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Dep. of Earth Sciences and Petroleum

Determination of the trace element concentrations in the well water accumulated on the pottery container, Erbil city-Kurdistan region-Iraq

Research project

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ABSTRACT

Water elements are one of the virtually important factors due to the fact that they have a direct bearing on human health Human life without water is just impossible. Quaternary deposit covers the rock units in studied area, these deposits are non-effected by Alpine orogeny, consist of clay, loam silt, and sand. Stratigraphy of quaternary deposit is unconformable with underling unit (vertically and horizontally appeared gravel alterative.

In three places the samples of water are taken, the collection of samples of water in wells (Darugul and Dhemat are near the waste water channel of Erbil (source of pollution) and Mahabad sample are far away from the source of pollution), after taken of samples added to pottery container (20 liter) for each week, until 100 liters (5 weeks) repeat this procedure, after drying the Pottery during 1 week. The 100gm of fine grain prepared and sent to Spanish to geochemistry analysis for mud samples by ME-ICP41 (Trace elements), in ALS Lab (Spain) Inductively Coupled Plasma - Atomic Emission Spectroscopy (ICP - AES).

The source of Pd in the water samples are lithogenic and anthropogenic, because the Darugul and Dhemat near the waste water (source pollution), while Mahabad far away from the pollution source. The trace elements Cd and Zn are less than the control. The As toxic element is less than the control in locations Dhemat and Darugul, while, in the Mahabad area is more than the control, the source is lithogenic, because, Mahabad far away from the pollution source.

1.INTRODUCTION

Water elements are one of the virtually important factors due to the fact that they have a direct bearing on human health Human life without water is just impossible.

Water is not only required for metabolic systems in human body but also required for other associated activities with human life. The specifications of water required for different purposes are different.

Our study is mainly the assessment of drinking water for certain major and trace elements so as to identify trends relevant to the deterioration of drinking water quality in water supply distribution systems. The available information provided a general indication of where water-quality constituent concentrations met or exceeded water-quality standards. The elements determined are Na, As, Cu, Cr, Fe, Co, Ni, Zn, Pb, Cd, Se, Ca, K, Mg, and Mn. Some of the important physicochemical properties of this water such as pH, turbidity, conductivity, phosphate, and nitrate are also presented. Polluted water can be very dangerous for human health and cases of serious diseases are often caused by various bacteria and viruses. Toxic metals such as Hg, Cd, As, Pb, and Ni tend to accumulate in certain reservoirs (water, soils, sediments, etc.) from which they may be released by various processes of remobilization and their solubility becomes available to the biological food chain. Kahraman (2004), studied physical and chemical properties of soil in Erbil plain. The soil tends to be alkaline soil in the studied area, Bapeer (2004), ecological study on the distribution of algae indifferent aquatic habitats with Erbil province.The waste water is very hard water, Amin and Aziz (2005) studied the suitability of sewage water for irrigation purposes. This water is suitable for irrigation, Lak (2007), Heavy metal analysis shows that the water unsuitable for irrigation, agriculture and livestock purposes, due to high concentrations of Cd, Pb, and Zn). The main aim of this project is prospecting the water pollution by trace elements in wells, in some location of Erbil city and detect the source of pollution (from lithogenic or anthropogenic source?).

2-GEOLOGOGICAL SETTING

2.1. Tectonics

The study area is a part of the unstable shelf zone that affected by Alpine orogeny in Mesozoic (Buday and Jassim, 1987) as shown in Figure (1), in chamchamal-butma sub zone in foot hill zone.

