A high level of heavy metals such as lead (Pb), zinc (Zn), copper (Cu), arsenic (As), cadmium (Cd) and antimony (Sb) are usually found in mining areas, mineral processing or metal factories, due to automotive traffic emissions or intense agricultural practices [1-5]. Consequently, soil contamination with heavy metals is a worrying global environmental problem, as these elements can be transferred into the hydrosphere and biosphere, thus becoming a danger to human health. Consequently, the mobility and bioavailability of heavy elements in the soil play an important role in the assimilation of these contaminants by plants and animals [11].

It is well known that heavy metal contamination does not directly affect the physical and chemical properties of soil but reduces soil biological activity and decreases the availability of nutrients. It is also a serious threat to human health by introducing into food chains through water and soil.

Contamination of soil with heavy metals is quite serious in some areas of Romania. It is, therefore, necessary to study the status of heavy metal contamination in the soil and to assess their impact on the environment [10]. Most studies on heavy metal contamination begin with the determination of its spatial distribution [4, 12-14].

Generally, pollutant concentrations can show complex spatial patterns with peak values and a large variation in concentrations. Therefore, it is difficult to detect polluted areas over a critical level, even if the data were collected at a large number of observation sites [14].

The Baia Mare (B), Copsa Mica (C) and Aghires areas represent areas of great interest for studies on the behavior of heavy elements in contaminated soils. In this respect, we conducted a research focused on the identification of heavy elements in contaminated soils. In this respect, we conducted a research focused on the identification of heavy elements in contaminated soils. In this respect, we conducted a research focused on the identification of heavy elements in contaminated soils.
Based on the data from figure 1 one can conclude that there is an acidic contamination in the analyzed area. The smallest values of pH (from 3.8 to 4.2) were measured for samples P from Aghires quarry. Acidic soils were identified also in Baia Mare (samples B1-B4 with a pH between 4 and 6), while in Copsa-Mica the soil is almost neutral (pH range between 6 and 7). Acidic soils contamination favor the increasing of the mobility of heavy metal ions and lead to soil degradation by exceeding the values for heavy metal content up to about 100 cm. Environment pollution in the Baia Mare area has also impacted on the health of the population. Studies on the risk groups for lead, cadmium and arsenic pollution [15-18] have shown concentrations of pollutants in the human body that have largely exceeded the reference levels, especially for the lead indicator (lead in blood being the main parameter to indicate the concentration of lead in the human body), which explains the increased incidence rates of specific morbidity in the area of respiratory, digestive, renal, endocrine and metabolic disease.

**Determination of dry matter and water content - Gravimetric method**

Figure 2 presents the hygroscopic water content of the soil determined under laboratory conditions recorded at 3 and 6 h. One can see the lowest values of hygroscopic water content after 3 h for P4 soil from Aghires and B2 soil taken from the Baia Mare area.

In the case of a dynamic soil system, the kinetics of mineral dissolution must be taken into consideration. The small rate of dissolution of lead compared to different minerals leads to a low bioavailability and a minor risk of circulation of lead in the soil and groundwater. Thus, in addition to solubility, the dissolution rate should be considered for assessing the stability of a Pb compound. Lead phosphates have low solubility (0.000014 g/100 mL), which are of several orders of magnitude less soluble than lead carbonates (0.00001 g/100 mL) and sulfates (0.00443 g/100 mL).

However, when solubility is estimated, the most studies are focused on soils that contain quite high concentrations of metal. Assessing the availability traces of metals is a problem not only in terms of contamination but also in situations of shortage in agricultural systems.

**Sieves gradation and size analysis**

Figure 3 shows the granulometric plot of soil size distribution in Baia Mare while figure 4 the granulometric distribution of Copsa-Mica soil.

One can see that in the soil from Baia Mare more than 44% from grains are smaller than 0.075 mm, 12.5% from soil are from 0.075 to 0.106 mm, while the rest have higher diameters. In the soil from Copsa-Mica, about 47% from grains are smaller than 0.075 mm, 12.7% grains from soil are from 0.075 to 0.106 mm, while the rest have higher diameters.

**Soil analysis by Scanning Electron Microscopy (SEM-EDAX)**

Total concentrations of soil metals traces are not good indicators of their bioavailability. However, information on total solid soil concentrations, together with chemically selected soil properties can be used to estimate the concentration of free metal ions in the soil.

