Evaluation of Impact Cadmium on Geo-Environment of Dibbis City in Kirkuk Government / Northern Iraq

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Abstract

The present study is to evaluate and investigate the distribution of cadmium element (cd) in soil of Dibbis City northern Iraq, by using Index (Igeo), (CF) and (EF). The concentration of cadmium were determined by using (ICP-MS) technique in Acme Lame of (Canada). Collected (8) Samples in July/2016, In each site taken two samples for two depth (0-20cm) (20-40cm). The results showing that the highest concentration of cd found in Hai Al-Taakhy with value (0.245 ppm) because its station is burial health of waste of city, then Hai Al-Askary (S3) with value (0.225 ppm)it was in the past agriculture are riched by phosphate fertilizer in addition to military district. The calculated Igeo values of Cd is unpolluted to moderately polluted in all sites of Dibbis soil, The Contamination Factor of Cd investigated in soil of present study Moderate contamination for all station and Enrichment Factor results of the Cd investigated in this present study of soil is indicates Moderate enrichment.

Introduction

Cadmium is toxic elements with symbol Cd and atomic number 48 occurring in the environment by two ways, naturally and as a pollutant from industrial and agricultural sources, that can cause health hazards when exposed populations were emphasized later (Kaji, 2012). Cadmium occurs at +2 oxidation state, and easily forms complex cataions and anions, especially with Cl, S, and OH, It exhibits chalcophilic properties and behaves very similar to Zn, but has a stronger at finity for S, and is more mobile in acidic environments (Kabata-Pendias and Szteke, 2015). Cd ranks as the 65 the most abundant elements in the Earth's crust (Shahid *et al.,* 2016), While cd can be found together with the Zn ore sphalerite, greewockite (cds) is the only known Cd-based ore (Rao

et al., 2011). Human exposure to cadmium in excessive concentrations has the potential to cause, bone lesions, lung insufficiency, cancer, *erotogenic* effects, renal (disturbances, anemia, hypertension and weight loss (Alina Kabata-Pendias, 2011), Because of it's potential to cause such adverse effects, cd is classed as potential human carcinogen (group2B) by the Us Environmental Protection Agency (EPA), human carcinogen (group1) by the International Agency for Research on cancer of the world Health organization (WHO) (Shahid *et al.,* 2016), and ranked No.7 among the top 20 priority hazardous substances by the Agency for Toxic substances and Disease Registry (ATSDR, 2012)of all the non-essential heavy metals, cadmium (cd) is perhaps the metal which has attracted most attention in soil science and plant nutrition due to its potential toxicity to

man, and the relative mobility in the soil-plant system (McLaughlin and Singh, 1999). Cadmium is produced mainly as a by-product in mining and refining of Zn, therefore its supply is more dependent on the Zn production than on the cd demand, cadmium is also recovered from recycled materials such as Zn-cd batteries (Kabata-Pendias and Mukherjee, 2007). They are many studies that focused on the assessment of cadmium in soils, most of them are carried out in Iraq (Al-jumaily, 2016), Nigeria (Ololade, 2014), China (Ololade, 2014). The main aim of the present study to investigate the concentrations of cadmium which are considered potential carcinogens to humans.

Materials and Methods Description of study area

The study area, Kirkuk city for Dibbis area with geographical position being (44°3'30.9"– 44°5'40" E) and (35°39'10.8"– 35°41'30" N) is located in Northern Iraq (Fig.1). The area of Kirkuk Government equal around (9676 km2) from Iraq.

Sampling Sites and Chemical analyses

The soil samples were collected in July-2016 using an auger tool, it were collected at two depth between (0-10 cm) and (10-20 cm), the samples represented by symbols, (S1-S8). The samples were dried on oven, pulverized and submitted to a screening process by 200 mesh sieves. The powder material of soil samples was stored in plastic sacks. The concentration of cadmium in soil was determined by employed assayed by the ICP-MS techniques.