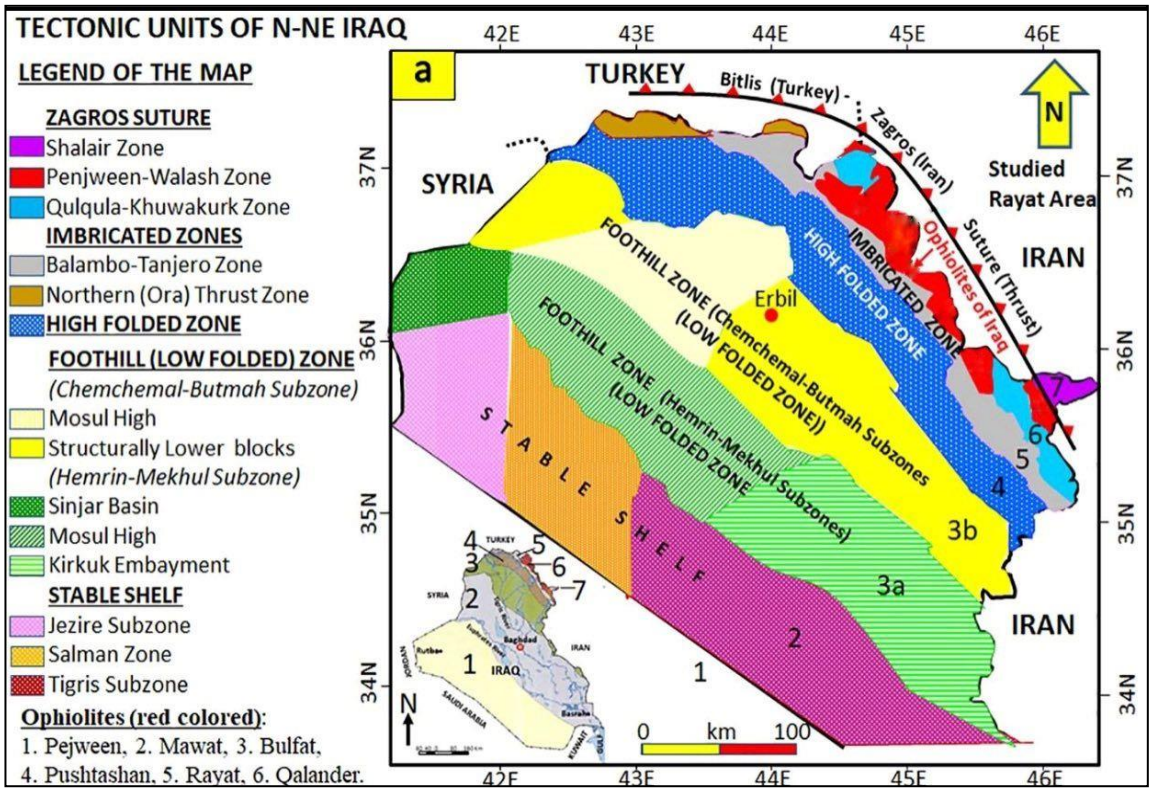

Figure 1: Tectonic map of the Iraq, and showing the study area (Ahmed, et al., 2020).

2.2. Stratigraphy

2.2.1 Quaternary deposit: -

Quaternary deposit covers the rock units in studied area, these deposits are non-effected by Alpine orogeny (Fig. 2), consist of clay, loam silt, and sand (Jawad, et.al, 1982). Stratigraphy of quaternary deposit is unconformable with underling unit (vertically and horizontally appeared gravel alterative (repeat) coarse, medium, and fine grain size). The age of quaternary deposits is Pleistocene to Holocene (Buday and Jassim, 1987).

These deposits were divided according to Yukhana and Sissakia (1986) into: -

2.2.2 River terrace: -

River terraces were produced by recent flood plain exposed along each side of river stream, produced by variation in base level or by climate variation in area along river stream (Mahsub, 1997, in AL-shidaifat, 2003). The age is Pleistocene; consist of rock fragment limestone, fragment, gravel (silica) and little amount of igneous and metamorphic rock fragments.

2.2.3 Slope deposit: -

Slope deposit is screes consisting of clay, silt, sand and rock fragments which are of Plistocen-Holocen age.

