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Research Paper

ASSESSMENT OF HEAVY METAL CONTAMINATION OF GROUNDWATER IN KARAJ PLAIN, IRAN

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The objective of the study is to reveal the seasonal variations in the groundwater quality with respect to heavy metal contamination. About 32 water well samples were analysed using Atomic Absorption Spectrophotometer for their mercury(Hg), cobalt (Co), cupper (Cu), zinc (Zn), nickel (Ni), chromium (Cr) and lead (Pb) content and their levels compared with international standards specified maximum contaminant level. Heavy metal contents of ground waters were below the permissible levels. Average total Hg, Co, Cu, Zn, Ni, Cr, Pb and As contents of ground waters were below the pollutant limits, but in some sampling sites for Hg and As concentrations were exceeded permissible limits. However, the average heavy metal evaluation index values for all metals in ground waters were below the critical value.

Keywords: Groundwater, Heavy metal, Contamination, Karaj plain

INTRODUCTION

Heavy metal is a metallic element that has relatively high density or relatively high atomic weight. A toxic heavy metal is relatively a dense metal or metalloid that is noted for its toxicity more so especially in environmental context. The term has particular application to cadmium, mercury, lead and arsenic. Other examples include manganese, chromium, cobalt, nickel, copper, zinc, selenium, antimony and Thallium. Heavy metals are natural components of the Earth's crust. They cannot be degraded or destroyed. To a small extent they enter our bodies via food, drinking water and air. As trace elements, some heavy metals (e.g., copper, selenium, zinc) are essential to maintain the metabolism of the human body. However, at higher concentrations they can lead to poisoning. Heavy metal poisoning could result, for instance, from drinking-water contamination (e.g., lead pipes), high ambient air concentrations near emission sources, or intake via the food chain.

Heavy metals enter water resources through natural processes. Heavy rains or flowing water can leach heavy metals out of the rock units. Such processes are exacerbated when disturbed by such of the activities like mining. These processes expose the mined-out area to air and

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water, and can lead to Acid Mine Drainage (AMD). The low pH conditions associated with AMD results in the mobilisation of heavy metals. Mineral processing operations can also generate significant heavy metal pollution, both from direct extraction processes as well as through leaching from ore and tailings stockpiles.

There is thus the need to assess the quality of ground water sources. The World Health Organisation has specified Maximum Contaminant Level for the presence of heavy metals in water. The aim of this study is to assess the quality of ground water sources in Karaj plain, central of Iran, with the aid of Atomic Absorption Spectrophotometer the presence and concentration of seven heavy metals (Cobalt, Chromium, Nickel, Zinc, Copper, Mercury and Lead) were determined and the results compared to the maximum contaminant level specified by the World Health Organisation. The study area, Karaj plain is situated in northwest of Tehran, Iran, lies between latitudes 34°502 to 35°302 N and longitudes 47°122, to 48°102 E covering an area of 818 sq km. The average height of the region is 1500 m above MSL. The most important city located in this Alborz Province is Karaj (Figure 1).