Geological setting

In order to facilitate the description of the exposed geological formations in the Kirkuk city, they are divided into four formation as well as recent deposit, each formation is described in a systematic style, starting with the type locality, age lithology and environmental deposition as follows:

Fatha Formation (Middle Miocene)

The type locality of the Fatha Formation is in Makhul Range, The lithology in the type section consists of green marl, limestone and gypsum as well as reddish brown claystone. It thickness in the type section is 445 m (Jassim *et al.,* 1984). The depositional environment was a closed lagoon of hypersaline condition (Aqrawi *et al.,* 2010).

Injana Formation (Late Miocene)

The type locality of the Injana Formation is along the northeastern limb of Himreen South anticline at Injana, The Injana Formation consists of Alternation of red, brown and grey clay stone, siltstone and sandstone as well as rare fresh water thin limestone and gypsum. It thickness in the type section is 620 m. The Injana Formation has been interpreted as shallow water to subcontinental environment (Jassim *et al.,* 1984).

Mukdadiya Formation (Late Miocene – Pliocene)

The type locality is along the northeastern limb of Himreen South anticline in Mukdadiya area with litology consists of Alternation of coarse sandstone; the sandstone is occasionally pebbly, clay stone and siltstone. It thickness in the type section is 2000 m. The fluvial environment is a deposited environment of Mukdadiya Formation(Jassim *et al.,* 1984).

Bai Hassan Formation (Pliocene – Pleistocene)

The type locality is in Bai Hassan anticline, northwest of Kirkuk city, it consists of Alternation of conglomerate, claystone and sandstone. The thickness of the Bai Hassan Formation is 638 m in the type section (Jassim *et al.,* 1984). The Depositional Environment is a fluvio – lacustrine environment (Buday, 1980).

Quaternary Sediments

The Quaternary sediments include different types of Pleistocene and Holocene sediments are Terraces (Pleistocene), Anthropogenic Sediments (Pleistocene-Holocene), Alluvial Fan (Pleistocene – Holocene), Flood Plain (Holocene), Valley Fill Sediments (Holocene).

Results and Discussion

Distribution of cadmium in Soil of Dibbis

The present geochemistry study of cadmium show the concentration with average (0.18 ppm) and range (0.135-0.245 ppm) (table1 and figure2), the maximum concentration of cadmium is (0.245 ppm) in Hai Al-Taakhi (S1) because its station near the location of burial health the waste of city such as remember (Kiran Khanum *et al.,* 2017),and Hai Al-Askari (S3) with average value (0.225),because this area was used in the past in agriculture are riched by phosphate fertilizer in addition to military district such as remember (Pinto *et*

al., 2004), while (S8 and S5) represent HaiAl_Shuhadaa and Dur Al-kahrabashow values (0.21 and 0.195 ppm) respectively, that's men Dur Al-kahrabanear electric energy increasing cadmium in soil and Hai Al-Shuhadaa are from garden are riched by phosphate fertilizer(Hu *et al.,* 2017).

Indices of Pollution

The soil contamination may be considered appreciable when concentrations of an element in soil and other environments were two-three times greater than the mean background levels (Logan and Miller, 1993). Evaluation for distribution of cadmium pollution is the most concerned (Hong-Gui *et al.,* 2012). In recent study, geo accumulation index (Igeo), contamination factor (CF) and enrichment factor (EF) was applied to assess cadmium contamination in soil located within Dibis city.

Geo-Accumulation Index (Igeo)

The geo-accumulation index (Igeo) was used to assess cadmium pollution in soil of Dibbis city; it is showing by the following equation (Muller, 1969):

$$Igeo = log2\frac{Cm}{1.5 * Bm}$$

Where *Cm* is the measured concentration of the examined metal (Cd) in the soil and Bm is the geochemical background concentration of the metal (Cd), the average of Cadmium earth's crust is (Bn = 0.1ppm) (Turekian and Wedepohl, 1961), Factor 1.5 is the background correction of matrix factor due to lithogenic effects (Muller, 1969). Müller has using seven classes of geoaccumulation index, Class 0 (practically unpolluted), Igeo $\leq$ 0; Class 1 (unpolluted to moderately polluted), 0 <Igeo< 1; Class 2 (moderately polluted), 1 <Igeo< 2; Class 3 (moderately to heavily polluted), 2 <Igeo< 3; Class 4 (heavily polluted), 3 <Igeo< 4; Class 5 (heavily to extremely polluted): 4 <Igeo< 5; Class 6 (extremely polluted), Igeo> 5 (Muller, 1969).

