

## Supplementary Materials:

# The Content and Sources of Potentially Toxic Elements in the Road Dust of Surgut (Russia)

Dmitriy Moskovchenko <sup>1,2,\*</sup>, Roman Pozhitkov <sup>1</sup>, Andrey Soromotin <sup>2</sup> and Valeriy Tyurin <sup>3</sup>

**Table S1.** Description of sampling sites.

Sample name	Sample number	Latitude	Longitude	Location	Traffic intensity	Collection date
SD1-2021	1	61.285056	73.381167	industrial and warehouse area	Low	17.07.2021
SD2-2021	2	61.287333	73.393500	industrial and warehouse area	Moderate	17.07.2021
SD3-2021	3	61.276222	73.404833	industrial and warehouse area	High	17.07.2021
SD4-2021	4	61.271250	73.425833	industrial and warehouse area	Low	17.07.2021
SD5-2021	5	61.281306	73.435944	industrial and warehouse area	High	17.07.2021
SD6-2021	6	61.273667	73.385833	industrial and warehouse area	High	17.07.2021
SD7-2021	7	61.258750	73.367833	high-rise residential area	Moderate	17.07.2021
SD8-2021	8	61.275778	73.482667	power plant area	Moderate	18.07.2021
SD9-2021	9	61.276333	73.501917	power plant area	High	18.07.2021
SD10-2021	10	61.279278	73.521000	power plant area	High	18.07.2021
SD11-2021	11	61.237222	73.483083	low-rise area	High	18.07.2021
SD12-2021	12	61.236417	73.474639	low-rise area	High	18.07.2021
SD13-2021	13	61.240111	73.473972	low-rise area	Moderate	18.07.2021
SD14-2021	14	61.238194	73.457639	low-rise area	High	18.07.2021
SD15-2021	15	61.236139	73.441528	high-rise residential area	Moderate	18.07.2021
SD16-2021	16	61.240972	73.407917	modern business zone	High	18.07.2021
SD17-2021	17	61.241000	73.392389	modern business zone	High	18.07.2021
SD18-2021	18	61.237333	73.374778	modern business zone	High	18.07.2021

SD19-2021	19	61.251056	73.376444	high-rise residential area	Moderate	18.07.2021
SD20-2021	20	61.253472	73.391667	high-rise residential area	Moderate	18.07.2021
SD21-2021	21	61.250000	73.418194	high-rise residential area	Moderate	18.07.2021
SD22-2021	22	61.261944	73.413694	high-rise residential area	High	18.07.2021
SD23-2021	23	61.265917	73.376056	high-rise residential area	High	18.07.2021
SD24-2021	24	61.338389	73.410583	transport hub	High	18.07.2021
SD25-2021	25	61.288972	73.322556	transport hub	High	18.07.2021

**Table S2.** Methods of analysis, analytical results and recovery of certified reference material.

Element	Method	DL	Trapp ST-2 (GSO 8670-2005)			BHVO-2 (US Geological Survey)		
			Certified value	Found average	Recovery %	Certified value	Found average	Recovery %
Na <sub>2</sub> O	AES	0.001	2.32	2.3	98.1	2.22	2.1	94.8
MgO	AES	0.005	7.51	7.4	98.1	7.23	7.2	99.0
Al <sub>2</sub> O <sub>3</sub>	AES	0.009	14.63	14.6	99.6	13.5	13.6	100.6
P <sub>2</sub> O <sub>5</sub>	AES	0.005	0.17	0.2	98.5	0.27	0.3	96.5
S	AES	0.002	0.026	0.022	85.3	-	0.018	-
K <sub>2</sub> O	AES	0.002	0.46	0.4	97.6	0.52	0.49	93.5
CaO	AES	0.005	10.42	10.4	99.7	11.4	11.3	99.4
TiO <sub>2</sub>	AES	0.0005	1.59	1.6	100.1	2.73	2.6	97.0
MnO	AES	0.0004	0.21	0.21	101.1	0.17	0.2	92.9
Fe <sub>2</sub> O <sub>3</sub>	AES	0.01	14.62	14.4	98.3	12.3	12.4	101.1
Li	MS	0.03	8.6	10.0	116.1	5	89.5	89.5
Be	MS	0.02	0.8	0.8	95.5	-	-	-
Sc	MS	0.06	41	43.0	104.9	32	98.7	98.7
V	MS	0.6	315	317.0	100.6	317	100.5	100.5
Cr	MS	0.7	213	242.4	113.8	280	96.8	96.8
Co	MS	0.2	52	54.1	104.1	45	96.0	96.0
Ni	MS	0.9	126	120.5	95.6	119	97.0	97.0
Cu	MS	0.8	180	186.5	103.6	127	96.9	96.9
Zn	MS	0.8	112	110.6	98.7	103	110.5	110.5
Ga	MS	0.02	17	19.5	114.5	21.7	84.6	84.6
As	MS	0.06	-	2.3	-	-	<DL	-
Se	MS	0.8	-	<DL	-	-	<DL	-

