Supporting Information

Are the new atmospheric health risk substances EPFRs oxidatively toxic?: Results from a large urban road dust study in Northwest China

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Text S1. Sample preparation

Experimental instrument: Mi V10 cleaner; performance parameters: vacuum suction is 22,000 Pa[4], operating power is 450 W, the power of suction is 140 AW[2], interception of particles as small as 0.3 μm, purification efficiency up to 99.9%, which can be well satisfied with the requirements of the experiment.

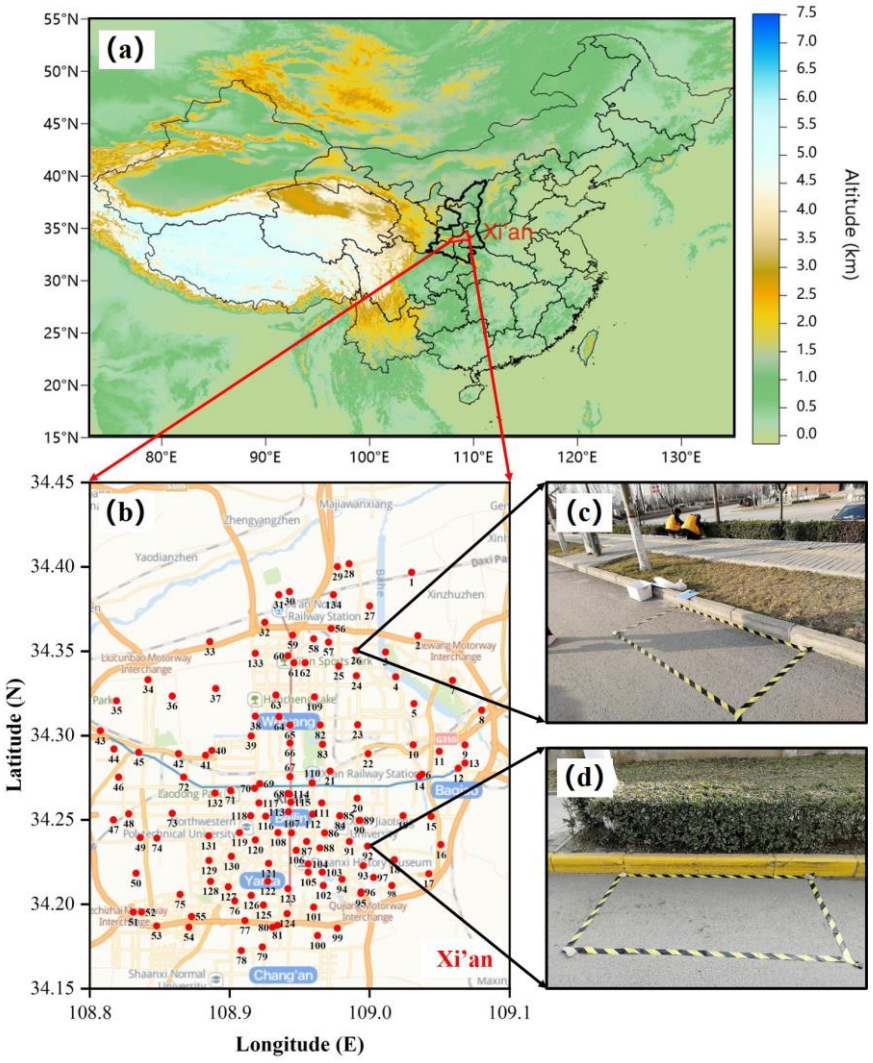


Fig. S1: Diagram of road dust sampling points and field sample collection in Xi'an. **a** Location of Xi'an in China. **b** Location of road dust sample collection in Xi'an. **c d** Quadratic of road dust sample collection.

Sampling points setting: As shown in Fig. S1, the urban area of Xi'an is 1066 km², with an average of 8 km² setting a sampling point. A total of 134 sampling points were

set in the whole urban area. The sampling point's square was set as a 1×2 m square box, and large garbage such as leaves, and stones were collected in the sample box. The cleaner was set to the high-efficiency mode, rolling uniformly on the ground, and the sample square was cleaned for an average of 2 min.

Collection and pretreatment of road dust samples: After collection, the release button on the bottom cover of the dust bucket was clicked to drop the absorbed road dust onto the prepared tin foil paper (weighed), and the particles adsorbed on the cup wall were cleaned with a brush, at least road dust samples were placed in a valve bag, labeled and transported to the laboratory for preservation.

Text S2. EPR analysis

Pretreatment of EPR samples: The road dust samples dried 24 h with desiccator, and then samples were weighted and passed through a 200-mesh sieve to obtain road dust samples with particle size <75 μm. At present, there are two methods for EPR detection of solid powder, firstly, direct coating, secondly, dispersing the particles with solvent and placing them on quartz film, using quartz plate detection (dispersed type). For this study, we randomly selected three samples and compared their detected signal intensity with the two methods. It was found that the EPR signal intensity detected by the two methods was similar (±5%), as shown in Fig. S2. However, the coating method requires delicate preliminary operation technology, thus, in this case, the concentration of EPFRs in road dust samples was studied by the decentralized method.

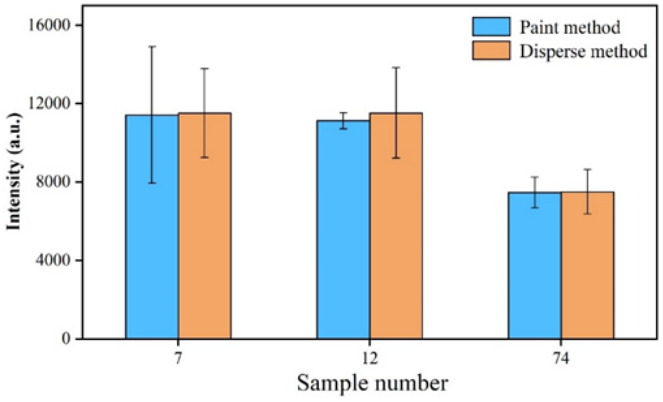


Fig. S2: Comparison of different ways to detect the concentration of EPFRs.

EPR spectra processing: In order to remove the interference of other magnetic substances (such as Fe_3^+, etc.), first of all, the signal of samples EPR spectrum should subtract the signal of background, and then, the EPR spectrum need to be polynomial baseline corrected, in the end the EPFRs signal was fitted by lorentz function to obtain the g factor, signal intensity I and $\Delta H_{P\text{-}P}$ characteristic information of the EPFRs in the samples. The software interface used is shown in Fig.S3.

Fig. S3: Wave spectrum signal processing software interface for EPFRs.

Samples pretreatment: As shown in Fig. S4, 1mg road dust sample were weighted and then, used to be cut pre-fired quartz filter film with φ 7mm punch, the road dust samples were spread evenly on the middle layer of quartz filter film, placed in OC/EC analyzer, and the content of OC/EC in the samples was tested by heating up.

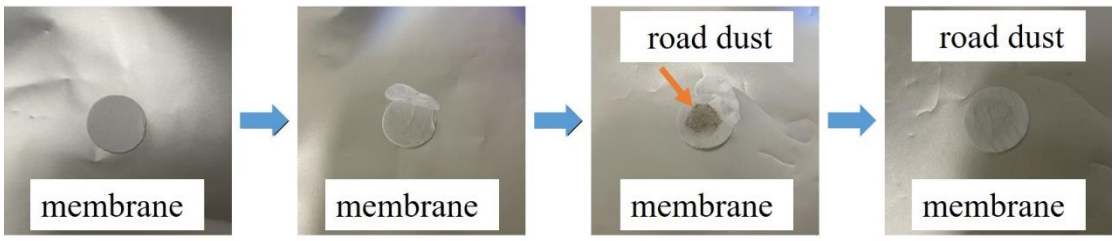
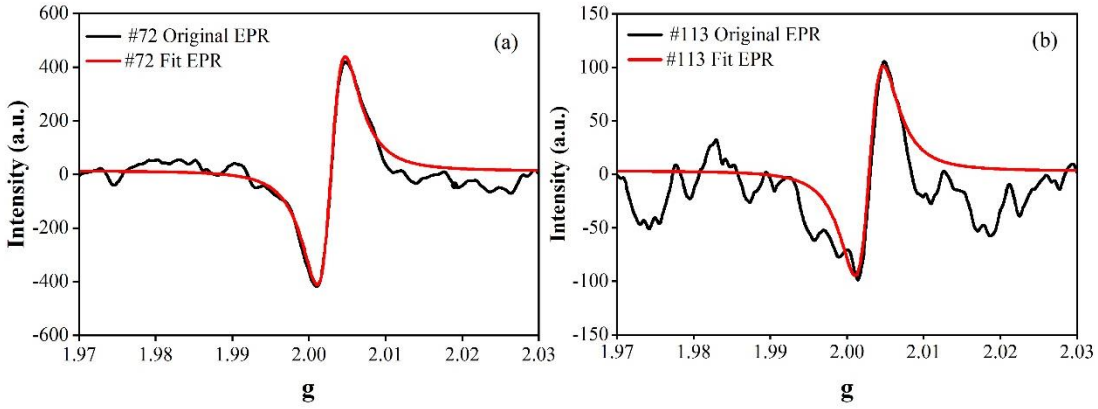


Fig. S4: Schematic diagram of the sample pretreatment process for OC/EC analysis in road dust.



