°18.7325'	29°28.9299'
S2	Under the Street Pipe	Yueyang	Loam	Dark brown	7.97	1.322	113°18.5096'	29°28.5405'
S3	Baling Petrochemical Plant 1	Yueyang	Loam	Yellowish-brown	8.81	1.556	113°18.5188'	29°28.6248'
S4	Baling Petrochemical Plant 2	Yueyang	Loam	Reddish-brown	8.27	0.777	113°18.5198'	29°28.6238'
S5	Metallurgical Plant	Zhuzhou	Loam	Reddish-brown	6.44	1.732	113°04.6846'	27°52.5269'



**Fig. S1** The particle size distribution of soil. (a) is S1, (b) is S2, (c) is S3, (d) is S4 and (e) is S5.

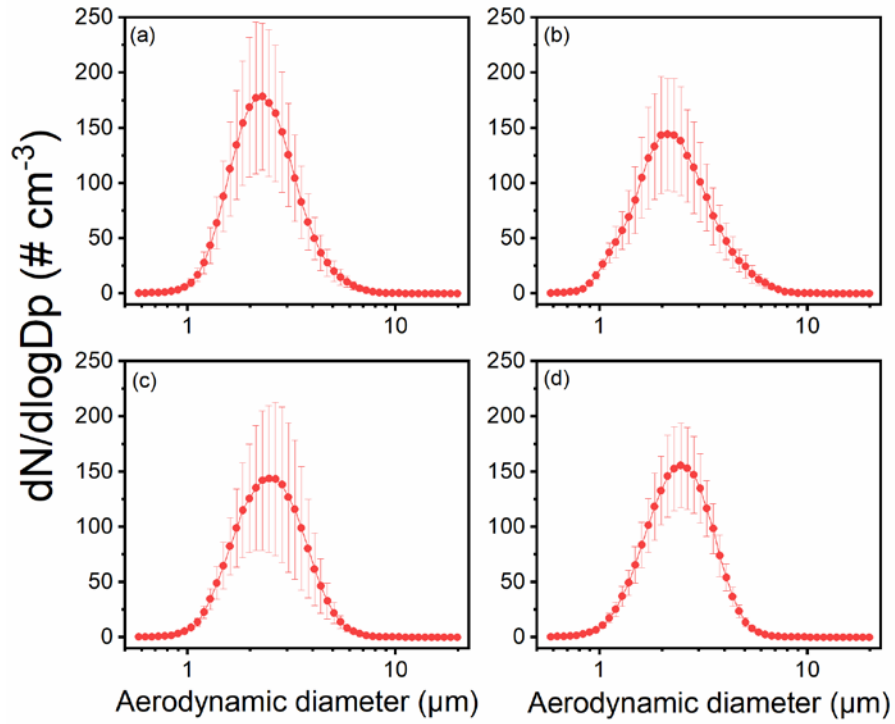


Fig. S2 The particle size distribution (PSD) of dust particles. (a) is S1, (b) is S2, (c) is S3 and (d) is S4.

