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Heavy Elements in Soil of West Qurna-1 Oil Field in Basrah Governorate, Southern Iraq

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Abstract

Soil samples were collected seasonally from ten locations in west Qurna-1 oil field from January-December, 2018 to determine the concentrations of some heavy elements (lead (Pb), nickel (Ni), Copper (Cu), Cadmium (Cd), Manganese (Mn) and Iron (Fe) in exchangeable and residual phases of soil. The results of seasonal mean concentrations in exchangeable phase of (pb, Ni, Cu, Cd, Mn and, Fe) showed that, the highest concentration were (16.85, 39.47, 21.21, 5.60, 358.42, and 641.44) µg/g dry weight respectively, while the lowest concentration were (14.50, 31.37, 18.39, 3.90, 340.41 and 619.48) µg/g dry weight respectively . The result of seasonal mean concentrations in residual phase of (pb, Ni, Cu, Cd, Mn and, Fe) showed that, the highest concentration were (27.04, 84.82, 28.75, 7.73, 259.83, and 649.30) µg/g dry weight respectively, while the lowest concentration were (24.95 , 81.38, 26.74, 6.71, 228.46, 641.44) µg/g dry weight respectively. Heavy elements indices (Geo-accumulation index (I-geo), Contamination Factor (CF) and Enrichment Factor (EF) were calculated for soil, according to I-geo Index, the soil in the study area was practically unpolluted with Ni, Cu, Mn, Fe, while the soil was unpolluted to moderately polluted with Pb, and for Cd the soil was strongly polluted to extremely polluted.

Keywords: Heavy elements • Pollution • Soil • West Qurna-1• Oil field

Introduction

Heavy elements is a type of pollutants that have a great potential harm effects to ecological environment. They usually cannot be biodegraded when released into the environment. Some elements are associated with a variety of health effects. For example, in experimental animals, Cd can produce acute toxic effects on various organs such as the kidney, liver, pancreas, and lung (by inhalation); moreover corrosive reactions on the nasal septum, acute irritative dermatitis, and allergic eczematous dermatitis among subjects who have been exposed to such pollutants [1]. The toxicity of Pb can also be largely explained by its interference with different enzyme systems; caused inactivates these enzymes by binding to SH groups of its proteins or by displacing other essential metal ions. Soil is an indicator for investigating of heavy metal pollution; therefore, analysis of elements is an important part of environmental pollution studies. Heavy elements released into the environment through natural and anthropogenic sources. Anthropogenic sources include emissions from traffic, industries and domestic, weathering of buildings and pavement surfaces, and atmospheric deposition. Urban soil pollution by heavy elements is an environmental concern [2]. Pollution sources in urban areas are both anthropogenic (industrial emission, traffic emission, coal combustion, waste incineration, and agriculture waste) and the other source was natural. Urban surface soil acts as sinks for heavy elements and many other pollutants that persist for long time periods [3].

Industrial Activities have brought numerous npotentially hazardous elements to the environment particularly during the productio period. These derived elements can be transported through the atmosphere to remote locations from emission sources, the collection of geochemical information is not only provides a close sight on the present environmental quality of the system but also serves as a baseline for future investigations. It could provide valuable information on the enrichment of surface soil with different contaminants. In recent years, a numbers of anthropogenic activities have implied notable contributions to the increase in the heavy elements concentrations. However, in Basrah governorate a numbers of anthropogenic activities have implied such oil production fields therefor the present study aim is to assess the soil pollution status with heavy elements at West Qurna-1 oil field.

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Literature Review

Soil samples were collected seasonally during the period from January 2018 to December 2018 at ten stations in West Qurna-1 oil field at Basrah city (Figure 1). Samples were warped with aluminum foil then transferred to the laboratory for analysis.

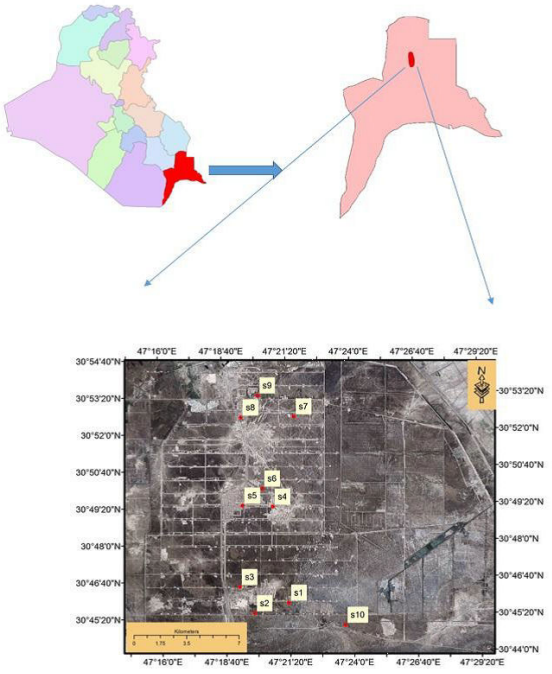

Figure 1. The study area.

