

Using GIS to study the probability pollution of surface soil in Babylon province, Iraq.

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Abstract: This study presents results on the environment characteristics of Babylon provincea geochemical survey was carried out. The survey provided data on the three trace element contents, Cr, Ni and Pb levels in soil samples determined using AAS. The trace element concentrations contents in soils agreed normal range values of natural soils. These results showed that there had been pollution of Ni in the some sampling points where the maximum values obtained more than the maximum allowable values. Spatial distributions of , Cr, Ni, and Pb were plotted in relation to the concentration values in soil using Geographic Information System (GIS) technology.

I. Introduction

Soils are porous media created at the land surface through weathering processes mediated by biological, geological, and hydrological phenomena. Soils differ from mere weathered rock, however, because they show an approximately vertical stratification (the *soil horizons*) that has been produced by the continual influence of percolating water and living organisms (G.Sposito, 2008). Soil contamination by trace elements is a significant issue on a global scale, mainly due to industrial and mining activities. Moreover, can produce great disasters that may have serious impacts on the environment for decades (Romero et al., 2012). Industrial activities releasing metals or organic particulates impact surrounding soils. These pollutants pose a significant risk for health and the natural environment (M.D.Somoano et al., 2012). Increasing concentrations of heavy metals in the environment result in continuously growing importance for elemental analysis in environmental samples (Florian et al., 199 & Falciani et al., 2010). Elevated metal loads in soil result in increased uptake by plants and thereby accumulate in the food chain. Thus any soil amendment and fertilizer such as compost, which are used as fertilizer, should be monitored for their elemental concentrations. Though total concentrations of metals in soil is used to characterize its base-line elemental composition (parent geological material), total metal concentration analysis allows to assess soil pollution and to ascertain heavy metal and other pollutant contents in the soil. Although different procedures have been described to determine total metal contents, the most widely adopted method is digestion (S.Oztan & R.-A. During, 2012). The aim of this study was to contribute to the knowledge of the state of the province environment. Our study focused on the determination of concentrations of trace elements in soil samples, then use GIS in mapping the concentration distribution. The work is intended to be a base for future investigations of activities leading to temporary changes in concentrations of elements in this region soil. Distribution maps produced will help to clarify the situation in the region with respect to heavy metal level.

II. Material and Methods:

Study area

Babylon province location inside Iraq Coordinates: is situated between longitudes 44° 00' – 45° 00' E and latitudes 32° 00' – 33° 15' N. Hilla city is a central. It is the capital of Babylon province and is located near the ancient cities of Babylon one the Hilla branch of the Euphrates River, 100 km south of Baghdad It is situated in a predominantly agricultural region which is extensively irrigated with water provided by the Hilla river. This region is one of the most important agricultural areas of Iraq and has very fertile soils. The organic matter content of the topsoil is normally low. The climate is semi-arid with a mean annual rainfall ranging from less than 50 mm to about 200 mm. The temperature in summer can reach as high as 50°C during day time. Dominate warm winter (National Meteorology Institute). Geologically, the study area is characterized by Holocene sediments are mainly constituted by clay, silt and sand as typical sediments of flood plane systems. Fig. 1 shows this region.

III. Sampling and chemical analysis:

Soil samples used in this study were collected from locations within study areas shown in (Fig. 1). The sampling points in each area were selected on the flat terrain and far from major roads. Soil samples from the 26 soil sites with (0–20 cm deep) were collected for investigating the distribution of Soil trace elements in upper soil horizons. Samples were collected using plastic tools and stored in plastic bags. All sampling sites were

recorded by global positioning system (GPS) and the related information such as land-use history, vegetation, soil type, and present and potential pollutant sources were also recorded in detail. The collected soil samples were air dried and then ground to 100 meshes for chemical analysis. The soil samples were digested by reverse aqua regia ($\text{HCl}/\text{HNO}_3 = 1/3$) (Burt et al. 2003). and the total concentrations of Cr, Ni, and Pb were determined by flame atomic absorption spectrometry (AAS 6300, Shimadzu, Japan). The pH was determined in triplicate in 10 g of soil mixed with 25 ml of distilled water after 10 min of shaking and 30 min of rest, using a (Microph 2002) pH-meter calibrated with buffer solutions at pH=4 and pH=7. Bulk mineralogical analysis was performed by X-ray diffraction (XRD) powder method at Babylon university fore sum soil samples . The sample was loaded on a side-loading sample holder and scanned using a (PW117/01 sample stage holder modal Xpert PRO MPD PaNalytical) with monochromatic Cu K α radiation at 30 mA and 40 kV. Samples were scanned at standard conditions between 5° and 70° 2 θ at a speed of 2° 2 θ /min The powder x-ray diffraction patterns and A full summary of the mineralogical results are presented in figure(2).