2.2.4 Polygenic deposit: -

The major part of the study area is covered by this type of deposit (Al-shidaifat, 2003). The age is Pleistocene-Holocene. Deposit type varied to clay silt, gyps, sand and gravel.

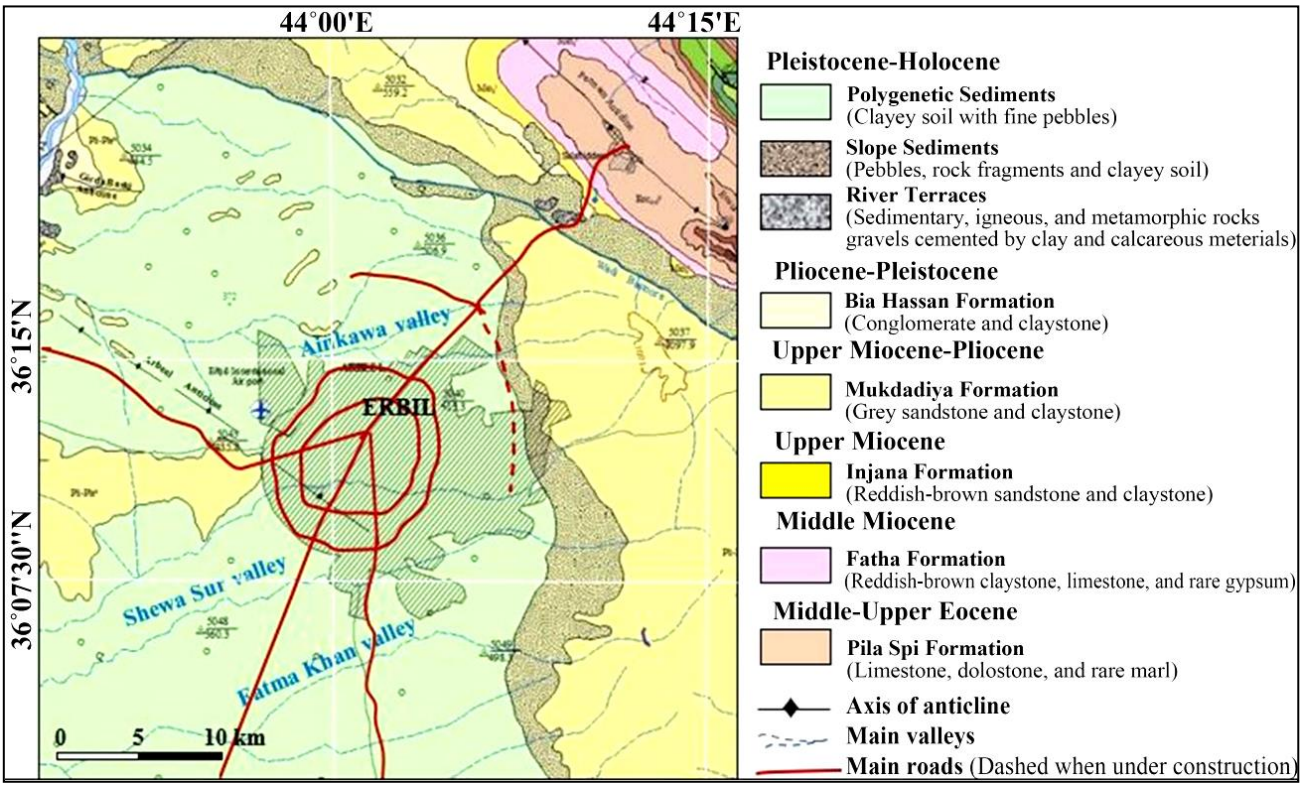

Figure 2: Geological map of the study area (Sissaskian, et.al., 2022).

2.2.5 Flood plain deposit: -

The sediments originate as a result of river erosion during flood periods. They consist of clay, silt, and sand with some fine pebbles, and rock fragment. The age of this deposit is Holocene.