Elemental analysis of toxic elements in samples in large quantities (major elements) or in traces (minor elements) is essential in addressing environmental pollution problems. Also, the analysis of these elements allows the obtaining of information on the formation and origin of different geological formations as well as data that contribute to the clarification of past geological processes [6-9].
Although there are several analytical methods that can be used to analyze environmental samples but only a few are non-destructive and allow for the determination of light elements. The statistical analysis was done after semi-quantitative analysis using SEM-EDAX (fig. 5) of soil microelements. The mean and standard deviation of the concentrations of some microelements (heavy metals) in the soil are shown in table 1.

Table 1

| Element | P2 Average | SD | P3 Average | SD | B2 Average | SD | B3 Average | SD | C1 Average | SD | C2 Average | SD |
|---------|------------|----|------------|----|------------|----|------------|----|------------|----|------------|----|
| O       | 40.29      | 0.133 | 26.99      | 0.066 | 50.41      | 0.163 | 39.56      | 0.062 | 38.51      | 0.404 | 36.47      | 0.446 |
| Al      | 17.16      | 0.664 | 4.107      | 0.053 | 3.659      | 0.018 | 10.86      | 0.639 | 3.521      | 0.026 | 8.844      | 0.116 |
| Ca      | 3.459      | 0.012 | 4.666      | 0.007 | 15.00      | 0.048 | 0.957      | 0.065 | 6.216      | 0.006 | 6.243      | 0.056 |
| Cu      | 1.994      | 0.010 | 2.098      | 0.003 | 2.940      | 0.047 | 1.867      | 0.066 | 2.587      | 0.023 | 1.300      | 0.039 |
| Fe      | 3.778      | 0.012 | 10.40      | 0.000 | 5.520      | 0.018 | 6.898      | 0.024 | 5.400      | 0.013 | 5.707      | 0.136 |
| K       | 0.439      | 0.003 | 2.330      | 0.033 | 1.385      | 0.047 | 1.622      | 0.007 | 1.834      | 0.008 | 3.758      | 0.125 |
| Mg      | 4.184      | 0.013 | 2.881      | 0.048 | 0.538      | 0.010 | 0.857      | 0.004 | 4.413      | 0.022 | 1.199      | 0.111 |
| Na      | 3.987      | 0.019 | 0.000      | 0.000 | 1.591      | 0.008 | 0.765      | 0.026 | 1.362      | 0.033 | 1.627      | 0.106 |
| P       | 1.127      | 0.005 | 3.668      | 0.004 | 1.949      | 0.022 | 1.295      | 0.066 | 1.961      | 0.027 | 3.480      | 0.073 |
| Pb      | 0.000      | 0.000 | 0.000      | 0.000 | 0.000      | 0.000 | 0.000      | 0.000 | 0.716      | 0.008 | 4.097      | 0.023 |
| Si      | 20.35      | 0.023 | 35.54      | 0.111 | 17.68      | 0.057 | 29.20      | 0.047 | 23.12      | 0.064 | 21.74      | 0.265 |
| Ti      | 0.170      | 0.001 | 0.939      | 0.052 | 0.913      | 0.066 | 0.309      | 0.003 | 0.644      | 0.067 | 1.659      | 0.008 |
| Zn      | 3.907      | 0.018 | 6.769      | 0.014 | 4.985      | 0.018 | 2.901      | 0.064 | 6.886      | 0.038 | 3.990      | 0.018 |

Although there are several analytical methods that can be used to analyze environmental samples but only a few are non-destructive and allow for the determination of light elements. The statistical analysis was done after semi-quantitative analysis using SEM-EDAX (fig. 5) of soil microelements. The mean and standard deviation of the concentrations of some microelements (heavy metals) in the soil are shown in table 1.

It is also noted that the average values of the pollutants (lead) concentration are higher in Baia Mare and Copsa Mica than in the Aghires area.

Conclusions

The study presents the results of soil quality studies from three contaminated areas, affected by exploitation from Romania: northwest of Baia Mare near Romplumb S.A., Aghires quarry area Copsa Mica. The smallest values of pH were measured for samples from Aghires (from 3.8 to 4.2)
followed by soils from Baia Mare (pH between 4 and 6), while in Copsa-Mica the soil is almost neutral (pH range between 6 and 7). The lowest values for hygroscopic water content after 3 h were obtained for soil from Aghires followed by the soil from the Baia Mare area.

Sieves analysis was also used for gradation and size analysis after soil drying in an oven. SEM-EDAX analysis revealed that the average values of the pollutants (lead) concentration are higher in Baia Mare and Copsa Mica than in the Aghires area. This study reports results will help to focus future research on soil remediation through new treatment methods.

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