SCANNING ELECTRONIC MICROSCOPE EVALUATION OF A TUNISIAN SOIL

MOHAMED ABDELWAHEB[1], VALENTIN NEDEFF[2,3], SONIA DRIDI-DHAOUADI[1], EMILIAN MOSNEGUTU[*2], ALEXANDRA-DANA CHITIMUS [2]

[1] University of Monastir, Faculty of Sciences of Monastir, Research laboratory of Environmental Chemistry and Clean Processes (LR21ES04) - 5000 Monastir, Tunisia

[2] "Vasile Alecsandri" University of Bacau, Calea Marasesti 157, Bacau, 600115, Romania

[3] Gheorghe Ionescu Sisesti, Academy of Agricultural and Forestry Sciences Bucharest, 61 Marasti Blvd., 01146, Bucharest, Romania

Abstract: This work present a soil analysis by scanning electronic microscope. The soil was collected from Tunisia. The analysis of soil show the highly presence of carbon and oxygen. The carbon is well used to retain heavy metals and pesticide. The soil presents also a high level of lead, this level present a high risk of water resource pollution.

Keywords: Tunisian soil, scanning electron microscope, heavy metals

1. INTRODUCTION

The soil is a vital and fundamental element for humanity. It is therefore essential to human life, it's a thin surface layer compared to the diameter of the planet [1]. It is made up of debris from rocks, grains of sand and clay, pieces of dead plants and animals.

Between these elements there are more or less space where air and water circulate and where a multitude of living beings live. The soil contains essentially of different mineral and organic compounds [2].

High agriculture activity influence the structure and the properties of soils. The pollution of soils by heavy metals represents a significant public health risk due to the various pathologies that these diseases can cause.

These pollutants are essentially cancer genic and toxic, which can damage the humanity health [3].

The scanning electron microscope presents in recent years a new technology to identify the presence of different elements in soils in order to show the presence of different sources of pollution of soil and water resource by infiltration such as heavy metals [4].

This work is about a soil analysis by scanning electronic microscope to study the composition of a soil and to show the importance of this technology to analyze a soil.

[*] Corresponding author, email: emos@ub.ro
doi.org/10.29081/jesr.v28i1.001

2. MATERIAL AND METHODS

A sample of soil was collected from agricultural region of Sousse, Tunisia (Figure 1).

Fig. 1. Soil location [5].

This sample was well analyzed by scanning electronic microscope (SEM), Tescan Mira, presented in Figure 2 to obtain SEM images of different maps of the soil sample [6]. An elemental analysis was done with a binding energy between 0 and 25 keV to show the variability of soil composition.

