TOXIC ELEMENT CONCENTRATION IN SOIL FROM GOLD MINE

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Abstract

Toxic element concentration in soil samples from 3m, 6m, 9m and 12m depths of gold mine at Satekalay village and Chaytawyar village, Shwegyin Township, Bago Division were investigated by using Energy Dispersive X-ray Fluorescent (EDXRF) method. Iron and silicon were found as major elements whereas potassium and titanium were found as second major elements. Other elements such as calcium, vanadium, chromium, manganese, copper, zinc, arsenic, rubidium, strontium, yttrium, zirconium and barium were found as minor elements in all the soil samples. The toxic elements such as cadmium and lead were measured by using Atomic Absorption Spectroscopy (AAS) method.

Key words: soil samples, Energy Dispersive X-Ray Fluorescent (EDXRF) method, elemental concentration, Atomic Absorption Spectroscopy (AAS) method, trace elements concentration

Introduction

In soils, some of the chemical elements occur as the components of minerals may be toxic. The chemical elements such as metals cannot break down, but their characteristics may change so that they can be easily taken up by plants or animals. Soil is clean when the concentration of elements contained in it is equal to the background concentration. The background concentration is the total element concentration obtained from soils that had not been affected by human activity.

Knowledge of elemental concentration in soil is very important for assessing the purity and quality of the soil in an environment. Energy Dispersive X-Ray Fluorescence (EDXRF) provides a rapid and nondestructive method for the analysis of elements in a sample. It is a very powerful technique for measuring the concentration of elements in a sample. In EDXRF, the intensities of the characteristic X-rays are measured to determine

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the elemental concentration of a sample. Atomic absorption spectrometry (AAS) is an analytical technique that measures the concentrations of certain elements in a sample. Atomic absorption is so sensitive that it can measure down to parts per million or milligram per litre in a sample.

The elemental concentrations of soil samples were measured by using the Energy Dispersive X-Ray Spectrometer and the trace concentrations of toxic elements in soil samples were measured by using the Atomic Absorption Spectrometer (AAnalyst-800). The measurement results were compared with the maximum permissible level recommended by the World Health Organization (WHO). The elemental concentrations of soil sample were determined in weight percent (W%) and the trace element concentrations were determined in milligram per litre (mg/L).

Experimental Work

The soils samples were collected from four different depths (3 m, 6 m, 9 m and 12 m) of gold mine at (1) Satekalay Village, Shwegyin Township, Bago Division, (2) Mine-1, Chaytawyar Village, Shwegyin Township, Bago Division and (3) Mine-2 Chaytawyar Village, Shwegyin Township, Bago Division. The collected soil samples were listed in the Table 1.

Table 1: The soil samples from four different depths of gold mines

No	G 1 (Satekalay)	G 2 (Mine 1,Chaytawyar)	G 3 (Mine 2,Chaytawyar)	Depths of the gold mine (m)
1	S 1	S 1	S 1	3
2	S 2	S 2	S 2	6
3	S 3	S 3	S 3	9
4	S 4	S 4	S 4	12

G1= gold mine at Satekalay Village , G 2= gold mine at Mine-1, Chaytawyar Village

G 3= gold mine at Mine-2, Chaytawyar Village

S 1= soil sample at 3 m , S 2= soil sample at 6 m

S 3= soil sample at 9 m , S 4= soil sample at 12 m

At first, the collected soil samples were dried in air and all the rocks were removed from the soil. Each sample was ground into fine powder by using the grinding machine. Then, the powder samples were filtered through 250 μm sieve to obtain the same grain size. For the EDXRF measurement, the powder samples were poured into a mould which is made of steel and pressed into a pellet. The powders can be pressed into pellets, either hydraulically or manually. By pressing, the powder sample would be compacted and homogeneous and thus the more exact and better result could be obtained. The determination of elemental concentration was performed by using EDX-720 Spectrometer.

For the AAS measurement, 1g of soil sample was accurately weighted by using the scientific balance and placed into 100 ml beaker. The sample was digested with 5 ml of 10% hydrochloric acid (HCl) at a temperature of (250-300 □C). After a digestion time of 5 hours, the beaker was cooled to room temperature and filtered the sample. And then the clear solution volume was made up to 100 mL for each sample using the distilled water. The determination of trace element concentration was performed by using AAnalyst-800 Spectrometer.