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60 **Fig. S5:** EPR spectra of different types of EPFRs in road dust samples in Xi'an. **a** The EPR profiles
61 showed symmetry when detecting EPFRs. **b** The EPR profiles showed asymmetry when detecting
62 EPFRs.)

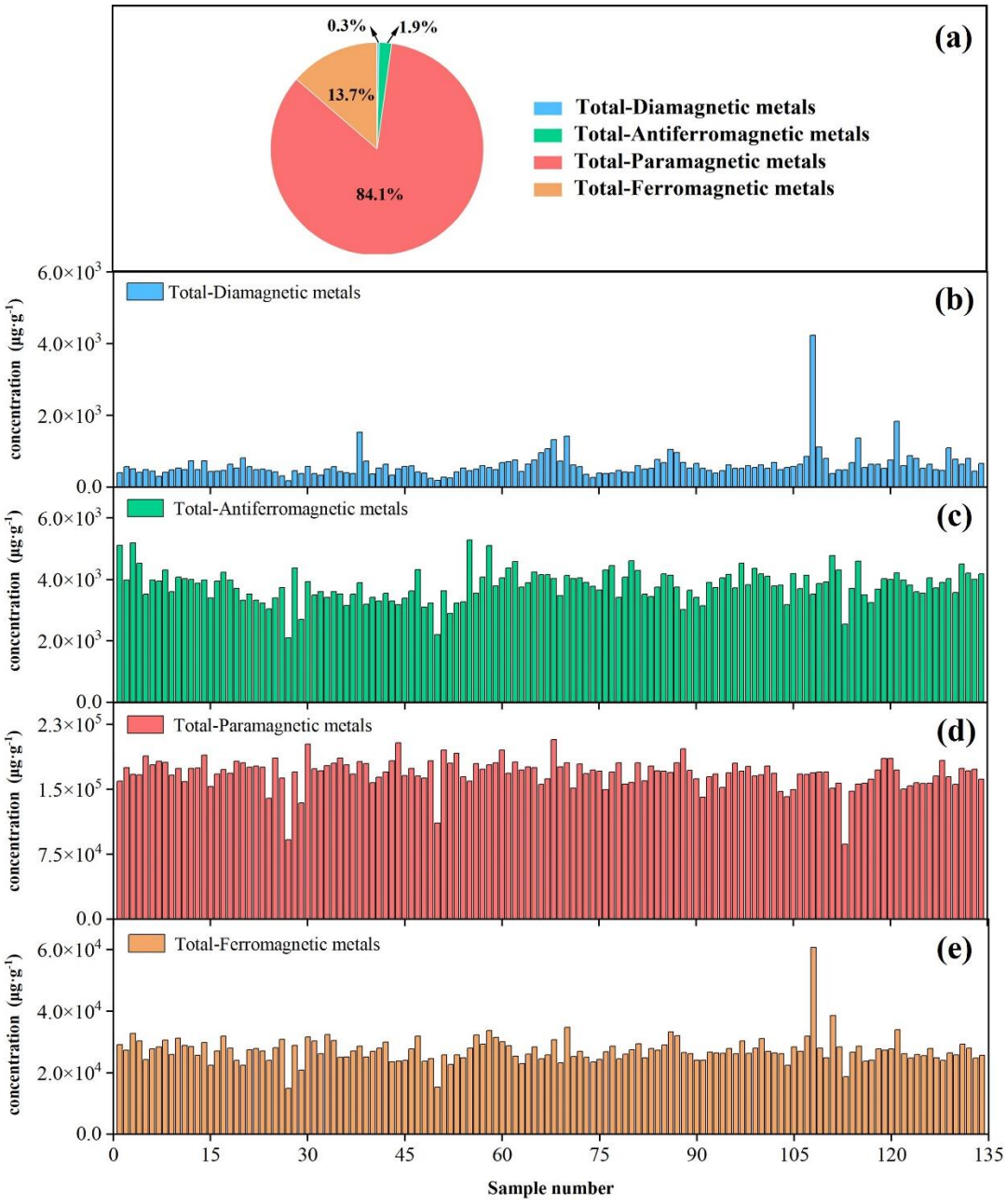

Fig. S6: Concentrations of Total-metals in road dust samples in Xi'an. **a** Proportion of the concentration of Total-metals with different magnetic properties in road dust samples. **b** Concentration of total diamagnetic metals in road dust samples. **c** Concentration of total antiferromagnetic metals in road dust samples. **d** Concentration of total paramagnetic metals in road dust samples. **e** Concentration of total ferromagnetic metals in road dust samples.

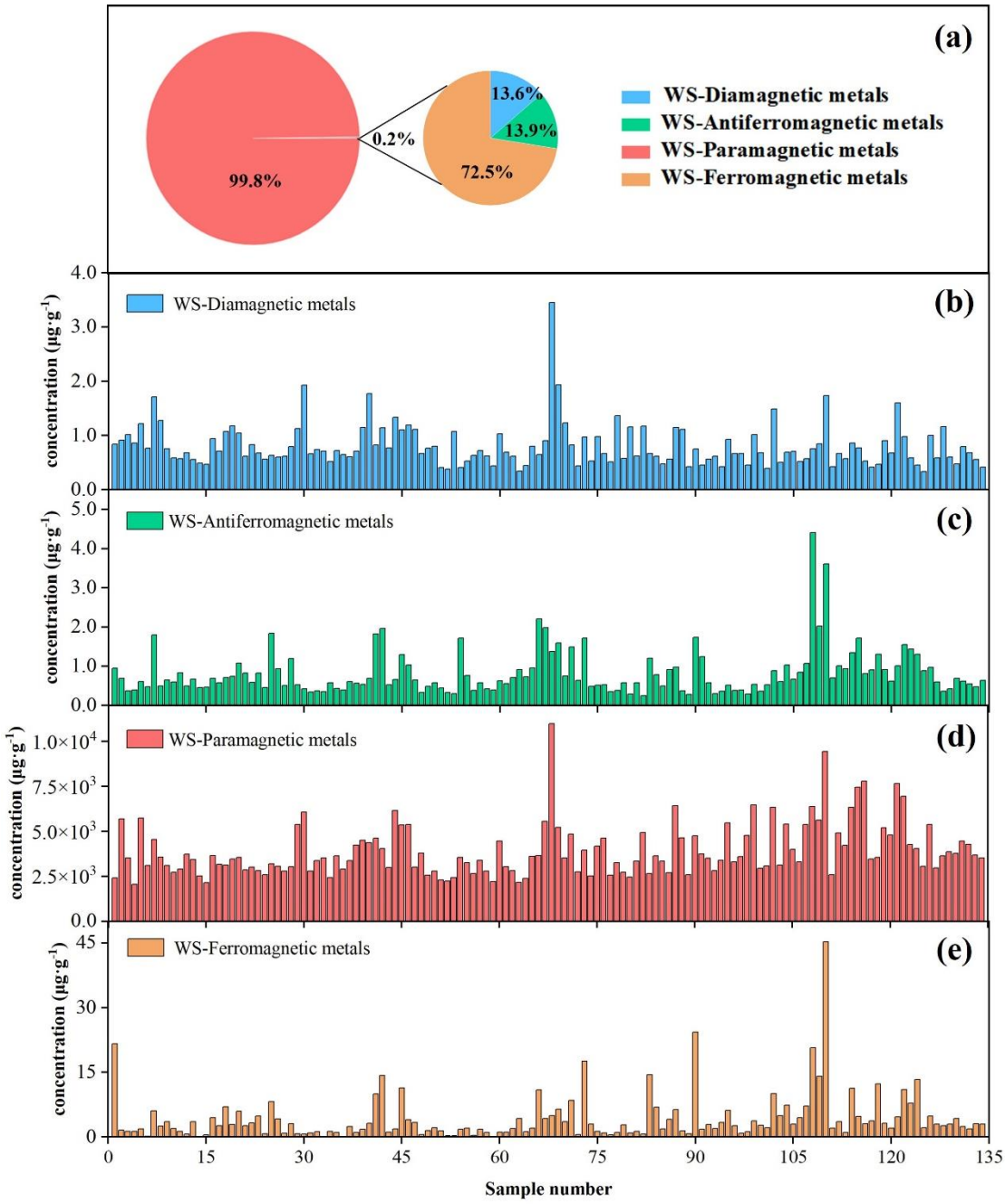

Fig. S7: Concentrations of WS-metals in road dust samples in Xi'an. **a** Proportion of the concentration of WS-metals with different magnetic properties in road dust samples. **b** Concentration of water-soluble diamagnetic metals in road dust samples. **c** Concentration of water-soluble antiferromagnetic metals in road dust samples. **d** Concentration of water-soluble paramagnetic metals in road dust samples. **e** Concentration of water-soluble ferromagnetic metals in road dust samples.