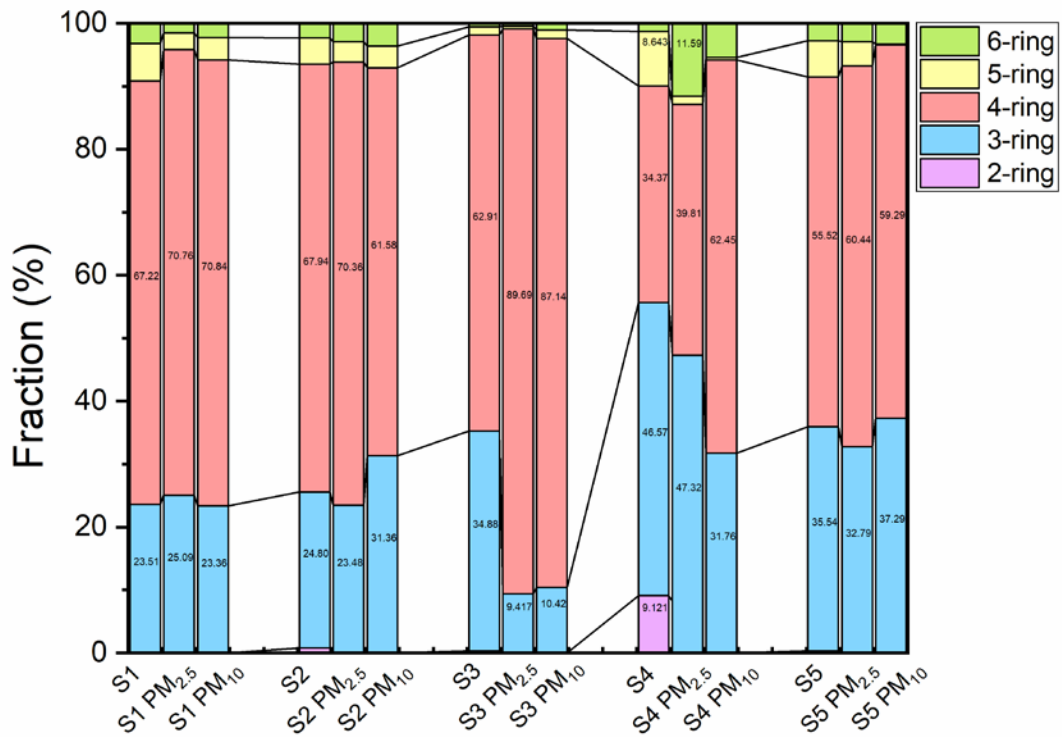


Fig. S3 The ring-fraction of PAHs in soil and dust aerosol.

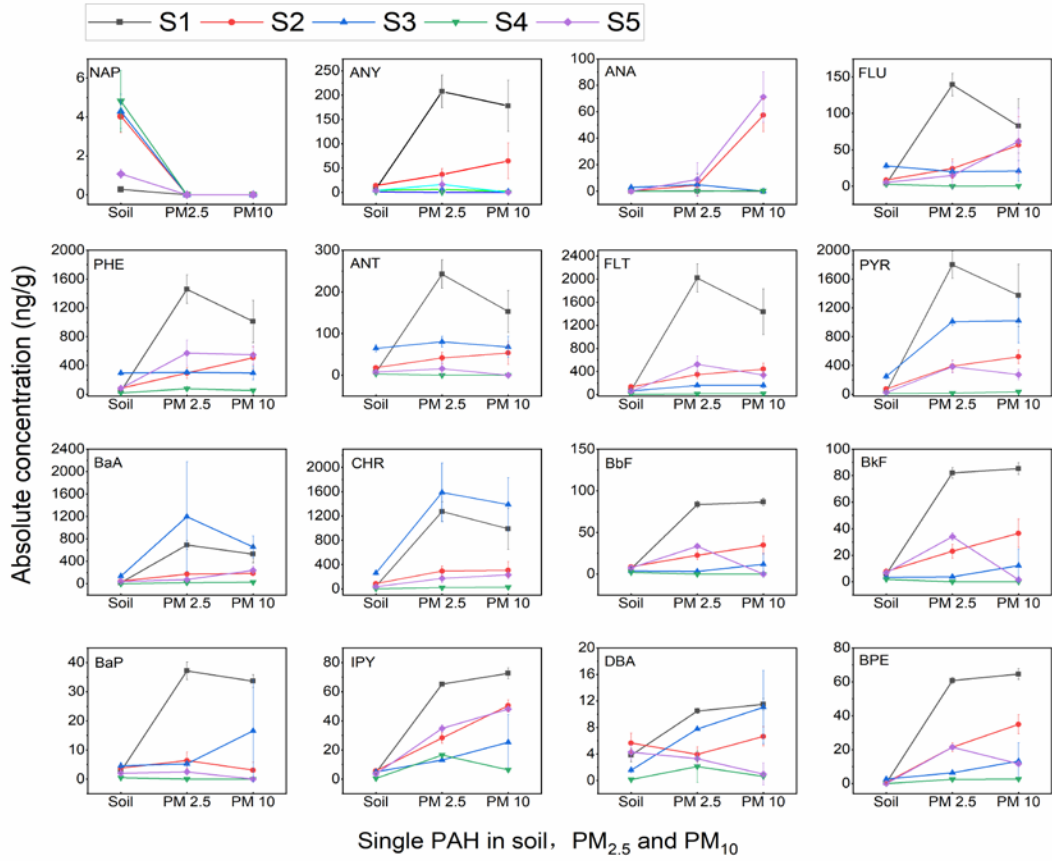


Fig. S4 Each PAH compound was obtained in S1–S5.