Results and Discussion

The results of the elemental concentrations in the soil samples were shown in Table 2 and the respective graph was shown in Figure 1. According to Table 2, it was found that iron and silicon were the major elements and potassium and titanium were found as second major elements. Other elements such as calcium, vanadium, chromium, manganese, copper, zinc, arsenic, rubidium, strontium, yttrium, zirconium and barium were found as very few amount in all samples. The toxic elements such as cadmium and lead were not detected in weight percent level.

Table 2: Measurements of Elemental Concentrations in soil samples from from gold mines at Shwegyin Township, Bago Division (W%)

Sample	Si	K	Ca	Ti	V	Cr	Mn	Fe	Cu	Zn	As	Rb	Sr	Y	Zr	Ba
G 1 (S 1)	43.29	8.17	ND	3.43	ND	ND	0.66	43.41	0.13	0.16	ND	ND	0.08	0.10	0.57	ND
(S 2)	53.83	9.46	ND	4.64	0.17	ND	0.51	29.82	0.11	0.14	ND	0.15	0.10	0.08	1.01	ND
(S 3)	39.97	9.05	3.66	2.68	ND	ND	0.81	42.91	0.11	0.17	ND	0.01	0.16	0.08	0.37	ND
(S 4)	42.99	7.86	9.64	2.55	0.12	ND	0.68	35.24	0.08	0.11	ND	0.01	0.33	ND	0.38	ND
G 2 (S 1)	40.44	7.31	ND	3.18	ND	0.14	0.08	46.77	0.11	ND	0.06	ND	0.08	0.06	0.42	1.35
(S 2)	44.25	10.84	ND	3.36	ND	0.16	0..05	39.16	0.10	ND	0.12	ND	0.05	0.05	0.44	1.43
(S 3)	43.58	12.75	ND	3.74	0.25	ND	0.12	39.04	0.11	ND	ND	ND	0.10	0.06	0.30	ND
(S 4)	45.09	12.61	ND	3.86	0.15	0.10	0.14	37.52	0.11	ND	ND	ND	0.09	0.06	0.26	ND
G 3 (S 1)	35.42	10.11	ND	4.18	0.22	0.31	0.16	48.94	ND	ND	ND	ND	ND	0.11	0.67	ND
(S 2)	31.13	8.12	ND	5.05	0.21	0.12	0.12	54.32	ND	ND	ND	ND	0.08	0.09	0.77	ND
(S 3)	31.78	11.22	ND	2.41	0.27	0.26	0.03	52.82	0.20	0.10	0.72	ND	ND	0.07	0.13	ND
(S 4)	29.54	4.94	ND	2.58	0.16	ND	0.14	62.16	ND	ND	ND	ND	ND	ND	0.47	ND

ND = not detected

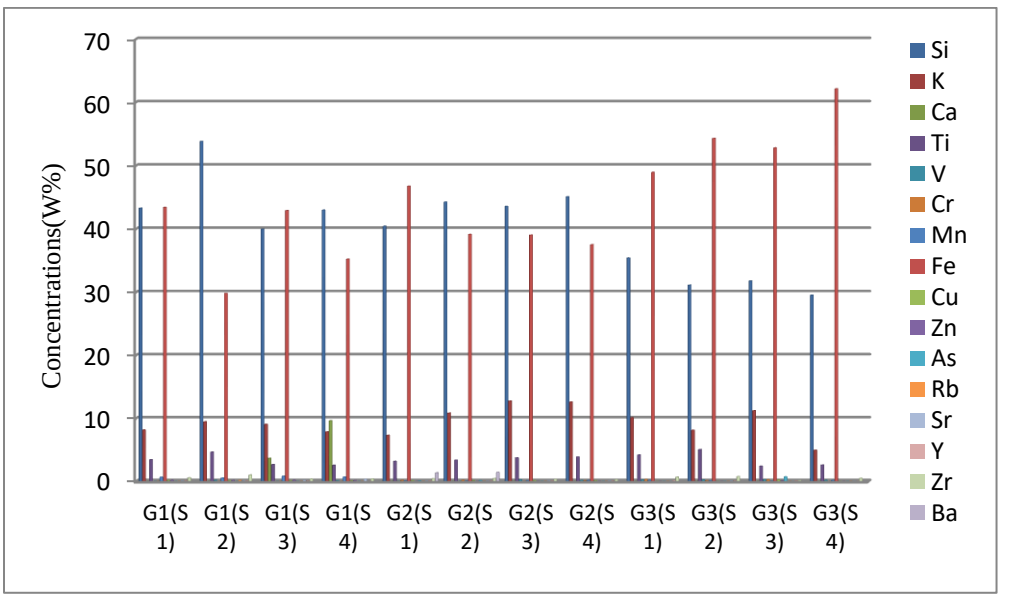

Figure 1: The elemental concentrations in the soil samples from gold mines at Shwegyin Township, Bago Division