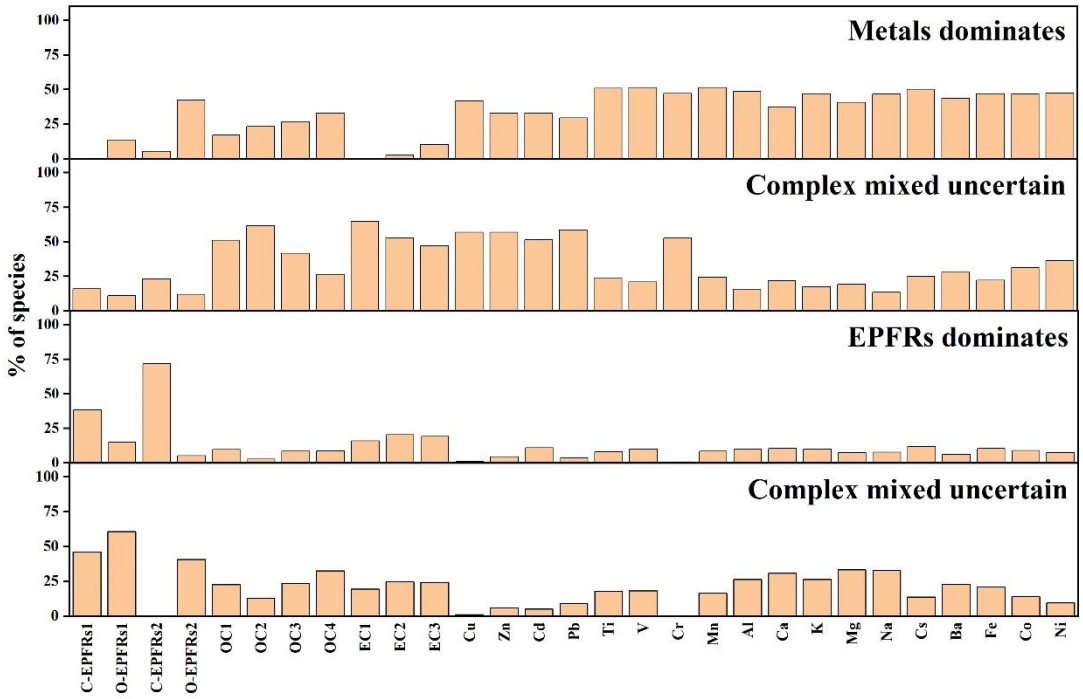

Fig. S8: Percentage diagram of the contribution of different components of PMF analysis to Total-DTT. (Factor 1 is determined to be the dominant metal type. Factors 2 and 4 are determined to be complex mixed type. Factor 3 is determined to be the dominant type of EPFRs.)

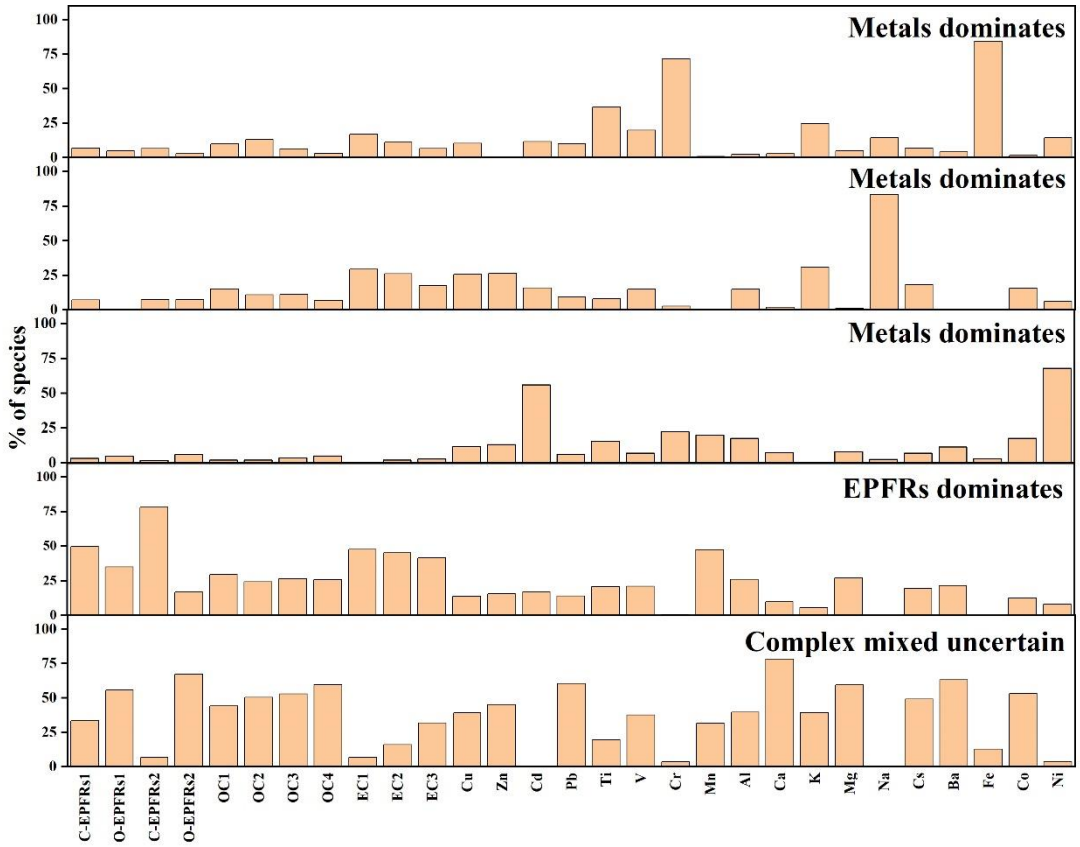

Fig. S9: Percentage diagram of the different components analyzed by PMF accounting for the contribution of WS-DTT. (Factors 1, 2 and 3 are determined to be the dominant metal type. Factor 4 is determined to be the dominant type of EPFRs. Factor 5 is determined to be the complex mixed type.)