The calculated Igeo values of Cd in all sites had been placed in (Table 2), which shows the degree of contamination of Dibissoil as (unpolluted to moderately polluted) for all sites.

Contamination Factor (CF)

The soil contamination was carried out using the contamination factorof toxic substance in a basin by (Hakanson, 1980). The Contamination factor (CF) is a ratio of the elements value (Cd) in samples to pre-industrial reference value for the element (Cd). It is Showing by the following equation

$$CF = \frac{Cm\ sample}{Sb\ background}$$
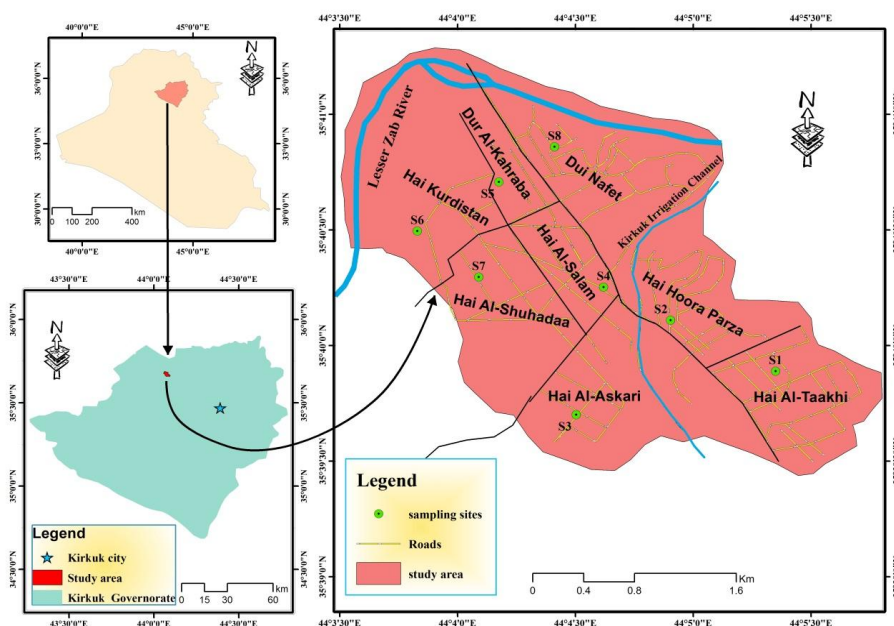
Fig.1 Dibs map sowing sampling site

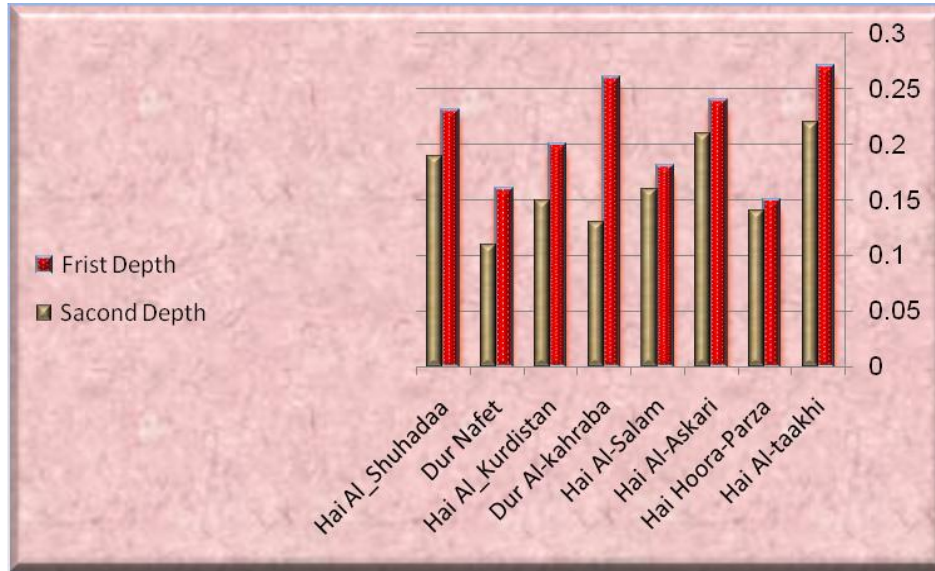**Fig.2** Concentration of cadmium in soil of Dibbis city with two depths