Rb	MS	0.04	11	12.0	109.2	9.8	88.6	88.6
Sr	MS	0.03	197	207.5	105.3	389	103.2	103.2
Y	MS	0.05	29	30.6	105.6	26	95.7	95.7
Zr	MS	0.02	125	114.6	91.7	172	102.6	102.6
Nb	MS	0.02	6.0	5.3	88.6	18	96.7	96.7
Mo	MS	0.06	1.0	0.8	78.2	-	<DL	-
Rh	MS	0.06	-	<DL	-	-	<DL	-
Pd	MS	0.06	-	<DL	-	-	<DL	-
Ag	MS	0.03	0.05	0.1	153.2	-	<DL	-
Cd	MS	0.03	-	0.1	-	-	<DL	-
Sn	MS	0.07	1.6	1.0	59.1	1.9	76.7	76.7
Sb	MS	0.03	-	0.2	-	-	<DL	-
Te	MS	0.06	-	<DL	-	-	<DL	-
Cs	MS	0.01	0.5	0.4	84.0	-	<DL	-
Ba	MS	0.07	227	158.4	69.8	130	99.3	99.3
La	MS	0.01	8	8.2	102.8	15.0	101.2	101.2
Ce	MS	0.02	22	20.9	95.2	38.0	100.6	100.6
Pr	MS	0.004	2.6	2.8	105.8	-	<DL	-
Nd	MS	0.01	13.2	14.0	105.8	25.0	98.0	98.0
Sm	MS	0.008	4.0	4.1	101.6	6.2	94.0	94.0
Eu	MS	0.007	1.4	1.4	102.7	-	<DL	-
Gd	MS	0.009	4.5	4.4	98.2	6.3	88.0	88.0
Tb	MS	0.006	0.8	0.8	98.8	0.9	98.6	98.6
Dy	MS	0.005	5.1	5.2	101.5	-	<DL	-
Ho	MS	0.007	1.0	1.1	107.8	1.0	89.4	89.4
Er	MS	0.005	2.9	3.2	109.5	-	<DL	-
Tm	MS	0.005	0.44	0.5	102.4	-	<DL	-
Yb	MS	0.007	3.3	3.2	98.0	2.0	104.5	104.5
Lu	MS	0.004	0.44	0.4	100.7	0.28	93.6	93.6
Hf	MS	0.01	2.7	3.0	110.1		<DL	-
Ta	MS	0.01	0.4	0.3	99.9	1.4	83.4	83.4
W	MS	0.02	0.4	0.3	63.2	-	<DL	-
Re	MS	0.007	-	<DL	-	-	<DL	-
Ir	MS	0.005	-	<DL	-	-	<DL	-
Pt	MS	0.01	-	<DL	-	-	<DL	-
Au	MS	0.03	0.0026	<DL	-	-	<DL	-
Hg	MS	0.01	-	0.018	-	-	<DL	-
Tl	MS	0.005	-	0.05	-	-	<DL	-
Pb	MS	0.07	3.0	2.6	85.9	-	<DL	-
Bi	MS	0.01	-	<DL	-	-	<DL	-
Th	MS	0.006	1.0	1.1	106.8	1.2	103.5	103.5
U	MS	0.005	0.5	0.5	107.2	-	<DL	-