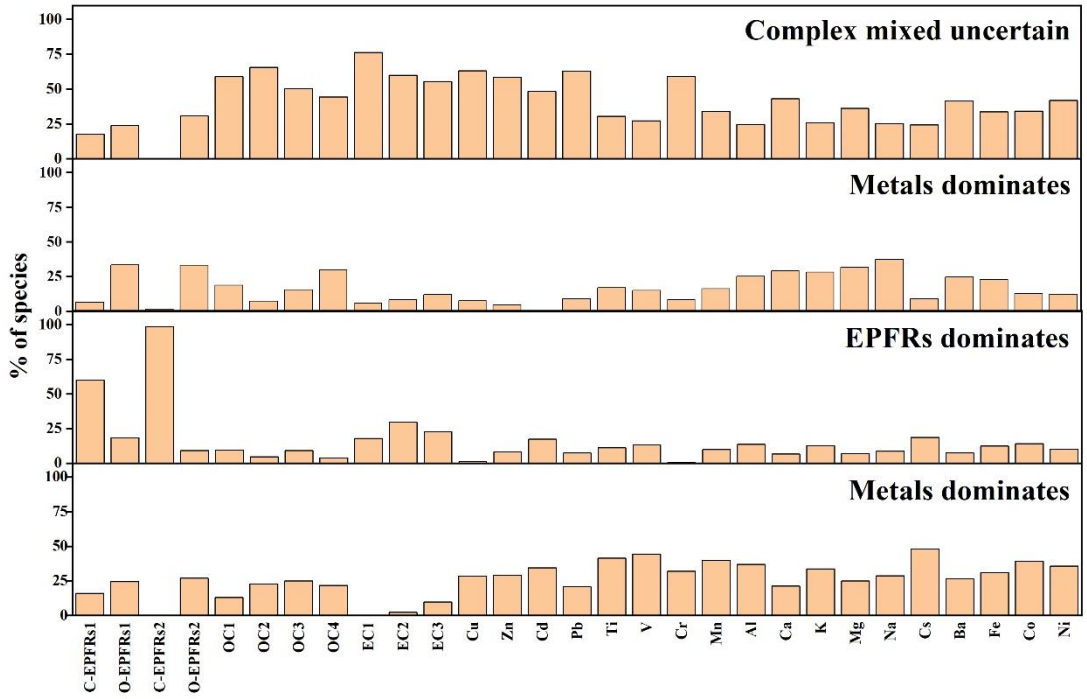

Fig. S10: Percentage diagram of the different components analyzed by PMF accounting for the contribution of WIS-DTT. (Factor 1 is determined to be the dominant type of EPFRs. Factors 2 and 4 are determined to be the dominant metal type. Factor 3 is determined to be the complex mixed type.)

Tab. S1: Characteristic information and concentration of EPFRs in road dust samples.

Sample	g_1	$\triangle H_{p\text{-}p1}$ (Gs)	A_{EPFRs1}	$Intensity_1$ (a.u.)	g_2	$\triangle H_{p\text{-}p2}$ (Gs)	A_{EPFRs2}	$Intensity_2$ (a.u.)	g	$\triangle H_{p\text{-}p}$ (Gs)	A_{EPFRs2}	Intensity (a.u.)	EPFRs (spins/g)
D-1	2.0029	6.7	11072	248	2.0041	5.0	742	30	2.0031	6.5	11547	269	4.78E+17
D-2	2.0030	6.4	30349	738	2.0041	3.7	553	40	2.0032	6.3	30730	763	1.27E+18
D-3	2.0023	5.1	11289	430	2.0041	3.5	1030	86	2.0026	5.5	13243	446	5.48E+17
D-4	2.0025	5.9	6676	194	2.0040	3.6	1211	94	2.0031	5.9	8116	234	3.36E+17
D-5	2.0026	5.6	15063	488	2.0042	4.1	3876	231	2.0032	5.8	20128	593	8.34E+17
D-6	2.0028	5.9	7563	221	2.0042	4.1	1129	68	2.0032	5.9	8762	252	3.63E+17
D-7	2.0027	5.9	7046	200	2.0041	3.5	673	56	2.0031	5.7	7296	228	3.02E+17
D-8	2.0026	6.0	25043	702	2.0045	4.2	1267	73	2.0028	6.0	25633	720	1.06E+18
D-9	2.0026	5.7	73094	2278	2.0040	4.6	19249	907	2.0031	5.9	96416	2790	3.99E+18
D-10	2.0026	6.6	28047	639	2.0040	3.8	2346	162	2.0029	6.5	30471	711	1.26E+18
D-11	2.0027	5.9	69892	1987	2.0040	4.4	8156	422	2.0030	6.0	79164	2215	3.28E+18
D-12	2.0029	6.5	19637	460	2.0040	6.9	1039	22	2.0030	6.7	21053	475	8.72E+17
D-13	2.0026	5.2	9706	361	2.0040	4.5	3880	192	2.0032	5.6	14908	467	6.17E+17
D-14	2.0028	6.6	42016	959	2.0040	4.0	2521	162	2.0030	6.4	42448	1050	1.76E+18
D-15	2.0026	6.3	13853	354	2.0042	4.2	1893	109	2.0030	6.2	15615	404	6.47E+17
D-16	2.0031	6.6	22509	523	2.0040	4.7	4389	201	2.0034	6.4	27664	681	1.15E+18
D-17	2.0029	6.0	15882	436	2.0048	3.5	525	43	2.0031	6.4	17979	440	7.45E+17
D-18	2.0028	5.6	17413	562	2.0041	4.3	3969	211	2.0032	5.7	22417	687	9.28E+17
D-19	2.0029	6.0	25259	701	2.0045	3.9	1204	78	2.0031	5.9	25301	729	1.05E+18
D-20	2.0031	5.1	9644	373	2.0050	4.0	1939	119	2.0035	5.7	12809	394	5.30E+17
D-21	2.0023	6.9	30609	637	2.0040	6.9	1026	22	2.0024	6.8	30137	653	1.12E+18
D-22	2.0027	6.8	21590	473	2.0040	3.7	878	65	2.0029	6.4	20872	504	7.75E+17

Tab. S1: (Continued)

D-23	2.0028	6.3	17822	456	2.0040	3.5	892	71	2.0030	6.2	19030	492	7.07E+17
D-24	2.0027	5.8	7180	214	2.0040	3.6	679	54	2.0030	6.0	8558	237	3.18E+17
D-25	2.0024	5.2	5634	209	2.0040	3.4	1242	107	2.0030	5.3	6955	249	2.58E+17
D-26	2.0025	7.2	3014	58	2.0040	3.8	733	51	2.0033	6.6	3795	88	1.41E+17
D-27	2.0026	6.7	11593	258	2.0040	3.9	859	58	2.0029	6.6	12615	287	4.69E+17
D-28	2.0031	5.9	10492	301	2.0046	3.5	521	42	2.0033	6.1	11506	314	4.27E+17
D-29	2.0026	6.2	18792	486	2.0040	3.7	1863	135	2.0030	6.2	21319	546	7.92E+17
D-30	2.0024	5.9	34615	989	2.0040	3.5	1948	160	2.0027	5.9	35776	1033	1.33E+18
D-31	2.0023	6.3	58924	1464	2.0040	3.4	2956	252	2.0026	6.4	61831	1529	2.30E+18
D-32	2.0023	5.6	21224	684	2.0040	3.5	2184	180	2.0027	5.8	24731	728	9.19E+17
D-33	2.0025	6.5	22859	540	2.0040	3.5	1961	162	2.0029	6.7	27331	600	1.02E+18
D-34	2.0023	5.9	29451	854	2.0041	3.5	1712	141	2.0026	5.8	30114	888	1.12E+18
D-35	2.0025	6.0	22645	620	2.0040	3.4	2517	217	2.0029	6.1	25792	697	9.58E+17
D-36	2.0026	6.1	20729	555	2.0040	3.7	1447	105	2.0029	6.0	21462	598	7.97E+17
D-37	2.0028	6.4	19527	480	2.0040	3.7	626	47	2.0029	6.4	20446	503	7.59E+17
D-38	2.0029	5.1	7779	296	2.0040	3.7	1177	87	2.0032	5.2	9249	345	3.44E+17
D-39	2.0033	5.7	11407	357	2.0040	6.9	3429	72	2.0035	5.8	14390	421	5.35E+17
D-40	2.0028	5.3	7881	285	2.0040	4.1	1831	108	2.0032	5.4	10221	350	3.80E+17
D-41	2.0025	6.4	19754	476	2.0040	3.5	1339	112	2.0028	6.5	21831	515	8.11E+17
D-42	2.0029	6.3	24672	631	2.0041	4.2	2010	113	2.0032	6.1	25870	705	9.61E+17
D-43	2.0028	5.2	8328	311	2.0040	3.9	1861	123	2.0032	5.4	11152	377	4.14E+17
D-44	2.0025	5.2	10336	390	2.0040	4.0	2946	189	2.0030	5.8	15927	465	5.92E+17
D-45	2.0029	6.0	23570	650	2.0041	4.6	2857	134	2.0031	5.9	25956	738	9.64E+17
D-46	2.0027	6.1	16294	436	2.0043	4.5	2941	144	2.0032	6.5	20914	502	7.77E+17
D-47	2.0024	6.9	12441	264	2.0040	3.4	805	69	2.0027	7.0	14007	287	5.20E+17

Tab. S1: (Continued)

