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SUPPLEMENTARY MATERIAL TO

Assessment of heavy metal pollution of topsoils and plants in the City of Belgrade

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STUDY AREA AND SAMPLING

The city of Belgrade, with about 2 million inhabitants, is characterized by high urbanization dynamic, intense traffic volume and industrial zones that are located on the peripheral parts of the city within which many factories until recently operated with old technologies. The main part of the Belgrade is positioned on a hilly landscape, whereas other parts, such as New Belgrade, lie on drained soil that was covered with sand more than 50 years ago. The main geological substrate in Belgrade consists of Neogene sediments that cover pre-Neogene rocks, such as clays, sands and carbonate rocks.[1] There is a large variety of natural soils; in the vicinity of the big Sava and Danube Rivers and in the lower altitudes, there are gley, semi-gley and alluvial soils, whereas at higher altitudes, there are different clay and skeletal soils. These soils in Belgrade were modified for many decades by different anthropogenic activities, such as wetlands draining, covering with sand or introducing new materials during infrastructure building. Comprehensive and more recent surveys on the quality of urban soils in Belgrade were realized by several authors.[2–7]

The soil and plant samples were collected from the urban centre of Belgrade. Plants samples and their associated topsoils were collected in the proximity to central urban boulevards (JNA Boulevard, Mihajlo Pupin Boulevard and Ustanička Boulevard) and from urban parks (Botanical Garden, Kalemegdan and Sava Quay). There were eighteen different sampling sites, positioned in six dif-

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ferent quarts in central Belgrade urban zone. Their acronyms and positions are shown in Table S-I and Fig. S-1.

TABLE S-I. Abbreviations of the sampling sites within the urban centre of the City of Belgrade

Species	Sampling site					
	Botanical garden	Kalemegdan	Sava Quay	JNA Blvd.	Mihajlo Pupin Blvd.	Ustanička Blvd.
B. sempervirens	B1	B2	B3	B4	B5	B6
M. aquifolium	M1	M2	M3	M4	M5	M6
P. laurocerasus	P1	P2	P3	P4	P5	P6

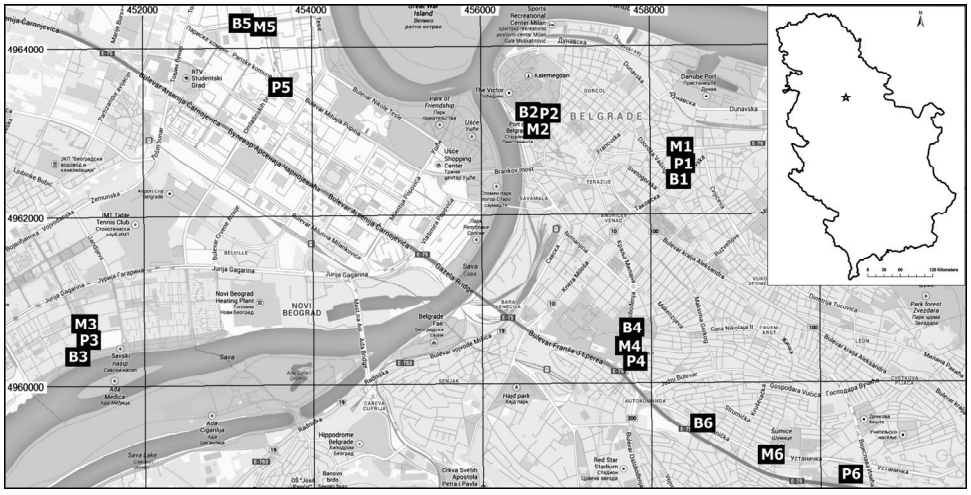

Fig. S-1. Map of the studied area within the urban centre of the city of Belgrade and sampling sites (for the abbreviations of the sampling sites see Table S-I).