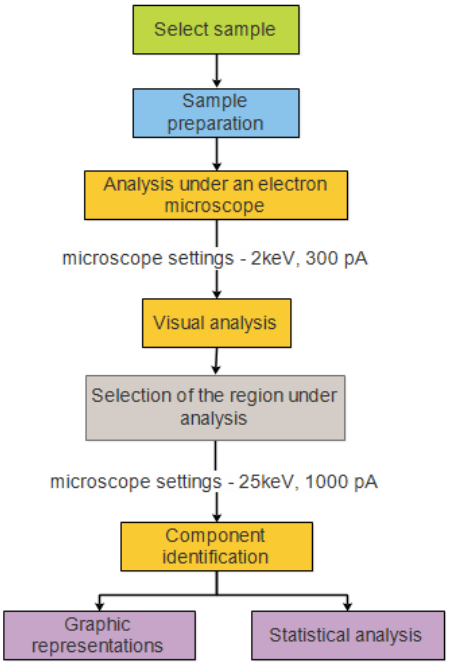
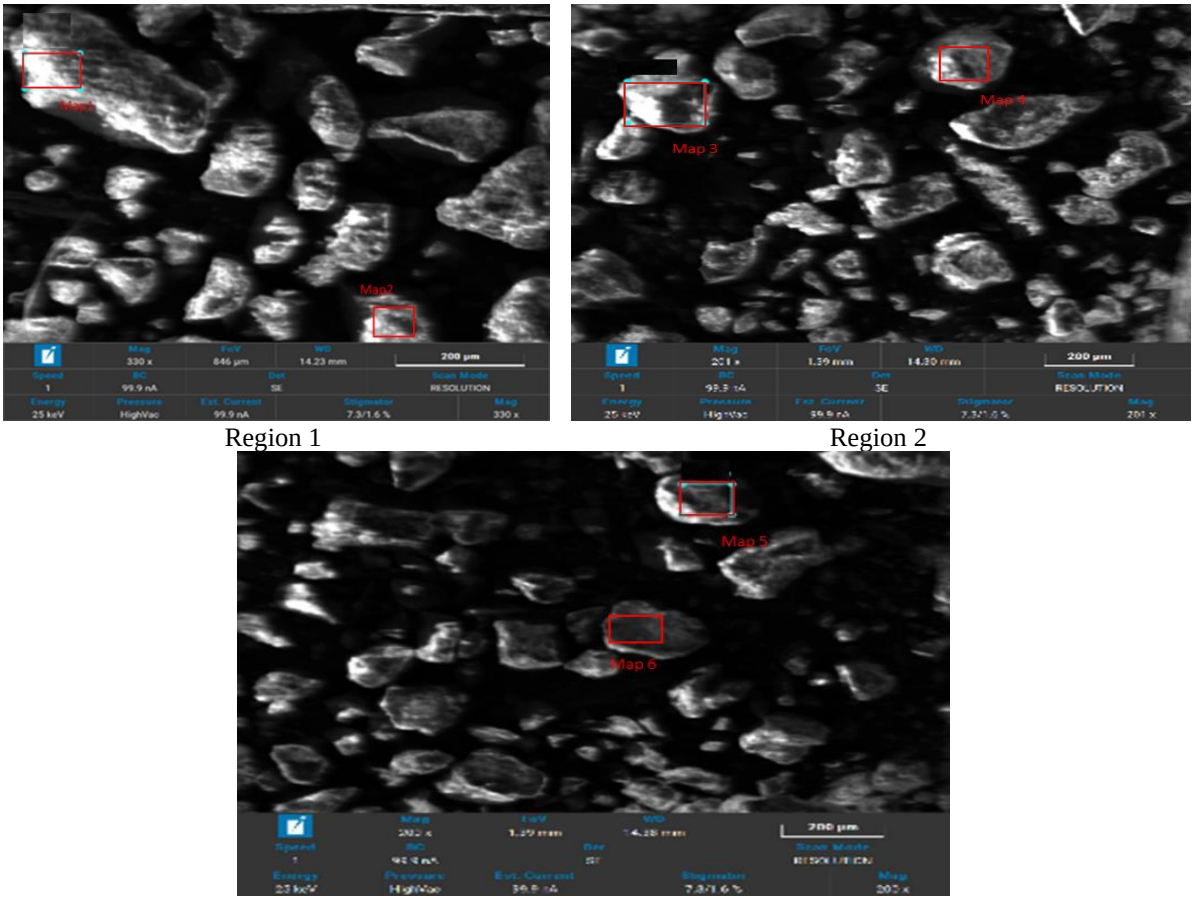


Fig. 2. Working methology.

3. RESULTS AND DISCUSSION

For the analysis of the soil sample, at the electron microscope, 3 regions were randomly selected, and from these regions was selected two soil samples to microscopic analysis, following which the soil composition was

identified. In Figure 3 was show a high heterogeneity of soil particle diameter. To obtain an image of good clarity SEM is set to 2 keV and 300 pA.



Region 1 Region 2

Region 3

Fig. 3. Soil regions image.

To have an overview of the analyzed soil sample, we opted for an analysis on regions, and not an analysis point or linear. These regions, that are under analysis, can be identified in the Figure 3 a, b and c, and are marked in red colour. To identify the components of the sample under analysis, a series of changes were made to the SEM work module, respectively the following values of 25 keV and 1000 pA were used. Following the analysis performed with SEM by means of energy dispersive X-ray spectroscopy, it was possible to identify the components from the six chosen regions.

The soil analyse for each maps is showed in Figure 4. The data analysis was carried out by Origin software [7].