D-48	2.0024	6.5	17443	413	2.0055	4.7	1052	48	2.0027	7.0	19973	404	7.42E+17
D-49	2.0028	5.3	5752	203	2.0045	3.6	754	60	2.0032	5.9	7485	216	2.78E+17
D-50	2.0029	5.7	4392	138	2.0040	3.5	648	53	2.0033	5.5	5140	168	1.91E+17
D-51	2.0030	4.9	5900	243	2.0044	3.9	956	64	2.0034	5.0	6842	270	2.54E+17
D-52	2.0027	4.0	3911	242	2.0040	4.9	4476	188	2.0034	5.0	8948	352	3.32E+17
D-53	2.0026	6.7	11943	270	2.0040	3.4	587	50	2.0029	6.6	12654	291	4.70E+17
D-54	2.0028	5.7	14423	447	2.0042	4.7	4655	215	2.0033	6.0	20293	570	7.54E+17
D-55	2.0025	7.0	11965	241	2.0040	3.7	1434	107	2.0031	6.4	12174	297	4.52E+17
D-56	2.0027	6.4	17056	416	2.0040	3.5	1054	88	2.0030	6.2	17842	458	6.63E+17
D-57	2.0023	6.8	8183	178	2.0040	3.5	934	77	2.0028	7.0	10052	204	3.73E+17
D-58	2.0027	7.8	21039	344	2.0040	3.6	553	42	2.0029	7.7	21657	363	8.04E+17
D-59	2.0027	5.0	7283	289	2.0040	4.9	3102	128	2.0032	5.8	12221	363	4.54E+17
D-60	2.0023	6.7	22369	500	2.0040	3.5	639	54	2.0025	6.8	23835	514	8.85E+17
D-61	2.0025	5.9	10632	305	2.0047	3.5	683	57	2.0026	6.6	13054	303	5.05E+17
D-62	2.0026	6.4	7168	174	2.0040	3.8	762	53	2.0029	6.5	8526	199	3.30E+17
D-63	2.0029	4.9	4997	207	2.0040	4.6	3914	188	2.0034	5.1	9137	346	3.54E+17
D-64	2.0027	6.5	7068	166	2.0040	3.9	1307	85	2.0031	5.8	7462	218	2.89E+17
D-65	2.0023	5.8	12014	352	2.0041	3.5	1271	106	2.0026	6.2	14358	379	5.56E+17
D-66	2.0027	6.0	12472	348	2.0044	3.6	534	42	2.0028	6.1	13327	356	5.16E+17
D-67	2.0024	5.8	12935	387	2.0040	3.9	3075	203	2.0029	6.2	17849	472	6.91E+17
D-68	2.0028	6.7	11282	248	2.0055	7.0	1658	34	2.0030	7.2	13114	253	5.08E+17
D-69	2.0025	6.2	9087	237	2.0040	3.5	741	62	2.0027	6.1	9714	260	3.76E+17
D-70	2.0025	6.2	9087	237	2.0040	3.5	741	62	2.0027	6.1	9714	260	3.76E+17
D-71	2.0032	6.9	22850	479	2.0040	3.6	528	42	2.0032	6.7	22652	508	8.77E+17
D-72	2.0028	6.1	31684	850	2.0052	4.0	819	50	2.0029	6.2	32629	850	1.26E+18

Tab. S1: (Continued)

D-73	2.0028	5.6	8828	286	2.0040	3.9	1935	125	2.0032	5.5	10929	361	4.23E+17
D-74	2.0023	6.6	7363	168	2.0041	4.7	5672	257	2.0034	6.6	14692	340	5.69E+17
D-75	2.0025	5.8	10401	309	2.0040	3.5	1476	123	2.0029	5.9	12430	356	4.81E+17
D-76	2.0027	6.2	10199	264	2.0040	3.5	529	44	2.0028	6.4	11623	282	4.50E+17
D-77	2.0030	8.4	22810	324	2.0041	4.5	672	33	2.0031	8.2	23333	347	9.03E+17
D-78	2.0028	5.9	18921	553	2.0043	4.3	2793	152	2.0031	6.0	22169	626	8.58E+17
D-79	2.0026	5.0	4877	198	2.0040	4.1	3152	187	2.0033	5.4	8972	308	3.47E+17
D-80	2.0027	6.3	8362	210	2.0040	3.4	845	71	2.0029	6.6	10492	241	4.06E+17
D-81	2.0027	6.2	15699	412	2.0040	3.4	1006	86	2.0029	6.1	16575	452	6.42E+17
D-82	2.0032	5.9	15115	431	2.0040	6.9	2539	53	2.0032	6.0	17101	477	6.62E+17
D-83	2.0032	5.7	9183	279	2.0040	6.9	1036	22	2.0033	5.9	10234	298	3.96E+17
D-84	2.0025	3.7	7264	542	2.0040	3.5	3891	324	2.0030	4.7	13839	639	5.36E+17
D-85	2.0032	6.3	11187	284	2.0040	3.7	641	47	2.0033	5.7	10429	319	4.04E+17
D-86	2.0027	5.7	8219	256	2.0049	6.9	2817	59	2.0030	6.3	10884	274	4.21E+17
D-87	2.0026	5.3	11557	409	2.0045	4.3	4147	226	2.0032	6.2	18374	482	7.11E+17
D-88	2.0032	5.8	8755	261	2.0052	6.3	947	24	2.0033	6.4	10889	266	4.22E+17
D-89	2.0023	6.7	9912	220	2.0040	3.5	1511	124	2.0028	6.6	11601	268	4.49E+17
D-90	2.0027	7.3	10945	204	2.0040	4.2	1426	79	2.0031	7.0	12256	253	4.75E+17
D-91	2.0023	5.4	6251	217	2.0041	4.1	3027	180	2.0031	5.8	10023	299	3.88E+17
D-92	2.0031	5.5	10899	357	2.0047	3.5	997	81	2.0033	6.0	13302	375	5.15E+17
D-93	2.0026	6.4	7410	181	2.0040	3.9	1751	118	2.0031	6.0	9061	251	3.51E+17
D-94	2.0028	5.5	6559	219	2.0040	3.5	889	73	2.0030	5.2	6987	257	2.71E+17
D-95	2.0028	6.2	19647	506	2.0040	3.9	2084	140	2.0030	6.1	21796	585	8.44E+17
D-96	2.0030	6.0	17606	492	2.0052	3.8	575	39	2.0031	6.2	18664	492	7.23E+17
D-97	2.0026	4.7	2513	112	2.0040	6.7	6603	148	2.0034	6.6	9524	221	3.69E+17

Tab. S1: (Continued)

D-98	2.0031	6.2	15697	414	2.0051	3.4	719	60	2.0032	6.5	17749	420	6.87E+17
D-99	2.0029	7.0	15232	315	2.0040	6.9	1044	22	2.0030	6.6	14692	334	5.69E+17
D-100	2.0026	5.8	6984	207	2.0040	3.6	795	60	2.0029	6.0	8334	232	3.23E+17
D-101	2.0023	7.0	14118	288	2.0040	3.5	523	43	2.0026	6.7	13487	302	5.14E+17
D-102	2.0030	5.8	10869	328	2.0041	6.9	1034	22	2.0031	5.8	11462	346	4.37E+17
D-103	2.0028	4.4	3914	201	2.0048	4.3	1332	72	2.0032	5.5	6119	205	2.33E+17
D-104	2.0028	6.2	19898	513	2.0051	3.4	984	84	2.0031	6.6	22169	512	8.45E+17
D-105	2.0031	5.7	8401	259	2.0040	6.9	1026	22	2.0033	5.6	8607	278	3.28E+17
D-106	2.0026	5.0	7103	289	2.0040	3.5	1253	103	2.0030	5.3	9198	328	3.50E+17
D-107	2.0029	5.8	12396	375	2.0049	3.5	615	50	2.0031	6.2	14401	377	5.49E+17
D-108	2.0023	5.7	9248	283	2.0041	3.5	867	71	2.0026	5.6	9400	301	3.58E+17
D-109	2.0027	6.3	13473	342	2.0040	3.5	1317	107	2.0031	6.2	14962	394	5.70E+17
D-110	2.0027	5.9	9783	279	2.0040	3.6	1506	115	2.0032	5.5	10466	345	3.99E+17
D-111	2.0025	7.1	12109	242	2.0040	3.5	825	66	2.0029	7.0	13163	270	5.01E+17
D-112	2.0031	5.3	9802	351	2.0051	3.5	1047	85	2.0034	5.9	12161	352	4.63E+17
D-113	2.0025	6.2	6332	163	2.0040	3.5	936	75	2.0030	6.2	7446	196	2.84E+17
D-114	2.0023	5.4	17098	581	2.0042	3.5	2168	179	2.0027	5.9	20837	604	7.94E+17
D-115	2.0024	5.9	13565	386	2.0040	3.5	643	53	2.0027	5.9	14167	402	5.40E+17
D-116	2.0028	4.6	4947	237	2.0054	6.9	3255	68	2.0032	5.5	7387	241	2.81E+17
D-117	2.0028	5.7	11895	368	2.0052	3.7	546	41	2.0029	6.3	14192	360	5.41E+17
D-118	2.0026	5.7	8964	280	2.0048	4.3	1899	103	2.0031	6.6	12836	293	4.89E+17
D-119	2.0025	5.4	8802	303	2.0040	3.5	1395	112	2.0030	5.4	10202	347	3.89E+17
D-120	2.0026	4.4	5185	265	2.0041	3.4	1924	163	2.0032	4.9	7733	320	2.95E+17
D-121	2.0023	5.4	8944	308	2.0040	3.4	1057	89	2.0027	5.5	9983	332	3.80E+17
D-122	2.0032	5.8	11991	355	2.0051	3.4	640	54	2.0035	6.0	12916	363	4.92E+17