Extraction the exchangeable phase

The exchangeable heavy elements ions were extracted from soil according to the method of Chester and Voutsinou (1981). (1gm) of the dried soil sample was put in (50 ml) polyethylene test tube having a tight cover. Then, (20 ml) of Hydrochloric acid (0.5N) was added and shaking for (16 hrs). After that the sample was separated by centrifuge at (3000rpm) for (20 min). Then, the solution was filtered put in plastic vial till the time of measuring by Flame Atomic Absorption Spectrophotometer (FAAS) [4].

Extraction the residual phase

The residual heavy elements were extracted to HNO_3 (5 ml) were added to each sample and evaporated using Teflon (PTFE) beakers to near dryness on a hotplate at 70°C, then 5 ml of a mixture of concentrated HClO4 and HF (1:1) were added, then 20 ml of HCl (0.5 N)were added to and cooled for 10 min. The extraction was filtered and decanted and completed into 25 ml plastic volumetric flask. Samples were stored in tight stopper polyethylene vials to be ready for analysis by (FAAS). To evaluate the magnitude of source material found in the Earth's crust the following equation was used to calculate the EF a contaminant in the environment, the Enrichment Factors (EF) were computed relative to the abundance of species.

Discussion

In order to assess the metal pollution in the soil, it's important to establish the natural levels of these elements in soil. Apart from natural contribution, heavy elements may be released into the system from anthropogenic sources such as solid and liquid waste of industries, in the studied areas that are considered as important commercial lines of the world oil transportation. However, knowledge of the distribution and concentrations of the heavy elements in the soil will help to detect the source of pollution in the plant. Generally, sediments had been used as environmental indicators, and this ability to identify heavy metal contamination sources and monitor contaminants is also well documented. Thus, the accumulation of elements in the sediments was strongly controlled by the nature of the substrate as well as the physicochemical conditions controlling dissolution and precipitation [5].

Result show that the concentration of lead in the exchangeable phase was highest at location 1 during summer, and lowest concentration observed at location 10 during Spring. The lowest value was because of the lowest sources of pollution in this Location whereas the highest concentration of trace elements in the soil of areas close to highly dense cities could be arising from industrial pollution, oil enrichment and transportation, Moreover, high concentrations of lead (Pb) is found everywhere which associated with high traffic density of automobile running by leaded gasoline. The average abundance of Pb in the earth's crust is 14.5 (14-15) mg/kg. The accumulation of Pb in the soil is exposed to various pollution sources and it is of great ecological significance because this element is known to greatly affect the biological activity in aqueous environments,. Lead is positively correlated with Fe, Zn, and Ni probably suggesting some association with the clay also it may be come from the same source of pollution.

According to the CF value for Pb in exchangeable phase are (CF<1) or (≤ CF ≤ 3), indicating that this environment was low contamination to moderate contamination. Nickel is not toxic, but high ingestion of it can cause renal problems and skin allergies by contact. Nickel is also an essential micronutrient. The highest mean value during winter because of pollution sources from Oil Pollution and the lowest value, due to distance from the flares. Copper is an essential micronutrient and can readily be accumulated .This fluctuation in Cu concentrations is mainly due to the different source of pollution in the locations such as the discharge of Industrial wastes, Cu concentration in surface sediment reflects the bioaccumulation of the metal and also recent anthropogenic sources of the element, the relative enrichment in copper content that could be due to environmental contamination. The increasing of Cd due to increased human activities and continued launch of pollutants without treatment and enrichment to extremely severe enrichment. According to, the CF, EF, I-geo value for Mn in exchangeable phase are (CF<1), indicating that this environment was low contamination very severe enrichment and practically unpolluted.

Conclusion

The fluctuation in the concentration of Fe due to the seasonal changes and weather conditions of heat, light, wind speed and erosion and sedimentation processes which effect the sedimentation

or superheat of Iron as a result of oxidation and reduction processes. In the present study, result shown that the concentrations of heavy elements in exchangeable phase of soil were higher than those in the residual phase of soil, this finding could be good evidence that there is an anthropogenic origin of pollutants which incorporated into the soil by different processes.

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