The results of the trace elements concentration of soil samples at Shwegyin Township, Bago Division were shown in Table 3 and the respective graph was shown in Figure 2. According to Table 3, it was found that cadmium and lead were found as very few amount in all samples of the gold mines and the concentrations were randomly with the depth. The trace concentrations of all the elements were much less than the maximum permissible level.

Maximum permissible level for cadmium = 3 mg/L

Maximum permissible level for lead = 100 mg/L

Table 3: The measure results of trace elements concentration in the soil samples from gold mines at Shwegyin Township, Bago Division (mg/L)

Sample	Cd	Pb
G1(S 1)	0.035	0.289
(S 2)	0.042	0.267
(S 3)	0.041	0.298
(S 4)	0.044	0.262
G2(S 1)	0.045	0.015
(S 2)	0.044	0.074
(S 3)	0.055	0.024
(S 4)	0.040	0.045
G3(S 1)	0.061	0.019
(S 2)	0.021	0.025
(S 3)	0.865	0
(S 4)	0.042	0

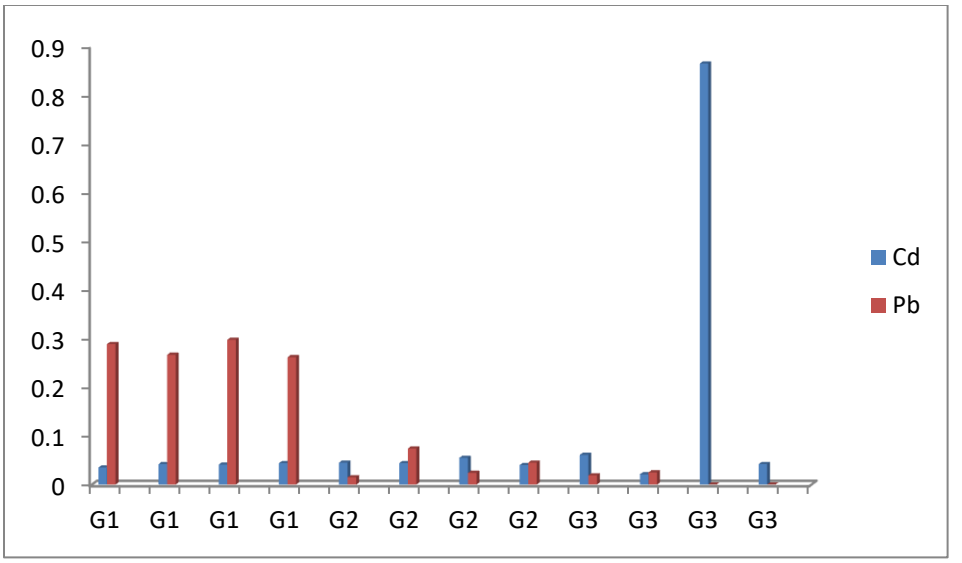

Figure 2: The trace elements concentration in the soil samples from gold mines at Shwegyin Township, Bago Division

Conclusion

From the EDXRF measurement, it was found that iron and silicon were the major elements and potassium and titanium were found as second major elements in all samples of all of the gold mine. Heavy elements such as copper and arsenic were detected but very few amount in comparison with iron and silicon. The other toxic elements such as cadmium and lead were not detected in weight percent level.

From the AAS measurement, it was found that the toxic elements cadmium and lead were detected but very few amount in all of the soil sample. The trace concentrations of all the soil samples were less than the maximum permissible level. From the point of view of AAS measurement, all of the gold mines cannot be affected by the toxic elements, cadmium and lead.

Therefore, it was found that the trace concentrations of toxic elements, cadmium and lead in the collected soil samples were less than the maximum permissible level. So that it can be concluded that the research gold mines were safe from the side effects of toxic elements such as cadmium and lead

for the health of human beings who live near the gold mine and miners who work at the gold mine.

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