Tab. S1: (Continued)

D-123	2.0025	3.5	18671	1558	2.0040	3.8	20122	1358	2.0033	4.7	46099	2078	1.76E+18
D-124	2.0023	7.6	17003	292	2.0041	3.4	1546	130	2.0028	7.4	18633	340	7.10E+17
D-125	2.0027	3.5	1902	156	2.0044	5.1	3100	121	2.0035	5.4	5720	194	2.18E+17
D-126	2.0025	6.3	7667	191	2.0040	3.5	635	51	2.0028	6.2	8160	211	3.11E+17
D-127	2.0030	5.2	10814	393	2.0040	3.4	793	67	2.0032	5.3	11966	432	4.56E+17
D-128	2.0029	7.2	9925	189	2.0040	4.8	720	31	2.0032	6.7	9537	213	3.63E+17
D-129	2.0026	5.4	9376	322	2.0047	3.5	569	47	2.0028	5.7	10363	319	3.95E+17
D-130	2.0026	5.7	5474	168	2.0040	3.6	542	41	2.0029	6.2	7023	183	2.68E+17
D-131	2.0027	6.1	8150	222	2.0040	3.4	932	79	2.0031	6.0	9360	261	3.57E+17
D-132	2.0024	6.4	9762	241	2.0040	3.4	538	45	2.0027	6.5	10744	255	4.09E+17
D-133	2.0030	6.5	8054	193	2.0041	5.3	789	28	2.0032	6.5	9151	215	3.49E+17
D-134	2.0023	5.4	8744	303	2.0040	3.5	1172	98	2.0027	5.4	9701	327	3.70E+17

91

92 **Tab. S2:** Characteristic information and concentration of EPFRs after decay in road dust samples.

Sample	g_1	$\triangle H_{p\text{-}p1}$ (Gs)	A_{EPFRs1}	$Intensity_1$ (a.u.)	g_2	$\triangle H_{p\text{-}p2}$ (Gs)	A_{EPFRs2}	$Intensity_2$ (a.u.)	g	$\triangle H_{p\text{-}p}$ (Gs)	A_{EPFRs2}	Intensity (a.u.)	EPFRs (spins/g)
D-1	2.0023	5.9	13788	393	2.0040	6.9	1034	22	2.0026	6.5	16942	397	5.85E+17
D-2	2.0027	4.9	5029	211	2.0047	3.8	565	39	2.0032	5.1	5489	212	1.90E+17
D-3	2.0023	6.4	8877	214	2.0040	7.0	1050	22	2.0024	7.5	11968	215	4.13E+17
D-4	2.0023	4.7	2152	98	2.0040	4.8	721	32	2.0029	5.2	2911	106	1.01E+17
D-5	2.0027	4.8	7293	319	2.0047	3.5	584	47	2.0032	5.3	8828	315	3.05E+17
D-6	2.0024	5.3	2497	90	2.0040	3.6	543	42	2.0032	5.8	3495	105	1.21E+17
D-7	2.0023	7.5	4410	77	2.0041	4.9	740	30	2.0030	7.5	5178	91	1.79E+17
D-8	2.0025	5.4	10450	358	2.0042	3.6	547	42	2.0031	5.4	10626	368	3.67E+17
D-9	2.0027	4.5	6735	334	2.0040	4.6	2715	128	2.0034	5.1	10333	398	3.57E+17
D-10	2.0024	4.5	3381	164	2.0040	3.5	713	59	2.0032	5.1	4632	178	1.60E+17
D-11	2.0027	5.8	30053	897	2.0040	4.3	645	36	2.0031	5.7	29822	915	1.03E+18
D-12	2.0028	4.9	3670	155	2.0043	5.2	768	29	2.0033	5.3	4685	166	1.62E+17
D-13	2.0028	4.8	3800	163	2.0048	3.5	520	43	2.0034	5.7	5175	161	1.79E+17
D-14	2.0025	6.3	10417	266	2.0040	3.5	524	43	2.0031	6.2	10708	282	3.70E+17
D-15	2.0026	6.7	6626	148	2.0040	6.9	1030	22	2.0032	6.5	7038	164	2.43E+17
D-16	2.0024	5.4	11318	384	2.0040	3.5	553	46	2.0028	6.3	15184	385	5.24E+17
D-17	2.0026	3.6	1327	103	2.0041	5.0	754	30	2.0032	4.2	1991	113	6.87E+16
D-18	2.0027	5.1	9483	370	2.0050	3.5	564	47	2.0032	5.4	10594	363	3.66E+17
D-19	2.0028	5.0	4995	204	2.0040	7.0	1050	22	2.0033	5.4	6269	217	2.16E+17
D-20	2.0028	3.7	920	69	2.0041	4.8	711	31	2.0035	4.6	1759	83	6.07E+16
D-21	2.0023	5.0	5745	230	2.0040	3.5	570	48	2.0029	5.2	6437	238	2.22E+17
D-22	2.0026	4.4	4065	208	2.0040	3.5	687	57	2.0032	4.6	4691	224	1.62E+17

Tab. S2: (Continued)

D-23	2.0023	6.1	4886	133	2.0040	3.4	507	43	2.0029	6.5	6042	145	2.09E+17
D-24	2.0023	3.5	919	73	2.0040	3.4	512	43	2.0031	4.2	1344	78	4.64E+16
D-25	2.0023	5.7	1779	54	2.0040	6.9	1030	22	2.0029	6.5	2772	65	9.57E+16
D-26	2.0023	4.6	1788	84	2.0055	6.9	1029	22	2.0025	5.2	2261	83	7.81E+16
D-27	2.0025	4.3	1615	89	2.0055	6.9	1036	22	2.0029	6.0	2949	81	1.02E+17
D-28	2.0025	4.3	1654	88	2.0040	6.9	1030	22	2.0031	4.8	2324	99	8.02E+16
D-29	2.0026	4.6	3164	151	2.0048	3.6	534	41	2.0033	5.5	4365	146	1.51E+17
D-30	2.0023	5.6	25844	815	2.0055	7.0	2105	43	2.0027	5.6	25738	812	8.89E+17
D-31	2.0026	5.2	10850	398	2.0041	4.0	1669	102	2.0032	5.5	13231	432	4.57E+17
D-32	2.0025	4.3	2325	129	2.0041	3.5	533	43	2.0032	4.9	3300	138	1.14E+17
D-33	2.0023	4.7	3342	152	2.0042	3.5	896	74	2.0032	5.6	4950	160	1.71E+17
D-34	2.0025	4.4	3437	178	2.0040	3.4	503	43	2.0031	4.9	4372	186	1.51E+17
D-35	2.0024	5.4	6393	219	2.0040	6.9	1032	22	2.0029	5.6	7277	231	2.51E+17
D-36	2.0026	5.1	3801	147	2.0041	3.4	513	43	2.0033	5.2	4353	163	1.50E+17
D-37	2.0024	4.8	5025	214	2.0040	3.4	512	43	2.0029	5.1	5764	222	1.99E+17
D-38	2.0025	6.3	3917	97	2.0040	4.0	603	37	2.0033	6.3	4624	117	1.60E+17
D-39	2.0026	4.5	3032	149	2.0042	3.5	515	43	2.0032	5.1	4003	156	1.38E+17
D-40	2.0023	4.3	1580	86	2.0040	3.9	590	38	2.0031	4.9	2343	96	8.09E+16
D-41	2.0023	6.3	10517	266	2.0055	6.9	1038	22	2.0029	6.5	11206	269	3.85E+17
D-42	2.0023	6.3	18304	455	2.0041	6.9	1039	22	2.0032	6.1	17450	470	5.99E+17
D-43	2.0023	5.3	8474	301	2.0055	6.9	1032	22	2.0032	5.6	9205	297	3.16E+17
D-44	2.0023	6.4	17417	424	2.0040	6.9	1018	22	2.0030	6.2	16969	437	5.83E+17
D-45	2.0023	5.7	19242	599	2.0049	4.0	590	38	2.0032	6.0	21073	592	7.24E+17
D-46	2.0024	5.9	7945	228	2.0055	5.4	801	28	2.0033	6.2	8516	224	2.92E+17
D-47	2.0023	6.8	8482	182	2.0055	6.9	1032	22	2.0030	6.9	8659	183	2.97E+17