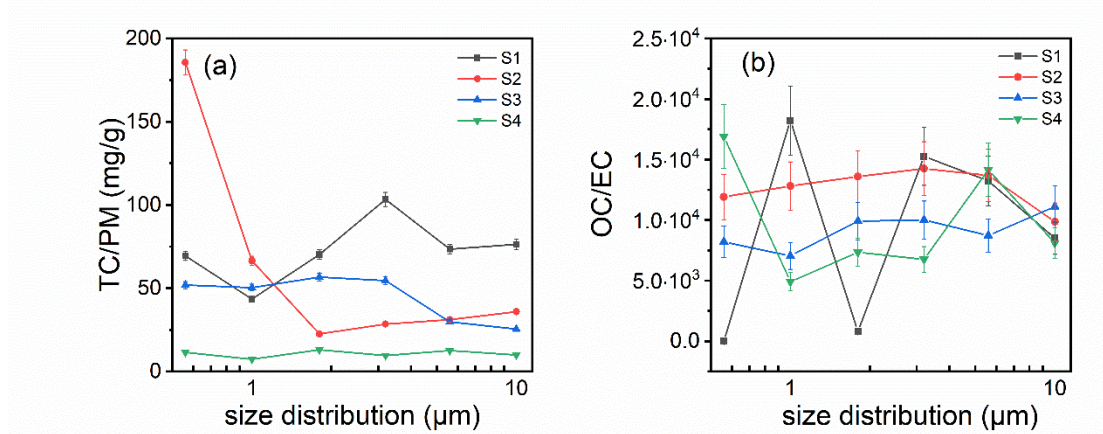
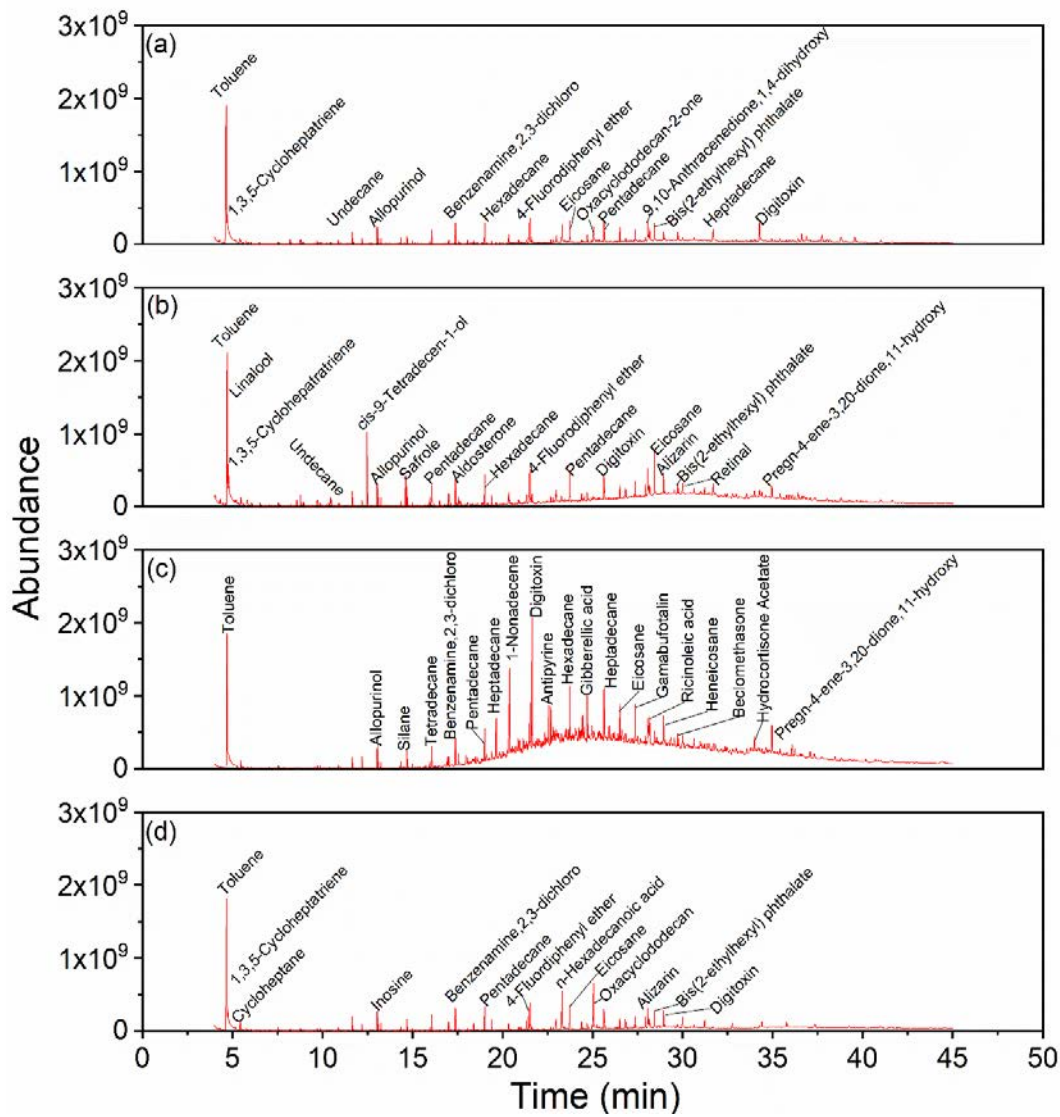
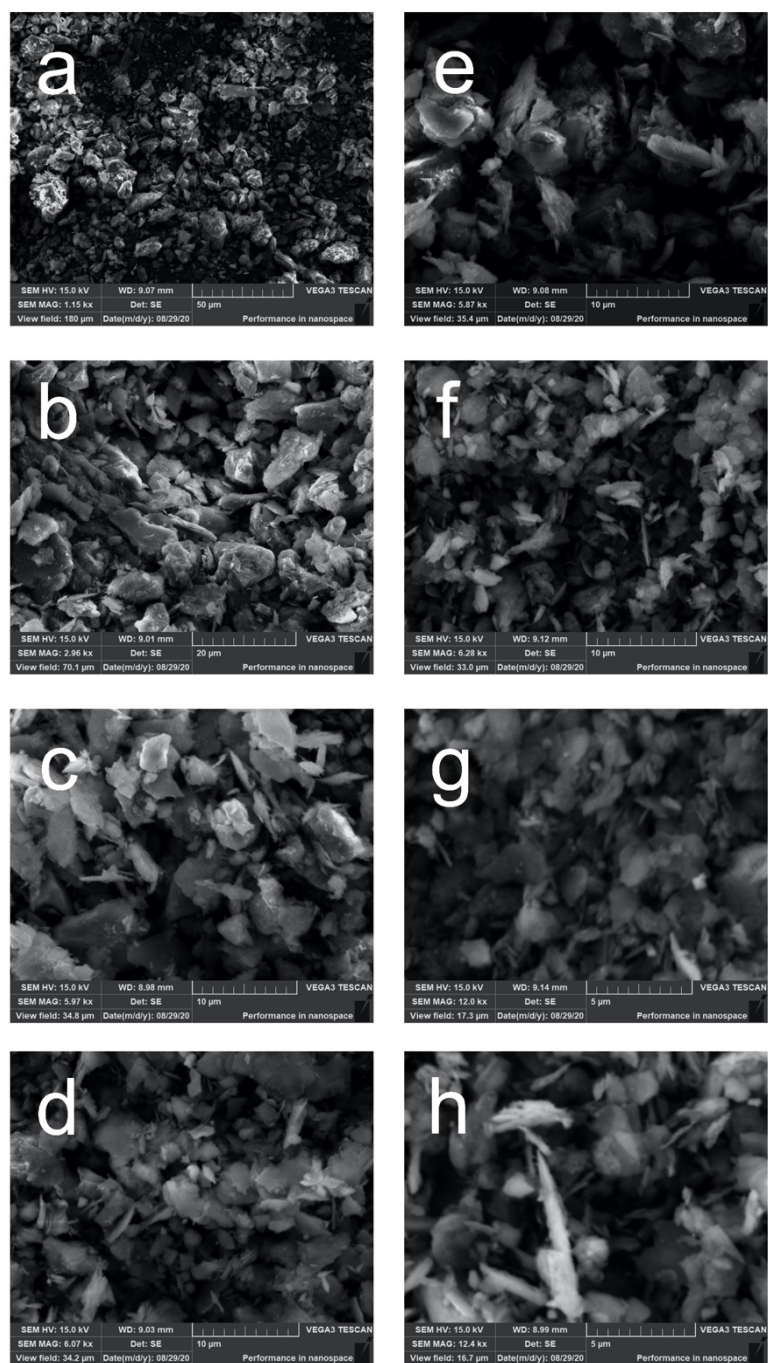


Fig. S5 The absolute concentration of (a)TC in dust generated by S1, S2, S3, and S4. (b) is the ratio of OC to EC in the dust.



**Fig. S6** Detailed information on the qualitatively TIC compounds. (a) is S1, (b) is S2, (c) is S3, and (d) is S4.



**Fig. S7** SEM-images of the parent soil and its generated dust with a particle size of 10  $\mu\text{m}$ , 5.6  $\mu\text{m}$ , 3.2  $\mu\text{m}$ , 1.8  $\mu\text{m}$ , 1  $\mu\text{m}$ , 0.56  $\mu\text{m}$  respectively. (a) and (b) are soil, (c) is PM<sub>10</sub>, (d) is PM<sub>5.6</sub>, (e) is PM<sub>3.2</sub>, (f) is PM<sub>1.8</sub>, (g) is PM<sub>1.0</sub>, (h) is PM<sub>0.56</sub>.

## Reference

Birch M E, Cary R A (1996). Elemental carbon-based method for monitoring occupational exposures to particulate diesel exhaust. *Aerosol Science and Technology*, 25(3): 221–241