IV. Heavy metals and trace elements.

This title is used to cover a number of metals (and their ions) which are mostly of high density and belong largely to the group ‘transition elements’ of the periodic table. Some of these have also been termed trace elements or micronutrients in agriculture, stressing their relatively low abundance in regular soil and the fact that they tend to be essential for plant growth. Other trace elements of non-metallic nature but presumably sometimes involved in pollution problems (G.H. Bolt& M.G.M. Bruggnwertm,1978). In another word trace elements refer to a number of elements that occur in natural systems in small concentrations . Trace elements include chemical elements used by organisms in small quantities that are essential to their physiology as well as those elements with no known physiological function, which are toxic to living organisms at high concentrations (Bradford et al., 1996).



Fig. 1: Location map of the study area

Geochemical mapping:

The GIS (Geographic Information System) mapping technique was employed to study the spatial distribution maps for three polluting elements in soils of Babylon Province with Geostatistical analyst, you can easily create a continuous surface, or map, from measured sample points stored in a point-feature. The sample points measurements the levels of pollution, The usefulness of this technique in environmental studies has already been demonstrated by (Albanese et al. ,2008); . Kriging is used to estimate the value of a soil property at a location where the value is unknown by using the known values at locations about the point of interest.

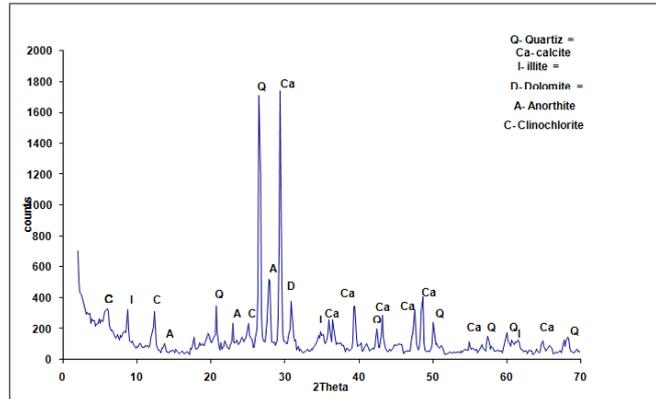


Figure (2) Representative XRD Chart for Special Diffraction Pattern of the Minerals in soil