Tab. S2: (Continued)

D-48	2.0023	6.6	11547	267	2.0040	6.9	1042	22	2.0023	6.8	13818	300	4.75E+17
D-49	2.0023	3.9	1833	118	2.0040	4.0	604	38	2.0033	4.5	2438	123	8.37E+16
D-50	2.0023	6.0	4758	131	2.0040	6.9	1037	22	2.0033	6.0	5239	144	1.80E+17
D-51	2.0023	5.4	6187	211	2.0040	6.1	918	24	2.0032	5.5	6816	222	2.34E+17
D-52	2.0026	5.8	6897	206	2.0040	4.3	652	35	2.0036	5.7	7301	223	2.51E+17
D-53	2.0024	5.8	9381	280	2.0040	3.5	525	43	2.0033	6.0	10410	290	3.57E+17
D-54	2.0025	6.8	12846	279	2.0040	4.0	601	37	2.0035	6.8	13806	295	4.74E+17
D-55	2.0023	5.9	6950	197	2.0040	3.4	513	43	2.0031	6.1	7727	205	2.65E+17
D-56	2.0025	6.4	9034	221	2.0055	3.9	621	41	2.0034	6.7	9559	214	3.28E+17
D-57	2.0027	7.1	6486	128	2.0040	6.9	1026	22	2.0037	6.8	6675	146	2.29E+17
D-58	2.0023	8.5	17977	247	2.0040	6.9	1044	22	2.0027	8.8	20414	261	7.01E+17
D-59	2.0023	6.5	13007	305	2.0040	6.9	1039	22	2.0031	6.5	13284	317	4.56E+17
D-60	2.0023	7.1	21021	414	2.0055	6.9	1032	22	2.0026	6.7	19847	442	6.82E+17
D-61	2.0023	6.6	10725	249	2.0040	6.9	1042	22	2.0029	6.9	12409	259	4.26E+17
D-62	2.0023	6.6	7107	164	2.0040	3.5	539	43	2.0034	6.4	7367	178	2.53E+17
D-63	2.0024	5.9	4386	124	2.0040	4.3	647	34	2.0034	6.4	5582	138	1.92E+17
D-64	2.0023	5.1	1858	70	2.0041	4.8	725	31	2.0034	5.8	2765	81	9.49E+16
D-65	2.0023	5.0	3458	138	2.0040	6.9	1040	22	2.0032	5.2	4044	148	1.39E+17
D-66	2.0023	8.4	10638	151	2.0040	7.0	1052	22	2.0028	8.8	12606	162	4.33E+17
D-67	2.0024	5.7	10697	324	2.0046	3.5	518	43	2.0033	6.1	11979	323	4.11E+17
D-68	2.0024	5.5	7262	240	2.0052	3.4	572	48	2.0034	5.9	8072	230	2.77E+17
D-69	2.0024	6.0	5433	151	2.0040	6.9	1040	22	2.0034	6.0	5995	164	2.06E+17
D-70	2.0026	5.4	2721	92	2.0040	3.5	517	43	2.0037	5.8	3694	110	1.27E+17
D-71	2.0025	6.8	12720	278	2.0041	5.2	781	29	2.0034	6.5	12581	295	4.32E+17
D-72	2.0024	6.1	7471	201	2.0040	4.4	665	34	2.0034	5.9	7552	216	2.59E+17

Tab. S2: (Continued)

D-73	2.0025	3.7	1296	95	2.0040	3.5	519	43	2.0035	4.5	2030	102	6.97E+16
D-74	2.0026	3.9	2008	133	2.0040	3.5	517	43	2.0036	4.3	2706	145	9.29E+16
D-75	2.0027	6.4	9196	224	2.0040	6.9	1044	22	2.0035	6.8	10929	237	3.75E+17
D-76	2.0028	5.2	5818	214	2.0040	6.9	1027	22	2.0036	5.4	6712	229	2.31E+17
D-77	2.0024	5.7	8167	249	2.0040	4.3	1224	67	2.0035	5.8	9127	276	3.13E+17
D-78	2.0027	5.7	7624	231	2.0040	7.0	1047	22	2.0036	5.7	8124	246	2.79E+17
D-79	2.0025	5.0	5190	205	2.0055	6.4	1599	39	2.0035	5.4	5822	201	2.00E+17
D-80	2.0028	3.4	882	75	2.0055	6.9	1034	22	2.0037	3.4	895	78	3.07E+16
D-81	2.0023	6.5	11713	275	2.0041	6.9	1032	22	2.0030	6.6	12589	287	4.32E+17
D-82	2.0025	5.4	5218	176	2.0040	3.5	521	43	2.0035	6.0	6734	189	2.31E+17
D-83	2.0026	6.0	6911	192	2.0055	4.4	666	35	2.0036	6.2	7118	188	2.44E+17
D-84	2.0026	6.3	11495	291	2.0047	3.8	771	52	2.0036	6.7	13194	297	4.53E+17
D-85	2.0026	5.5	7298	240	2.0055	7.0	1051	22	2.0035	5.8	8144	239	2.80E+17
D-86	2.0026	6.3	7442	185	2.0048	6.9	1044	22	2.0035	6.2	7516	193	2.58E+17
D-87	2.0023	7.1	20545	405	2.0040	5.7	855	26	2.0032	7.0	20734	419	7.12E+17
D-88	2.0023	7.2	10046	191	2.0055	6.9	1025	22	2.0033	7.4	10443	193	3.59E+17
D-89	2.0029	3.5	1457	120	2.0055	6.9	1029	22	2.0038	3.3	1383	128	4.75E+16
D-90	2.0025	6.9	9195	196	2.0040	4.7	701	31	2.0034	7.0	10325	211	3.55E+17
D-91	2.0025	6.6	8175	186	2.0055	7.0	1046	22	2.0035	6.6	8279	188	2.84E+17
D-92	2.0028	5.4	6043	208	2.0052	3.6	537	43	2.0038	6.0	7233	201	2.48E+17
D-93	2.0023	6.0	4000	110	2.0040	6.9	1037	22	2.0029	7.4	6505	118	2.23E+17
D-94	2.0024	4.6	1639	79	2.0040	5.2	794	29	2.0035	5.1	2386	91	8.19E+16
D-95	2.0025	6.2	7013	183	2.0040	3.8	577	39	2.0035	6.3	7929	197	2.72E+17
D-96	2.0025	6.9	6480	136	2.0040	5.8	875	26	2.0035	6.9	7378	153	2.53E+17
D-97	2.0024	5.6	6568	213	2.0040	7.0	1049	22	2.0033	5.8	7497	225	2.57E+17

Tab. S2: (Continued)