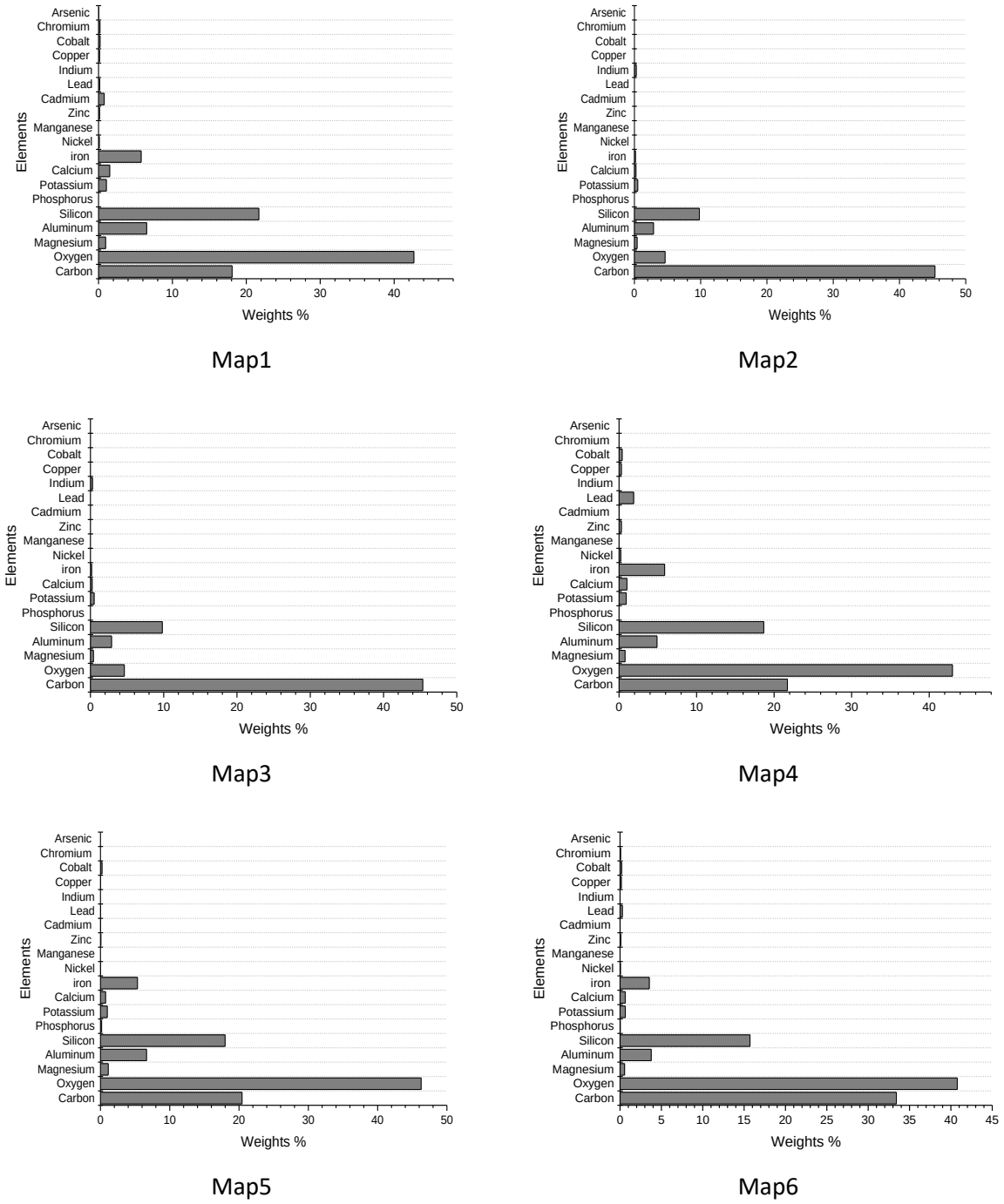


Fig. 4. Elemental analysis of different maps of soil.

Following the analysis of the results obtained, presented in Figure 4, the next conclusions can be drawn [8]:

- the carbon and oxygen are the most common elements whose present in the soil;
- silicon is also presented in a good level which assume that the soil presents a high percent of sand;
- aluminum, iron, potassium are also an essential compound of a analysed sample of soil;
- contrariwise, the presence of some heavy metals such lead copper and cobalt present a pollutant of soil.

To summarize the final soils composition, a statistical analysis was done by using the Origin software [9]. The result is presented in the Figure 5.

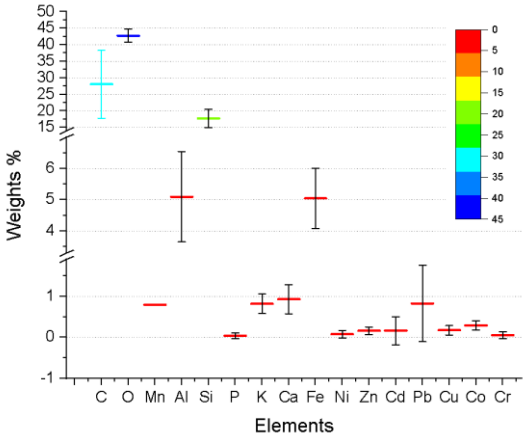


Fig. 5. Elemental analysis of soil sample.

