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Volume II

SOILS

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MARINE & OCEAN ECOSYSTEMS

16th INTERNATIONAL MULTIDISCIPLINARY SCIENTIFIC GEOCONFERENCE

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SOILS

SECTION SOILS

URBAN SOILS. RECENT APPROACHES IN ASSESSMENT OF THE SOILS QUALITY IN BUCHAREST CITY

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ABSTRACT

This study reports the degree of heavy metal pollution (Cu, Zn, Pb) in 36 urban topsoil samples from the metropolitan area of Bucharest City. The levels of heavy metals in the analized samples show a wide range of variation. Geochemical maps were produced to assess the spatial distribution of pollutants. It is concluded that emisions from the vehicles may be the major sources of the Pb contamination; furthermore, other small or large factories are posible sources in soil pollution (Cu, Zn). The assessment of of the soil environmental quality in the metropolitan area of Bucharest City can be used as the basis for a monitoring programme for implementing suitable pollution control measures.

Keywords: urban, soil, assessment, pollution, anthropic

INTRODUCTION

The urban area of Bucharest City is characterized by a high degree of urbanization, extensive changes of the urban infrastructure, the growth of residential areas by the appearance of new districts and, not least by reducing of the industrial activities. Bucharest, capital of Romania is approximately 228 square kilometers territorial expanded and the number of residents exceeds 2 million. Increasing of the urban infrastructure and the residential areas affecting the quality of urban environmental components, especially the soil covers. Moreover, non-functionality in urban areas, such as heavy traffic in town, with a low fluency, also has a negative impact.

Ecological importance of the presence of heavy metals in urban soils is closely related to human health due to their high ecological transference reported as an indicator of urban environmental quality, however the severity of pollution depends not only on total heavy metal concentration of the soil, but also on the proportion of their mobile and bioavailable forms [1].

Bucharest City has an area of 228 square kilometers (0.8% of Romania), of which building area is 70%. The city is located at 44°24'49" North latitude (as Belgrade, Geneva, Bordeaux, Minneapolis) and 26°05'48" East longitude (as Helsinki or Johannesburg), in southern part of Romania at a distance of 64 km North from the Danube River, 100 km South of the Carpathians Mountains and 250 km West of the

Black Sea [2]. In figure 1 is presented localization of the study area (Bucharest City) on physical map of the Europe.

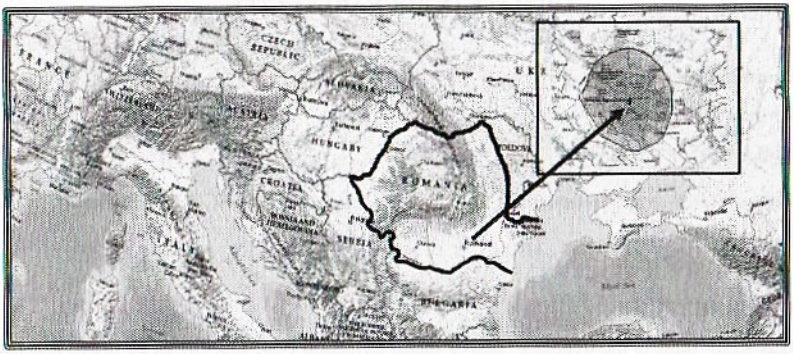

Figure 1 – Localization of the study area (Bucharest City) on physical map of the Europe
(source of basemap: ArcGis Earth, 2016)

The experimental field was design in order to establish quality of the urban soils in Bucharest City. This field was set up to cover more different areas: areas potential affected by industrial pollution, parks or other recreation zones, areas with high or light road traffic, commercial areas, residential areas and more others. Localizattion of the sampling points with a GPS receiver is shown in Table 1.

Table 1 – Soil samples localization (latitude and longitude coordinates)