**Table S3.** Exposure parameters used for the health risk assessment.

Element	RfD <sub>inh</sub>	RfD <sub>derm</sub>	RfD <sub>inh</sub>	SF <sub>ing</sub>	SF <sub>derm</sub>	SF <sub>inh</sub>	References
Mn	0.14	0.0084	0.000014	-	-	-	US EPA (2020a)
Fe	0.7	0.07	-	-	-	-	US EPA (2020b)
Pb	0.0036	0.00036	-	0.0085	0.085	0.042	OEHHA (2020)
Cr	1.5	0.0195	0.00143	-	-	-	US EPA (2020a)
Co	0.0003	0.00003	0.0000017	-	-	-	US EPA (2020b)
Ni	0.011	0.00044	0.0000257	-	-	-	OEHHA (2020)
Cu	0.01	0.0057	-	-	-	-	ATSDR (2020)
Zn	0.3	0.03	-	-	-	-	US EPA (2020a)
As	0.0003	0.000285	0.000429	1.5	1.58	15.05	US EPA (2020a)
Cd	0.001	0.000025	0.00000286	-	-	-	US EPA (2020a)
Sb	0.0004	0.00006	0.0000857	-	-	-	US EPA (2020a)

Equations for the human health risk assessment

The average daily dose (ADD), which reflects chronic exposure to a contaminant received through each exposure pathway, was calculated using the following equations (US EPA 1989)

$$ADD_{ing} = \frac{Ci \times IRs \times FI \times EF \times ED \times CF}{BW \times AT} \quad (1)$$

$$ADD_{derm} = \frac{Ci \times SA \times AF \times ABSd \times EF \times ED \times CF}{BW \times AT} \quad (2)$$

$$ADD_{inh} = \frac{Ci \times IRa \times EF \times ED}{BW \times AT \times PEF} \quad (3)$$

Individual noncancerogenic risk was calculated as

$$HQ = \frac{ADD}{RfD} \quad (4)$$

To access the overall potential for noncancerogenic risk posed by all PTE for all proposed pathways, a total hazard index was calculated (UA EPA 1989). The cumulative noncancerogenic risk of k number of contaminants was calculated as

$$HI = \sum_{k=1}^n \left( \frac{ADD_{ing}}{RfD_{ing}} + \frac{ADD_{derm}}{RfD_{derm}} + \frac{ADD_{inh}}{RfD_{inh}} \right) \quad (5)$$

## References

- ATSDR (Agency for Toxic Substances and Disease Registry).(2020). Minimal risk levels (MRLs) list. March 2020.<https://www.atsdr.cdc.gov/mrls/pdfs/ATSDR%20MRLs%20-%20March%202020%20-%20H.pdf>. Retrieved March20, 2020.
- OEHHA (California Office of Environmental Health Hazard Assessment). (2020) Chemical database. <https://oehha.ca.gov/chemicals>. Retrieved March 21, 2020

US EPA (US Environmental Protection Agency). (2020a). Integrated Risk Information System (IRIS). Washington, DC:Office of Research and Development. [https://cfpub.epa.gov/ncea/iris\\_drafts/AtoZ.cfm](https://cfpub.epa.gov/ncea/iris_drafts/AtoZ.cfm). Retrieved March 20, 2020.

US EPA (US Environmental Protection Agency). (2020b). Provisional peer-reviewed toxicity values (PPRTVs).Washington, DC: Office of Research and Development. <https://www.epa.gov/pprtv/provisional-peer-reviewedtoxicity-values-pprtvs-assessments>. Retrieved March 20,2020.