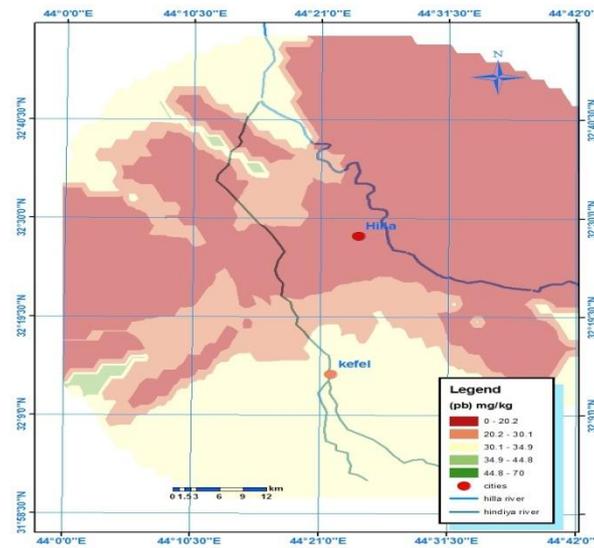


Figure 3. Pb trace element concentrations spatial distribution map

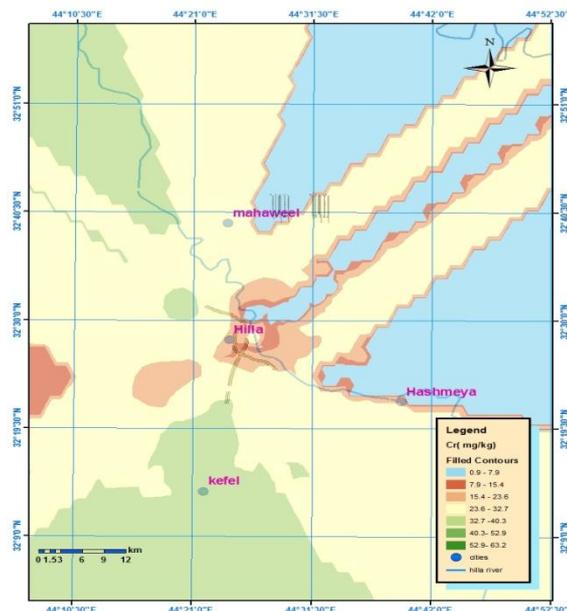


Figure 4. Cr trace element concentrations spatial distribution map

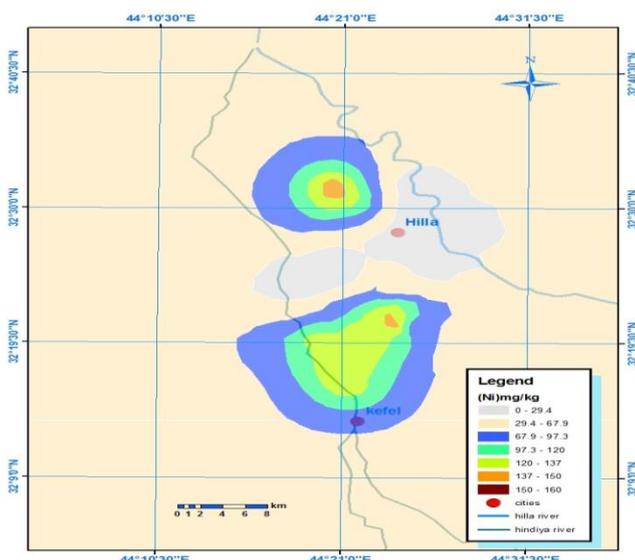


Figure 5. Ni trace element concentrations spatial distribution map

TABLE I Descriptive statistics for heavy metals studied in this work (mg/kg) and Normal range of heavy metals in natural soil

Metals	Maximum allowable level)	Range in natural soil ^b	World median ^a	Present study (range)	Present study (Median)	Heavy Metal in Soil within Baghdad City, Iraq (median) ^c	Heavy Metal in Soil within Damascus City, syria (median) ^c
Cr	250	7-4.28	50	0.9-63.2	34.6	31.65	
Ni	100	1-1000	70	0.35-160	119	78.67	35
Pb	150	2-200	35	0.1-70	31.5	79.82	10
Ph				7.2-7.6	7.4		

(a) Bowen (1979)

(b) Lacatusu, R.: 1998; EEA, 1999.

(c) A.M.J Al obaidy et al ,2013.

V. Results and discussion:

The results of analysis of Babylon Province soils trace elements values are presented in table (1). We measured Cr, Ni and Pb elements. Chromium concentration values have ranged from 0.9 to 63.2 (mg/kg) with an median value of 34.6 (mg/kg). Nickel concentrations have been found in the range of 0.3–160 mg/kg with median value of 119 mg/kg. Lead concentrations are in the range of 0.1–70 mg/kg and the median value is 31.5 mg/kg. Present results for Cr, Ni, and Pb were compared with international reference values for soils (EEA, 1999; Lacatusu, 1998, were listed in Table 1. The present maximum values of all elements in Table 1 except Cr are below than the maximum value of normal range values of natural soils cited by the EEA report. On the other hand, the maximum values of Cr, Ni and Pb are below than the maximum allowable levels of standard values. These results showed that there had been pollution of Ni in some sampling points where the maximum values obtained more than the maximum allowable values. The results obtained in this work are also compared with the world median values for soil. The present median values also show close agreement in most cases with world median values for soil (Bowen, 1979). The above results show that there are some areas region that are polluted with heavy metal (Ni) to undesirable levels. A comparison of metal concentration in study area soil and Baghdad City, Damascus City. The investigation of soil heavy metal content indicated that the concentrations of Ni often exceeded the calculated median for the Baghdad and Damascus City soil, while soil in study area displays lower values of Pb than in Baghdad soil. It can also observe that study area soil exceeded values of Pb than the reported values of soil in Damascus City. Spatial distributions of elements were plotted according to their concentrations (Figures 3,4,5).

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