Sample code	GPS coordinates Latitude and longitude WGS 84	Sample code	GPS coordinates Latitude and longitude WGS 84
S1	44°26'31.87"N 26° 3'46.75"E	S19	44°31'36.37"N 26° 9'51.92"E
S2	44°25'52.12"N 26° 3'39.71"E	S20	44°31'26.99"N 26° 2'3.36"E
S3	44°25'26.61"N 26° 3'46.61"E	S21	44°27'10.85"N 25°59'45.48"E
S4	44°24'56.04"N 26° 4'12.08"E	S22	44°29'16.92"N 26° 1'56.88"E
S5	44°24'26.56"N 26° 4'42.40"E	S23	44°29'49.98"N 26° 1'55.62"E
S6	44°23'56.90"N 26° 5'3.37"E	S24	44°29'33.24"N 26° 3'51.72"E
S7	44°23'26.58"N 26° 5'12.18"E	S25	44°29'5.04"N 26° 4'34.86"E
S8	44°21'50.08"N 26° 6'7.91"E	S26	44°24'26.70"N 26° 7'33.66"E
S9	44°21'56.38"N 26° 7'43.12"E	S27	44°22'10.86"N 26° 8'33.48"E
S10	44°21'36.45"N 26° 8'16.78"E	S28	44°22'37.38"N 26° 5'14.46"E
S11	44°21'43.69"N 26° 8'30.54"E	S29	44°23'8.82"N 26° 5'12.66"E
S12	44°23'39.77"N 26° 8'52.04"E	S30	44°23'15.60"N 26° 5'31.02"E
S13	44°23'53.02"N 26° 9'43.99"E	S31	44°22'58.50"N 26° 6'34.14"E
S14	44°24'57.29"N 26°13'6.12"E	S32	44°24'28.80"N 26°11'22.92"E
S15	44°26'2.90"N 26°11'7.21"E	S33	44°26'7.92"N 26°10'34.32"E
S16	44°27'53.24"N 26° 9'47.21"E	S34	44°26'21.30"N 26°11'25.02"E
S17	44°29'2.81"N 26° 8'23.41"E	S35	44°26'40.74"N 25°59'13.80"E
S18	44°29'8.28"N 26° 7'34.81"E	S36	44°28'21.30"N 26° 0'44.70"E

The soil investigations activities was performed in period March- November 2015, were conducted in accordance with the standard methods of sampling, using appropriate sampling equipment and the samples being taken from depths of 0-10 centimeters and 30-40 centimeters. Distribution of the soil samples on physical map of Bucharest City is presented in figure 2.

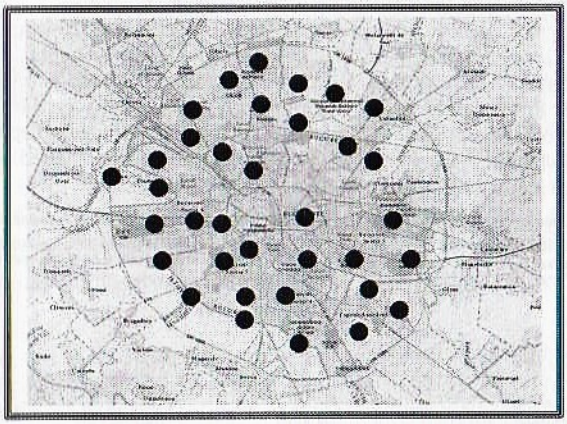

Figure 2 – Distribution of the soil samples on physical map of Bucharest City
(source of basemap: ArcGis Earth, 2016)

EXPERIMENTAL

The investigation proposed for evaluating the quality of the urban soil in Bucharest are carried out in relation to scientific concerns and all methods were applied are nationally and internationally recognized [3-8], presented in table 2.

Table 2 – Soil quality indicators and laboratory test methods

No.	Quality indicator	Test method
1	pH	ISO 10390-2005
2	Dry matter	SR ISO 11465-1998
3	Humus	SR ISO 14235:2000 STAS 7184/21:1982
4	Kjeldahl Nitrogen	SR ISO 11261-00
5	Sulphates	SR ISO 11048-99
6	Clorides	STAS 7184/7:1987 SR ISO 9297:2001
7	Iron	SR EN ISO 17294:2005
8	Copper	SR EN ISO 17294:2005
9	Lead	SR EN ISO 17294:2005
10	Zinc	SR EN ISO 17294:2005

11	Total Chromium	SR EN ISO 17294:2005
12	Cadmium	SR EN ISO 17294:2005

Analyzing the results of the soil quality indicators revealed the following aspects:
- a pH of the soils variable, both in neutral - weak acid, and in the neutral - slightly alkaline domains;
- organic matter content (humus) small-medium is much smaller than the one mentioned in the literature for urban soils;
- quality indicator values "sulphates" are found below the alert threshold (2000 miligramms / kg dry matter) stipulated in specific national legislation.

Processing the results obtained with a geostatistical method allowed to drawing maps of a distribution for 2 levels depth according to investigations performed (first 10 centimeteres from the topographic surface and 30 up to 40 centimeters depth).
In figure 3 is show the distribution of quality indicator "copper" based on the results obtained for all soil samples analyzed in Bucharest.