3.METHODOLOGY AND SAMPLING

Methodology and sampling first using GPS constructed elevations and coordination Longitude and Latitude of the area Elevations (Table 1 and Fig. 3). In three places the samples of water are taken ,the collection of samples of water in wells (Darugul and Dhemat are near the waste water channel of Erbil (source of

pollution) and Mahabad sample are far away from the source of pollution), after taken of samples added to pottery container (20 liter) for each week, until 100 liter (5 weeks) repeat this procedure, after drying the Pottery during 1 week, then crushing the mud samples in front of sunshine to become little dry and put in oven(60 ^{o}C) to until are well dried to easy to sieving, so when samples dried well the fine sieving process done to differentiate the grain sizes and sieve 80 mesh is used. The 100gm of fine grain prepared and sent to Spanish to geochemistry analysis for mud samples by ME-ICP41 (Trace elements), in ALS Lab (Spain) Inductively Coupled Plasma - Atomic Emission Spectroscopy (ICP - AES).

Fig 3: geographic map, showing sample stations.

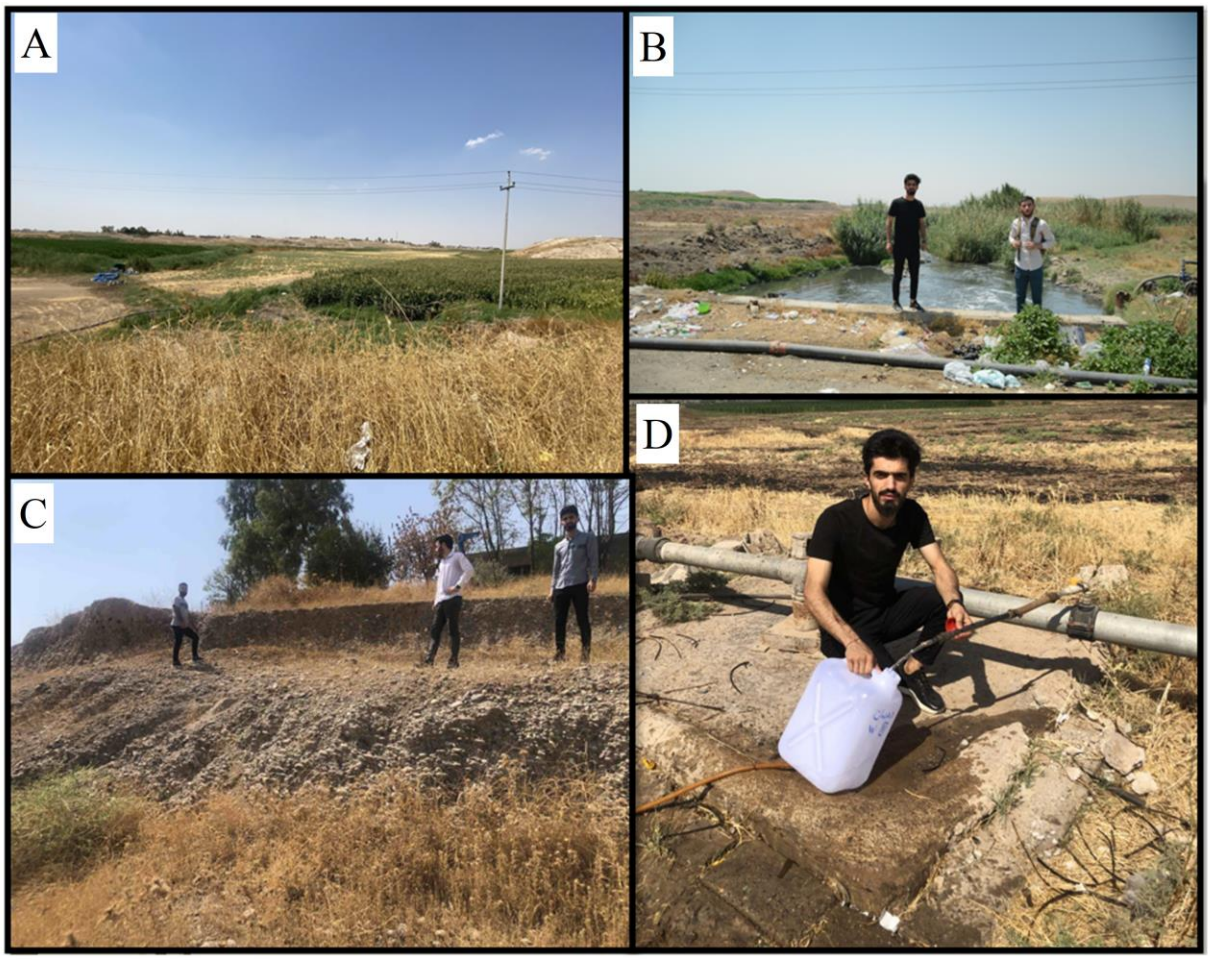

Fig 4: A and B the waste water channel near the Darugul area, C- gravel recent deposits in the study area, D- Dhemat during water sampling.

- **Trace Elements**

A prepared sample (0.50 g) is digested with aqua regia (HNO3 – HCl Aqua Regia Digestion) for 45 minutes in a graphite heating block. After cooling, the resulting solution is diluted to 12.5 mL with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. The analytical results are corrected for inter element spectral interferences (ALS lab procedure).

- **Hydrogen Potential (pH)**