D-98	2.0023	8.5	11975	166	2.0040	4.5	840	42	2.0035	7.6	11097	190	3.81E+17
D-99	2.0023	7.1	10496	210	2.0040	6.9	1041	22	2.0032	7.0	10833	223	3.72E+17
D-100	2.0023	6.3	5657	142	2.0040	6.9	1029	22	2.0033	6.7	6841	154	2.35E+17
D-101	2.0024	7.2	11843	231	2.0040	4.2	634	36	2.0034	6.9	11669	247	4.01E+17
D-102	2.0023	4.9	5797	242	2.0040	4.3	637	35	2.0033	5.1	6494	252	2.23E+17
D-103	2.0024	6.1	5800	158	2.0040	4.3	645	35	2.0034	6.1	6485	172	2.23E+17
D-104	2.0023	6.9	18739	391	2.0055	6.9	1043	22	2.0030	6.7	17959	395	6.17E+17
D-105	2.0025	6.4	8924	219	2.0055	6.9	1040	22	2.0035	6.5	9298	221	3.19E+17
D-106	2.0023	6.6	8548	194	2.0040	3.5	519	43	2.0034	6.9	9878	207	3.39E+17
D-107	2.0024	5.5	13604	455	2.0055	5.8	878	26	2.0032	5.3	12565	453	4.31E+17
D-108	2.0024	6.2	9762	255	2.0055	6.9	1544	32	2.0034	6.8	11858	253	4.07E+17
D-109	2.0023	4.8	3604	156	2.0043	3.5	528	43	2.0040	6.0	5384	151	1.98E+17
D-110	2.0026	4.8	3558	154	2.0040	7.0	1049	22	2.0043	5.7	5231	164	1.92E+17
D-111	2.0023	5.1	3482	133	2.0040	5.3	792	29	2.0040	6.0	5110	142	1.88E+17
D-112	2.0025	4.9	5230	214	2.0055	3.8	562	40	2.0041	5.0	5105	204	1.87E+17
D-113	2.0023	5.2	3312	122	2.0040	3.8	570	40	2.0038	5.8	4238	128	1.56E+17
D-114	2.0023	7.8	27646	460	2.0040	7.0	1054	22	2.0035	7.7	28346	474	1.04E+18
D-115	2.0023	7.3	15311	287	2.0040	6.9	1034	22	2.0037	7.5	16802	299	6.17E+17
D-116	2.0023	7.3	6338	120	2.0040	4.9	735	31	2.0040	7.5	7537	134	2.77E+17
D-117	2.0025	5.2	6781	248	2.0040	6.9	1029	22	2.0040	6.3	10038	252	3.68E+17
D-118	2.0025	5.7	3563	109	2.0055	6.5	1647	38	2.0045	7.2	5614	108	2.06E+17
D-119	2.0025	5.3	4431	159	2.0055	4.5	708	35	2.0042	5.7	4884	151	1.79E+17
D-120	2.0026	5.3	6231	221	2.0050	3.5	627	52	2.0043	5.6	6686	215	2.45E+17
D-121	2.0023	5.4	5856	198	2.0055	7.0	1048	22	2.0039	6.0	7077	194	2.60E+17
D-122	2.0026	5.8	6826	203	2.0055	5.1	768	30	2.0042	7.1	9898	194	3.63E+17

Tab. S2: (Continued)

D-123	2.0023	6.0	10334	288	2.0044	3.8	2429	169	2.0045	6.7	14402	325	5.29E+17
D-124	2.0028	3.5	935	77	2.0055	6.9	1043	22	2.0044	3.1	823	83	3.02E+16
D-125	2.0029	4.6	1351	64	2.0054	4.1	619	37	2.0050	6.7	2685	59	9.85E+16
D-126	2.0027	4.3	2016	111	2.0055	4.1	645	38	2.0044	6.0	3545	97	1.30E+17
D-127	2.0029	3.5	1726	139	2.0055	5.7	848	26	2.0045	3.9	2055	133	7.54E+16
D-128	2.0028	3.6	1635	125	2.0048	4.8	727	31	2.0045	4.6	2620	123	9.62E+16
D-129	2.0024	3.9	1617	105	2.0042	4.3	1150	64	2.0045	6.3	4560	115	1.67E+17
D-130	2.0024	5.4	3367	114	2.0040	3.8	564	39	2.0041	6.6	5380	124	1.97E+17
D-131	2.0023	7.3	8334	156	2.0041	4.7	702	32	2.0039	7.3	9092	169	3.34E+17
D-132	2.0023	6.3	3833	96	2.0040	3.4	515	43	2.0043	6.4	4598	112	1.69E+17
D-133	2.0023	8.1	5854	88	2.0040	4.5	676	34	2.0042	7.8	6405	106	2.35E+17
D-134	2.0026	4.6	1871	88	2.0050	3.6	539	41	2.0045	5.8	2790	82	1.02E+17

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Tab.S3: Correlation coefficients between the atmospheric concentrations of EPFRs and DTT in road dust samples.

		Original EPFRs	Original C-EPFRs	Original O-EPFRs	Decay EPFRs	Decay C-EPFRs	Decay O-EPFRs	⊿EPFRs	⊿C-EPFRs	⊿O-EPFRs
Total-DTT	Pearson	0.040	0.052	-0.022	.230**	.250**	0.033	-0.067	-0.080	-0.028
	Sig.（two-tailed）	0.642	0.550	0.800	0.007	0.004	0.707	0.442	0.359	0.746
	n					134				
WS-DTT	Pearson	0.122	0.129	0.026	0.124	0.095	-0.003	0.075	0.089	0.028
	Sig.（two-tailed）	0.162	0.136	0.769	0.154	0.277	0.969	0.392	0.308	0.751
	n					134				
WIS-DTT	Pearson	0.006	0.015	-0.027	.199*	.227**	0.037	-0.090	-0.108	-0.035
	Sig.（two-tailed）	0.947	0.864	0.753	0.021	0.008	0.674	0.299	0.215	0.692
	n					134				

*Indicates a significant correlation at the 0.05 level. **Indicates a significant correlation at the 0.01 level; indicates $p < 0.001$.

Tab.S4 Correlation coefficients between the EPFRs concentration, DTT consumption rate and the concentration of different magnetic metals in road dust sample.

		A_1	B_1	C_1	D_1	A_2	B_2	C_2	D_2	A_3	B_3	C_3	D_3
EPFRs	Pearson	-0.071	-0.022	0.096	0.046	0.007	-0.079	-0.061	-0.093	-0.071	-0.022	0.101	-0.048
	Sig.（two-tailed）	0.413	0.804	0.271	0.595	0.936	0.364	0.486	0.286	0.413	0.804	0.245	0.579
	n	134											
Total-DTT	Pearson	-.187*	0.049	-0.085	-0.067	-0.077	-0.106	-0.036	-0.040	-.187*	0.049	-0.082	0.026
	Sig.（two-tailed）	0.030	0.571	0.329	0.438	0.378	0.224	0.681	0.648	0.030	0.570	0.347	0.766
	n	134											
WS-DTT	Pearson	0.158	0.137	-0.101	0.013	-0.151	0.083	.178*	-0.009	0.158	0.137	-0.116	-0.068
	Sig.（two-tailed）	0.069	0.115	0.247	0.885	0.083	0.340	0.039	0.913	0.069	0.116	0.180	0.435
	n	134											
WIS-DTT	Pearson	-.243**	0.011	-0.052	-0.067	-0.032	-0.132	-0.096	-0.036	-.243**	0.011	-0.044	0.046
	Sig.（two-tailed）	0.005	0.898	0.547	0.440	0.712	0.127	0.268	0.681	0.005	0.897	0.614	0.594
	n	134											

*Indicates a significant correlation at the 0.05 level. **Indicates a significant correlation at the 0.01 level; indicates $p < 0.001$.

A_1: Total-Diamagnetic metals； B_1: Total-Antiferromagnetic metals； C_1: Total-Paramagnetic metals； D_1: Total-Ferromagnetic metals

A_2: WS-Diamagnetic metals； B_2: WS-Antiferromagnetic metals； C_2: WS-Paramagnetic metals； D_2: WS-Ferromagnetic metals

A_3: WIS-Diamagnetic metals； B_3: WIS-Antiferromagnetic metals； C_3: WIS-Paramagnetic metals； D_3: WIS-Ferromagnetic metals

Tab.S5: Correlation coefficients between DTT consumption rate and metals concentration in road dust.

WS-Metals			Al	K	Mg	Be
WS-DTT		Pearson	-.362**	.235**	.371**	.192*
		Sig. (two-tailed)	0.000	0.006	0.000	0.026
		n		134		
WS-Metals			Sc	Co	Ga	Ge
WS-DTT		Pearson	.201*	-.249**	.183*	-.250**
		Sig. (two-tailed)	0.020	0.004	0.035	0.004
		n		134		
WIS-Metals			Zn	Sn	Pr	Pb
WIS-DTT		Pearson	-.250**	-.250**	.187*	-.213*
		Sig. (two-tailed)	0.004	0.004	0.030	0.013
		n		134		
Total-Metals			Zn	Sn	Pr	Pb
Total-DTT		Pearson	-.192*	-.195*	.173*	-.171*
		Sig. (two-tailed)	0.026	0.024	0.046	0.048
		n		134		

*Indicates a significant correlation at the 0.05 level. **Indicates a significant correlation at the 0.01 level; indicates $p < 0.001$.