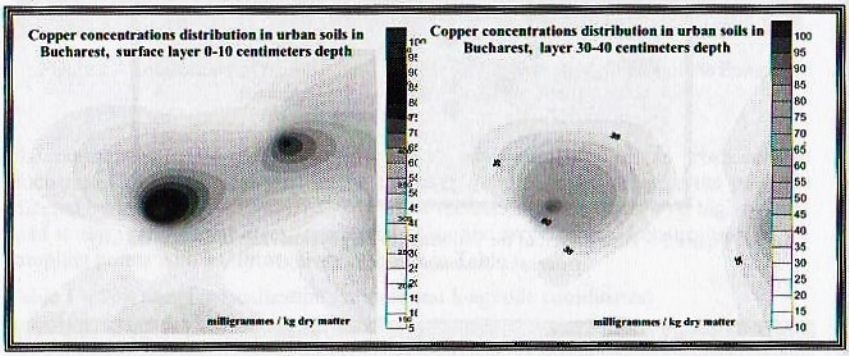

Figure 3 – „Copper" distribution in soil samples in Bucharest City investigations performed in 2015

Is observed that the values of the results obtained for this quality indicator are higher in the first level of depth, the maximum being recorded in soil samples from an area under the influence and its impact of the construction activities at the new subway public transportation line and a zone with intense road traffic, including heavy traffic.
Exceeding the normal values for this pollutant in the soil (established to the value 20 miligramms per kg dry matter) in the extensive areas of Bucharest, highlights the vulnerability of urban soils under the impact of anthropogenic activities.
Figure 4 shows the distribution of the quality indicator "Lead" based on the results for the all 72 soil samples taken.

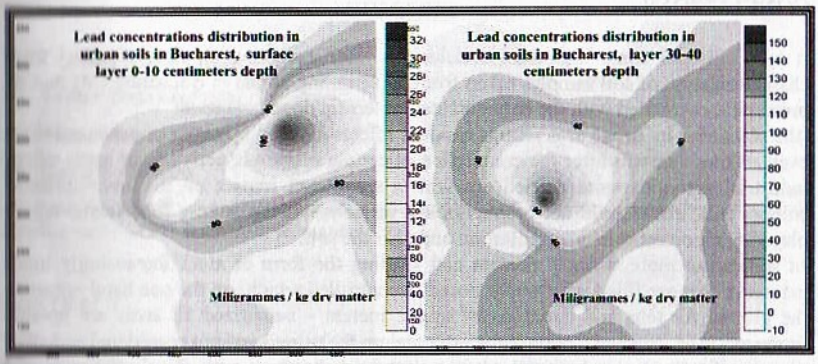

Figure 4 – „Lead" distribution in soil samples in Bucharest City, investigations performed in 2015

It is observed that the values recorded for this quality indicator is higher on depth reported to the first level, these layer being more vulnerable. In 23.8% of the analyzed samples from the 0-10 centimeters depth exceed the normal values in accordance with specific legislation of the environmental pollution assessment, and in the two sampling points is exceed the intervention threshold, respectively is exceeded the amount of 100 miligramms / kg dry matter.

Figure 5 shows the distribution of the quality indicator "Zinc" based on the results for the all soil samples.

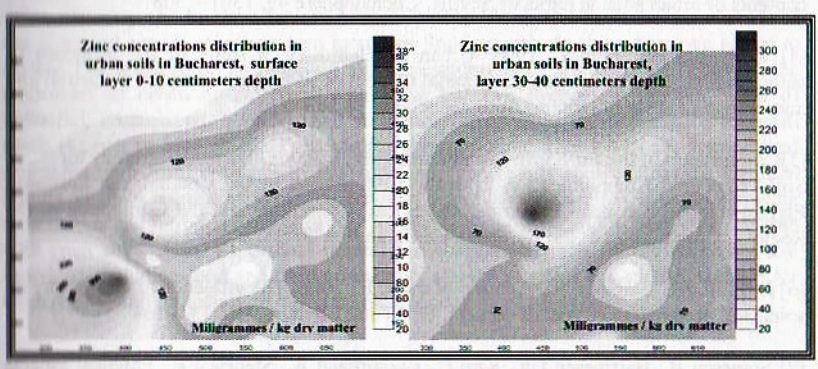

Figure 5 – „Zinc" distribution in soil samples in Bucharest City, investigations performed in 2015

It is observed that the values recorded for this quality indicator shows small variations from surface level to the 40 centimeters depth as in the previous case. Overcoming

normal values in soils, respectively 100 miligramms per kg dry matter is happens punctual.

CONCLUSIONS

It can highlight some important conclusions after analyzing all data obtained from characterization of soil samples taken from 36 sampling points in Bucharest City and its proximity, correlated with the data obtained in terrain documentation:

-the soil cover in urban area retains residual effects induced by anthropogenic activities even at long intervals after the completion of certain economic activities or areas where industrial activities were carried out with a significant impact on the environmental components; also should not be overlooked influence of the intense road traffic which plays an important role in air pollution and also the soil;

-it stands out more strongly present and shaping the form of areas increasingly more extensive that are filled with waste stored uncontrolled which, on the one hand occupies the ground for tens and hundreds of square meters – sumarized all areas are notable (order scale of thousands square meters), and on the other hand are considered potential sources of pollution in both the environmental components, respectively the soils and groundwaters.

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