TABLE S-II. Minimum, maximum concentrations of heavy metals (mg kg^{-1}) in the urban soils of several cities in the world

City	Element								
	Mn	Ni	Zn	Cr	Co	Cu	Cd	Pb	V
Belgrade	810−1223	45−83	101−343	39−65	17.4−22.2	35−103	1.3−2.4	34−511	74−127
Hamburg[8]	–	<2–182	<5–11850	5–492	–	<2–3688	–	<2–3074	–
Bangkok[9]	50–810	4.1–52.1	3–814	4.3–57.4	–	5.1–283.0	0.05–2.53	12.1–269.3	–
Mexico city[10]	–	20–146	34–1641	50–265	–	15–398	–	5–452	50–179
Palermo[11]	142–1241	7.0–38.6	52–433	12–100	1.5–14.8	10–344	0.27–1.86	57–682	21–124
Hong Kong[12]	–	–	38.7–435	–	–	5.1–190	0.02–5.89	5.3–404	–
Zagreb[13]	79.2–4537	0.7–488	27.1–479	11.5–400	2.74–47.2	3.64–1335	0.02–4.94	1–216	–
Damask[14]	–	24–58	46–293	12–116	7–23	16–97	–	<5–108	–

TABLE S-II. Continued

City	Element								
	Mn	Ni	Zn	Cr	Co	Cu	Cd	Pb	V
Naples[15]	–	–	30–2550	1.7–73	–	6.2–286	–	4–3420	–
World average[16]	488	13–37	7–89	60	6–14	14–109	0.4	27	150

REFERENCES

1. S. Jovanović, *Ecological study of ruderal flora and vegetation in Belgrade*, Faculty of Biology, University of Belgrade, Serbia, 1994, p. 222 (in Serbian)
2. V. Vratuša, in *Proceedings of the Third Balkan scientific conference*, Sofia, Bulgaria, 2002, Vol. 3, p. 387
3. M. Tomašević, S. F. Rajšić, D. Đorđević, M. Tasić, J. Krstić, V. Novaković, *Environ. Chem. Lett*. **2** (2004) 151
4. V. Vratuša, N. Anastasijević, in Proceedings of the 7th Symposium on Flora of South-eastern Serbia and Neighboring Regions, Dimitrovgrad, Serbia, 2002, p. 153
5. I. Gržetić, G. H. A. Ghariani, *J. Serb. Chem. Soc.* **73** (2008) 923
6. M. D. Marjanović, M. M. Vukčević, D. G. Antonović, S. I. Dimitrijević, Đ. M. Jovanović, M. N. Matavulj, M. Đ. Ristić, *J. Serb. Chem. Soc.* **74** (2009) 697
7. M. M. Kuzmanoski, M. N. Todorović, M. P. Aničić Urošević, S. F. Rajšić, *Hem. Ind.* **68** (2014) 643
8. W. Lux, *Appl. Geochem.* **8** Suppl. 2 (1993) 135
9. W. Wilcke, S. Muller, N. Kanchanakool, W. Zech, *Geoderma* **86** (1998) 211
10. O. Morton-Bermea, E. Hernández-Álvarez, G. González-Hernández, R. Lozano, L. E. Beramendi-Orosco, F. Romero, *J. Geochem. Explor.* **101** (2009) 218
11. D. S. Manta, M. Angelone, A. Bellanca, R. Neri, M. Sprovieri, *Sci. Total Environ.* **300** (2002) 229 Palermo
12. X. Li, C. Poon, P. S. Liu, *Appl. Geochem.* **16** (2001) 1361
13. K. Czarnowska, B. Gworek, T. Kozanecka, B. Latuszek, E. Szafranska, *Polish Ecol. Stud.* **9** (1983) 63
14. I. Thornton, in *Soils in the Urban Environment*, P. Bullock, P. J. Gregory, Eds., Blackwell, Oxford, 1991, p. 47
15. J. A. Markus, A. B. McBratney, *Aust. J. Soil Res.* **34** (1996) 453
16. H. Meuser, *Contaminated Urban Soils,* Springer, Dordrecht, 2010, p. 320.