The soil pH in bulk samples was analyzed using a glass electrode in a 1:1 soil/water suspension by mixing 30g air-dried soil with 30mL of deionized water (Ryan et al., 2001). For this purpose, pH-meter (HANNA) instrument, type Hl9811-5 was used.

- **Electrical Conductivity (Ec)**

Electrical conductivity of the soil samples was measured using the electrometric methods (EC-meter JENWAY- model 4510) as described by Ryan et al., (2001).

Table 1: showing the samples location in the studied area.

No.	Locaton of sample	GPS/ elevation
1	Dhemat	36°6’11" N 43°48’47" E /310m
2	Daleguly	36°6’11" N 43°49’29" E /320m
3	Mahabad	36°9'20" N 44°1'19" E /420m

4-RESULT AND DISCUSSION

The results of physical-chemical of samples showing in the table (2), the concentration of parameters in control sample Pb, Cd, Zn, As, pH and EC are 13.33, 7.93, 46.73, 24.0 ppm, 11.27 and 5.35 m/s respectively, and for other locations Darugul (26.67, 6.53, 41.83, 22.0, 10.46, 1.32), Dhemat (50, 6.73, 35.77,

20.0 ppm, 10.90, 2.04 m/s)and for Mahabad (20.0, 7.7, 32.07, 26.0 ppm, 10.64, 1.46 m/s).

Table 2: showing the physico-chemical parameters for pottery jar samples

	Darugul	Dhemat	Mahabad	Control
Pb	26.67	50.00	20.00	13.33
Cd	6.53	6.73	7.70	7.93
Zn	41.83	35.77	32.07	46.73
As	22.00	20.00	26.00	24.00
pH	10.46	10.90	10.64	11.27
EC (ms)	1.32	2.04	1.46	5.35

The physical parameters (pH and EC), most of samples are alkaline pH, because, treated by heating then increasing the pH (Zhihao, et. al., 2021), and just control sample are level of pH are more than another, and the EC parameter are same (Table 2 and Fig. 5), because the pottery control not added any water like the other locations.

Figure 5: Histogram showing the concentration of pH and EC for samples.