Table.1 Concentration of cadmium in soil of Dibbis city

Quarter	Symbol	First depth	Second depth	Total
Hai Al-taakhi	S1	0.27	0.22	0.245
HaiHoora-Parza	S2	0.15	0.14	0.145
Hai Al-Askari	S3	0.24	0.21	0.225
Hai Al-Salam	S4	0.18	0.16	0.17
Dur Al-kahraba	S5	0.26	0.13	0.195
HaiAl_Kurdistan	S6	0.2	0.15	0.175
DurNafet	S7	0.16	0.11	0.135
HaiAl_Shuhadaa	S8	0.23	0.19	0.21
Min		0.15	0.11	
Mix		0.27	0.22	
Average		0.211	0.163	

Table.2 The results of the *I*geo, CF and EF in soil of Dibbis city-northern Iraq

Name of Site	Cd ppm	Igeo	CF	V ppm background	EF
Hai Al-taakhi	0.245	0.491	2.45	49	4.9
HaiHoora-Parza	0.145	0.290	1.45	48	2.960
Hai Al-Askari	0.225	0.451	2.25	49.5	4.454
Hai Al-Salam	0.17	0.341	1.7	50	3.332
Dur Al-kahraba	0.195	0.391	1.95	47	4.065
Hai Al-Kurdistan	0.175	0.351	1.75	48	3.572
DurNafet	0.145	0.270	1.45	49.5	2.870
Hai Al-Shuhadaa	0.23	0.421	2.3	49	4.6
Average	0.187	0.376	1.875	48.75	3.769

Where the Cm sample is the values of metal (Cd) in present study and Cd background is the average background of metal (cd) in earth's crust equal (0.1 ppm) (Turekian and Wedepohl, 1961). the contamination factor are characterized as follows: (CF<1 indicates low contamination); (1< CF <3 is moderate contamination); (3< CF <6 is considerable contamination); and (CF >6 is very high contamination) (Hakanson, 1980).

The Contamination Factor of Cdinvestigated in soil of present study are presented in (Table 2), describe the class of contamination in soil of dibbissity is $(1 \leq CF <3)$ (Moderate contamination) for all station.

Enrichment Factor (EF)

The enrichment factor is the relative abundance of a element in a soil compared to the background (Hernandez *et al.,* 2003). The enrichment factor was calculated using the equation originally introduced by (Buat-Menard and Chesselet, 1979)as shown in the following shape:

$$EF = \frac{(Cd / V)sample}{(Cd/V)background}$$

Where the Cn sample is the concentration of the examined element (Cd) in the examined soil, Crefsample is the concentration of the examined element (Cd) in the reference environment, for Cd is (0.1 ppm)(Turekian and Wedepohl, 1961)*, Bn*is the concentration of the reference element (Vanadium) in the examined environment (Schiff and Weisberg, 1999)(Table 2) and Bref is the concentration of the reference element(Vanaium) in the reference earth crust, for Vanaium is (98 ppm) (Turekian and Wedepohl, 1961). EF values were interpreted as follows: (EF <1 indicates no enrichment); (1-3 is minor enrichment); (3-5 is moderate enrichment); (5-10 is moderately severe enrichment); (10-25 is severe enrichment); (25-50 is very severe enrichment); and (>50 is extremely severe enrichment) (Sakan *et al.,* 2009).

The Enrichment Factor results of the Cd investigated in this present study of soil are presented in (Table.2); the descriptive of enrichment is indicates Moderate enrichment with class $(2 \leq EF <5)$.

Conclusion

This study has allowed the determination of the level of important cadmium at two layers of the soil. Based on the geo accumulation index (Igeo) the soils can be classified as " Unpolluted to moderately pollute ", contamination factors (CF) in soils (moderate contamination) and enrichment factors (EF) is indicated (moderate erichment) in all station.

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