Figure 4 show a high heterogeneity of soil surface, especially for oxygen carbon and silicon. The soil is rich in carbon whose highly implicate in pollutants retention by the soil, such pesticides and heavy metals. The potassium and calcium are a highly exchangeable cation which can used to retain cationic pollutants such us heavy metals by cationic exchange mechanism. The lead in the soil present high risk of water resource pollution by infiltration [10].

As a result of the statistical analysis of the data obtained, several conclusions can be drawn:
- are elements in the composition of the soil whose weight varies widely, such as:
    - the carbon - the minimum value of this component is with 64% lower than the average value and with 161% higher for the maximum value, compared to the reference value;
    - the manganese - there is a difference of 141% between the minimum and maximum ponderal value;
    - the calcium - a difference of 0.88% was identified between the maximum and minimum value of this component;
    - the cadmium - in the case of this component a difference between the minimum and maximum value of 0.77% was obtained;
- are components of the soil composition whose value varies in a small range, such as:
    - the oxygen, aluminium, silicon and lead showed variations between the minimum and maximum values of up to 10%;
    - the other components showed differences between the minimum and maximum values below 1%

4. CONCLUSIONS

The scanning electronic microscope is a high technology to identify the soil image and especially the composition of soil.

The soil presents a high percentage of carbon, the carbon is always interesting to retain the different pollutants such as heavy metals and cationic pesticides. The soil is also polluted by different heavy metals such as nickel, cobalt and especially lead.

This soil need to be more controlled because the presence of toxic heavy metal can damage water resource by leaching.

REFERENCES

[1] Kress, W.J., Stine, K.J., Living in the anthropocene: Earth in the age of humans, Smithsonian Books, Washington, DC, 2019.
[2] Chițimuș, A.D., Moșneguțu, E., Lazăr, G., Nedeff, V., Technologies for soil depollution, Alma Mather Publishing House, Bacau, 2012.

[3] Ebrahimi, R., Hayati, B., Shahmoradi, B., Rezaee, R., Safari, M., Maleki, A., Adsorptive removal of nickel and lead ions from aqueous solutions by poly (amidoamine) (PAMAM) dendrimers (G 4), Environmental Technology and Innovation, vol. 12, 2018, p. 261-272.
[4] Lima, L.R.P A., Bernardez, L.A., Characterization of the soil contamination around the former primary lead smelter at Santo Amaro, Bahia, Brazil, Environmental Earth Sciences, vol. 76, no. 14, 2017, p. 1-11.
[5] https://www.google.com/maps/place/Sousse,+Tunisie/@35.1792308,9.5443415,765748m/data=!3m1!1e3!4m5!3m4!1s0x130275759ac9d10d:0x698e3915682cef7d!8m2!3d35.8245029!4d10.634584 (3.11.2021).
[6] https://www.tescan.com/?utm_term=tescan&utm_campaign=TESCAN+%7C+General+KWs+%7C+Global&utm_source=adwords&utm_medium=ppc&hsa_acc=3637663133&hsa_cam=12570325672&hsa_grp=119225102333&hsa_ad=507318974853&hsa_src=g&hsa_tgt=kwd-317895126889&hsa_kw=tescan&hsa_mt=p&hsa_net=adwords&hsa_ver=3&gclid=EAIaIQobChMInYe4_6_U9AIVWOJ3Ch1twQmcEAAYASAAEgKy2vD_BwE (4.11.2021).
[7] Yongzhen, C., Wang, S., Li, J., Huang, X., Li, C., Wu, J., Engineering and mineralogical properties of stabilized expansive soil compositing lime and natural pozzolans, Construction and Building Materials, vol. 187, 2018, p. 1031-1038.
[8] Radojcic, R.I., Proietti, C., Hanousek, Č.K., Sedak, M., Bilandžić, N., Jakovljević, T., Poplar response to cadmium and lead soil contamination, Ecotoxicology and Environmental Safety, vol. 144, 2017, p. 482-489.
[9] https://www.originlab.com (3.11.2021).
[10] Abdelwaheb, M., Jebali, K., Dhaouadi, H., Dridi-Dhaouadi, S., Adsorption of nitrate, phosphate, nickel and lead on soils: risk of groundwater contamination, Ecotoxicology and Environmental Safety, vol. 179, 2019, p. 182-187.