Lead is rare in nature, it occurs in the mineral's anglesite, cerussite, minimis and galena, are in earth crust reached 16 mg/Kg (Al – Saddi, 2006). The source of pb in environment are comes from two source: the first one is geologic source as it is present in the structure of mineral and rocks (olivine, pyroxene, amphibole, feldspar, and chlorite), and in clay mineral (montmorilonite) and (sulphur, galena,

cerusite, anglesite) (Drever, 1997). It is soluble under oxidizing condition in acid environment. It is a toxic element for organisms in high concentration and causes cancer in human (WHO, 1989). Chronic exposure to lead cause weight loss constipation and loss of teeth, lead also damages liver, kidney and central and peripheral nervous system (Pandey.et.al, 2005).

In present study Pb concentration ranges between 13.33 – 50 ppm, in all samples except Dehemat are below the control, but in Dhemat are the Pb is more than the control (Fig. 7), the main source is anthropogenic and lithogenic, because the conetration of Pb in waste water ranged between 0.23 – 0.29 ppm (Lak, 2007), may be the lithogenic source from the pottery.

Cadmium is most commonly found associated with zinc in carbonate and sulfide ores (Moore & Ramamorthy, 1984). It seldom occurs in geological sediment, geochemical behaviors tend to sulphophilic group (Goldsmith, 1957). Similar with zinc but differs by little occur in nature (Hem, 1985). Soluble under acidic condition. It forms complex compound with organic matter and absorbed on ferrous hydroxide manganese effected by absorbed on calcite. Natural occurrences of cadmium are pyroxene minerals, apatite, biotite, and feldspar rich with calcium (Fairbridge, 1972).

In present study Cd are less than the control (Fig. 7), not affected by pollution source, because the concertation of Cd in waste water is very low ranged between 0.02 – 0.021 ppm (Lak, 2007).

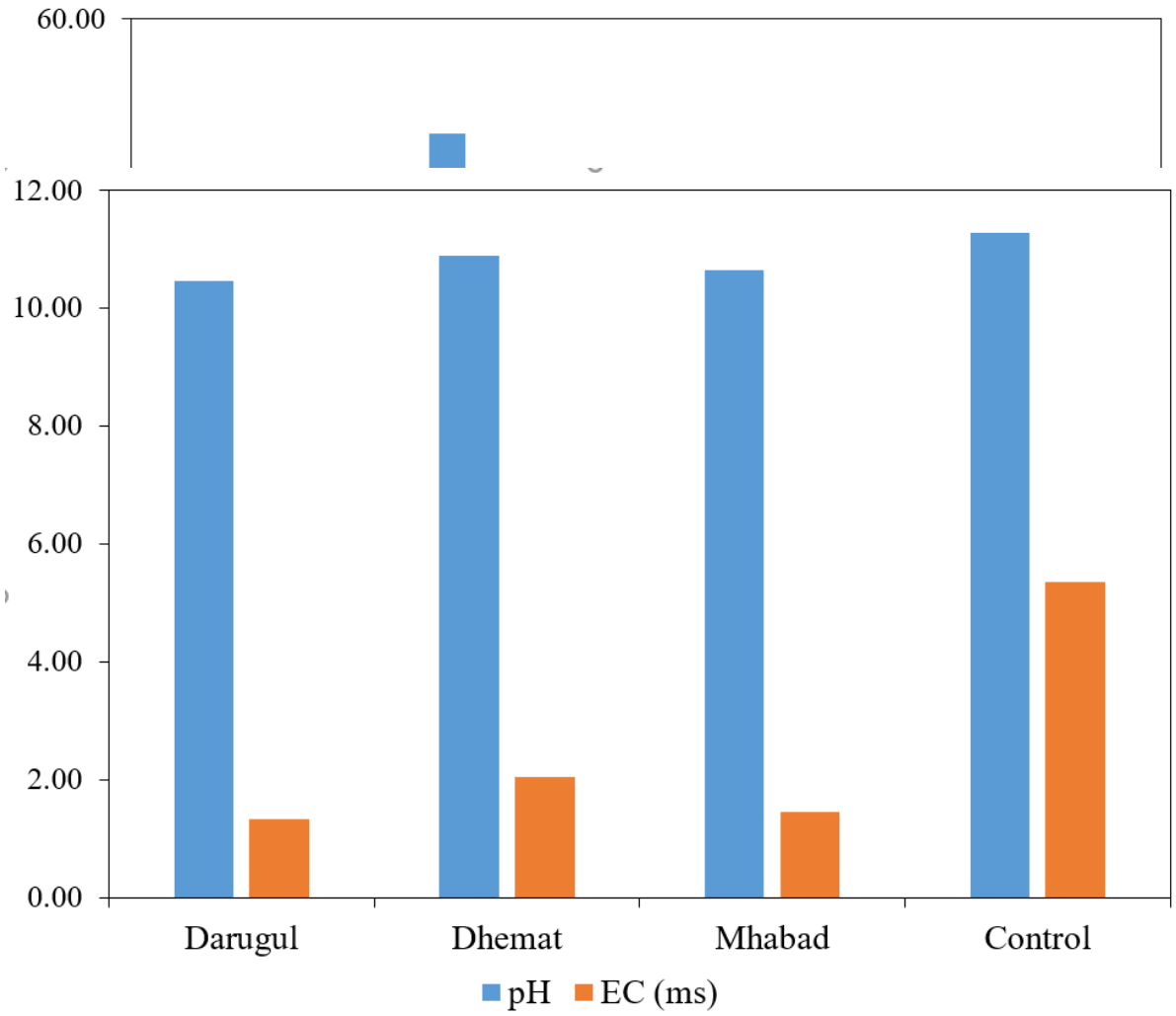

Figure 6: Histogram showing the concentration of trace elements for samples.

Zinc is relatively rare constituent in Earth Crust (nature) minerals which contain zinc ion and are less soluble in water and immobile, that is related with. (Boyd, 2000). Zinc occurs in ion form under oxidizing and acidic conditions, reducing in dissolvent, when sulphate occurs under reduction condition the sulfur compound less soluble (Drever, 1997), when pH – value is more than 7 it is deposited, Cadmium is a pathfinder of zinc, impure zinc compound contains ratio of Cd+ (Alloway & Ayres, 1997).

Sources of zinc in nature are as component in minerals such as sphalertie, smithsonite, willemite, and zincite, and biotite, amphibile, ilmenite, magnetite, muscovite, and olivine, it associated with sphalertie and galena (Fairbridge, 1972). It is widely used in industry to make dye, paint, rubber, wood preservative and ointments (Tucker et al., 2005). It is a common element which found in air, soil, water and all food – component in waste water, soap, detergent and pesticides, animal waste also added more zinc concentration to environment. Atmospheric zinc is higher in industrial area (Pandey, et. al, 2005).

In present study Zn are less than the control (Fig. 7), not affected by pollution source, because the concertation of Zn in waste water is low ranged between 0.12 – 0.3 ppm (Lak, 2007).

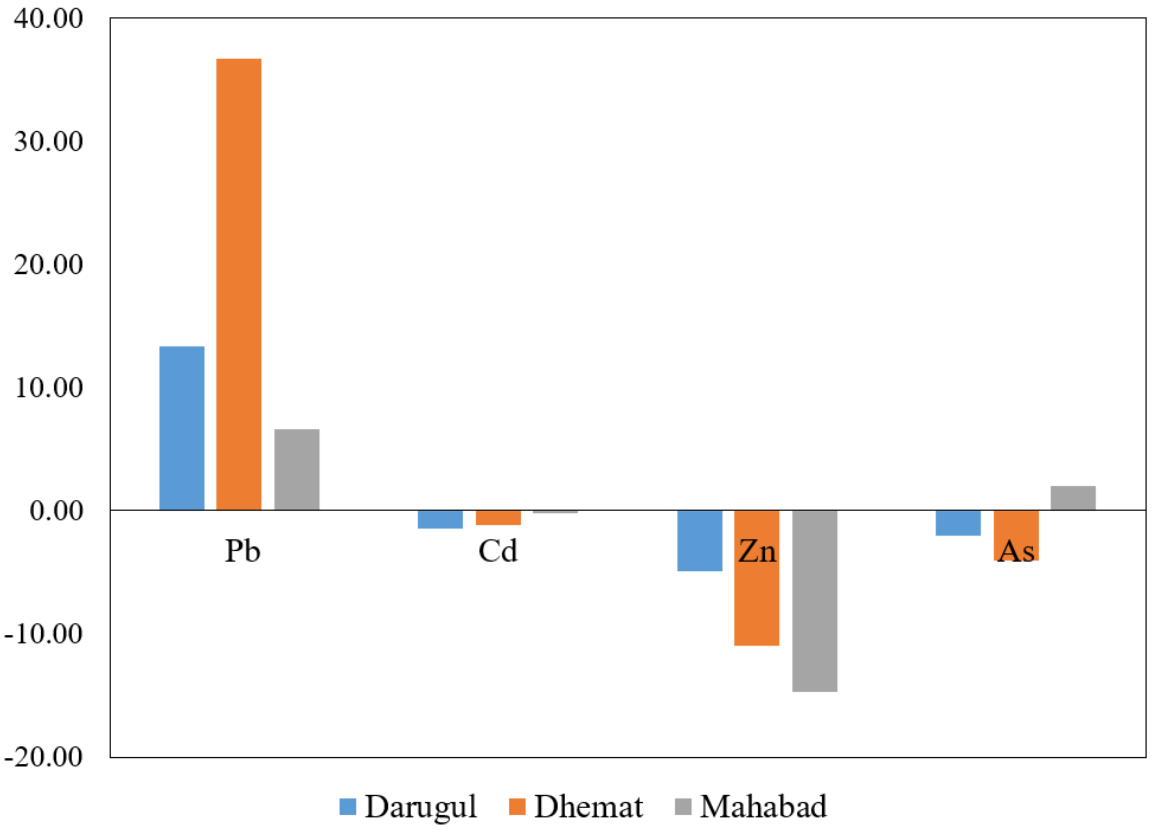

Figure 7: Histogram showing the difference between samples – control.

Contamination of the environment with arsenic (As) from both anthropogenic and natural sources has occurred in many parts of the world and is recognized as a global problem. Principal anthropogenic sources of As include base metal smelters, gold mines, power plants that burn As-rich coals or treated lumber, disposal sites for wastes from As-processing plants, as well as industrial and municipal dump sites. In many areas, the levels of As in the environment have become one of concern and epidemiological studies have documented various adverse health effects on local populations. Arsenic is a natural constituent of the Earth's crust and ranks 20th in abundance in relation to the other elements, with an average As content in continental crust varying between 2 and 3 mg As/kg. Arsenic is found in 200 mineral forms, which include arsenates (60%), sulfides and sulfosalts (20%), and the minor amounts of arsenides, arsenates, oxides, silicates, and As in its native form (Nriagu, et.al., 2007).

In present study As concentration ranges between 20 – 26 ppm, in all samples except Mahabad are below the control, but in Mahabad is the As is more than the control (Fig. 7), the main source is lithogenic, because the location of Mahabad far away from the waste water.

6- Conclusion

1- The pH of pottery jars is alkaline environment, due to the precipitation of ions and trace elements in Clay (pottery jars).

2- The source of Pd in the water samples are lithogenic and anthropogenic, because the Darugul and Dhemat near the waste water (source pollution), while Mahabad far away from the pollution source.

3- The trace elements Cd and Zn are less than the control.

4- The As toxic element is less than the control in locations Dhemat and Darugul, while, in the Mahabad area is more than the control, the source is lithogenic, because, Mahabad far away from the pollution source.

5-

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