Figure 1: Location of the Study Area and Ground Water Samples

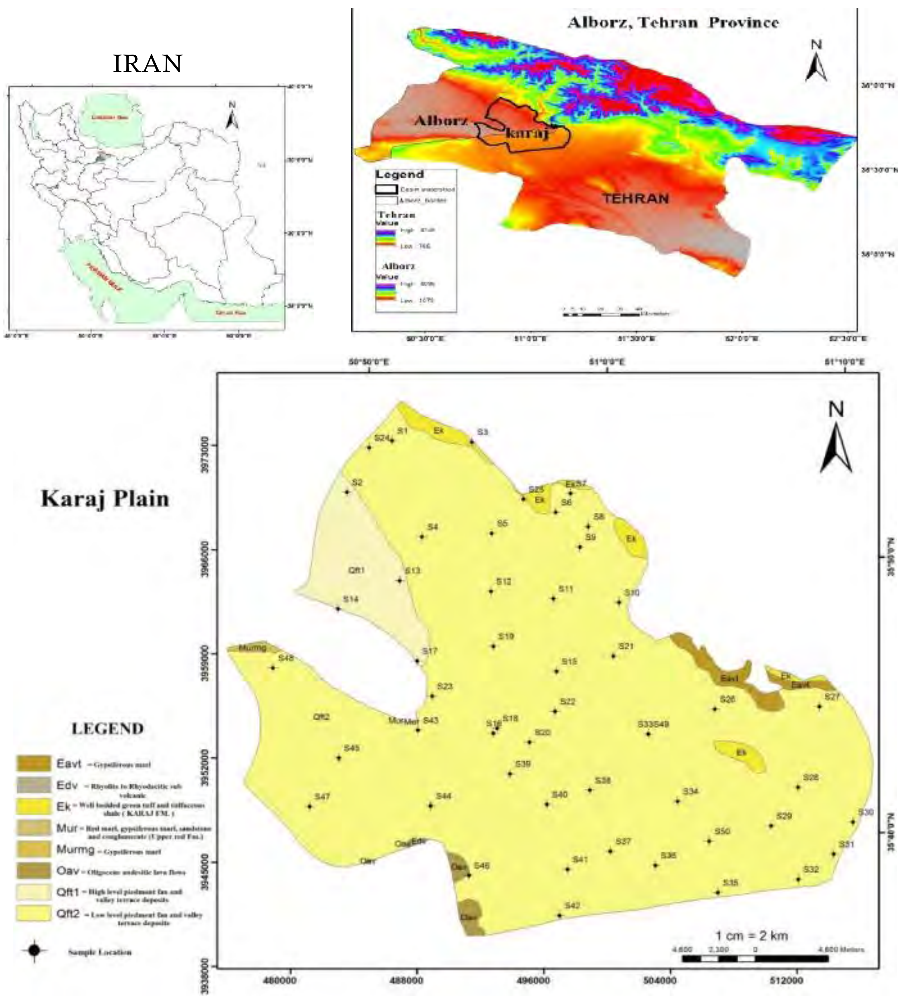


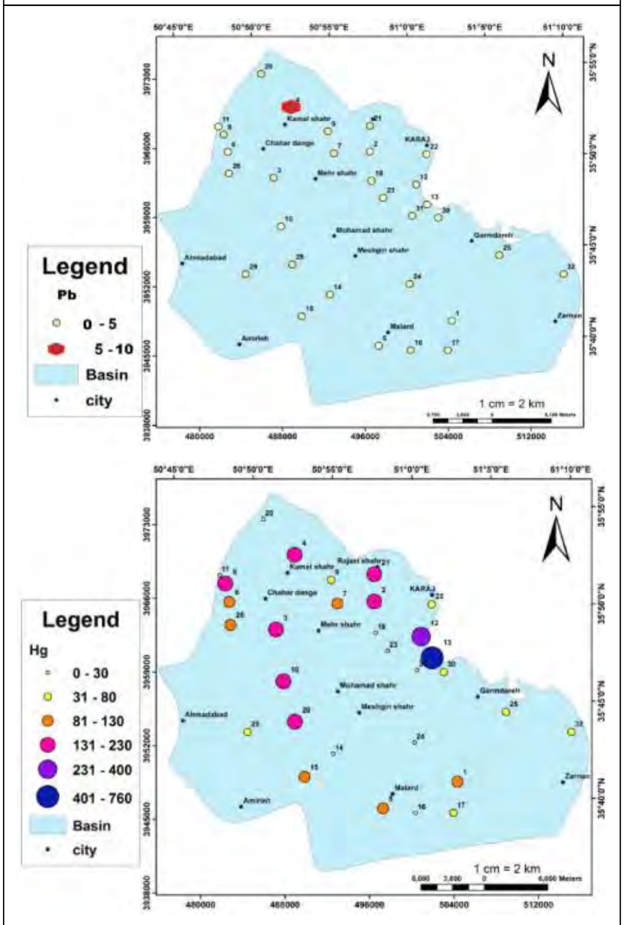
Table 1: Summarizes the Status of the Maximum Concentration Measured and Compared with International Standards and Iran

Element	The Maximum Measured in the Area ppb	Ministry of Energy in Iran		EQG Canadian	America	EPA	WHO ppb	Result
		MAX Permissible ppb	MAX Desirable ppb	MAX Permissible ppb	MAX Permissible ppb	MIN Desirable ppb		
Pb	6	100	0	0	15	-	10	Negative
Hg	760	1	0	-	2	-	1	Positive
Cr	41/2	-	-	-	-	-	50	Negative
Co	42937	-	-	-	-	-	-	-
Cu	7/116	1500	50	1000	1000	-	2000	Negative
Zn	1624	15000	5000	5000	5000	-	3000	Negative
Ni	-	-	-	-	-	-	20	-

MATERIALS AND METHODS

Totally, 32 water samples from different wells in the region were collected in 4-liter polyethylene containers and got tested in the laboratory by adopting Atomic Absorption Spectrometry. The said atomic absorption device is made of Varian Plant, model A-240. After determining the concentration of heavy metal elements in the samples, the data were tabulated and maps of the concentration of individual metals were prepared and interpreted. The results of the analysis of the samples and the concentration of each of the elements specified in terms of micrograms per liter and in table form (Table 1) summarized and presented.

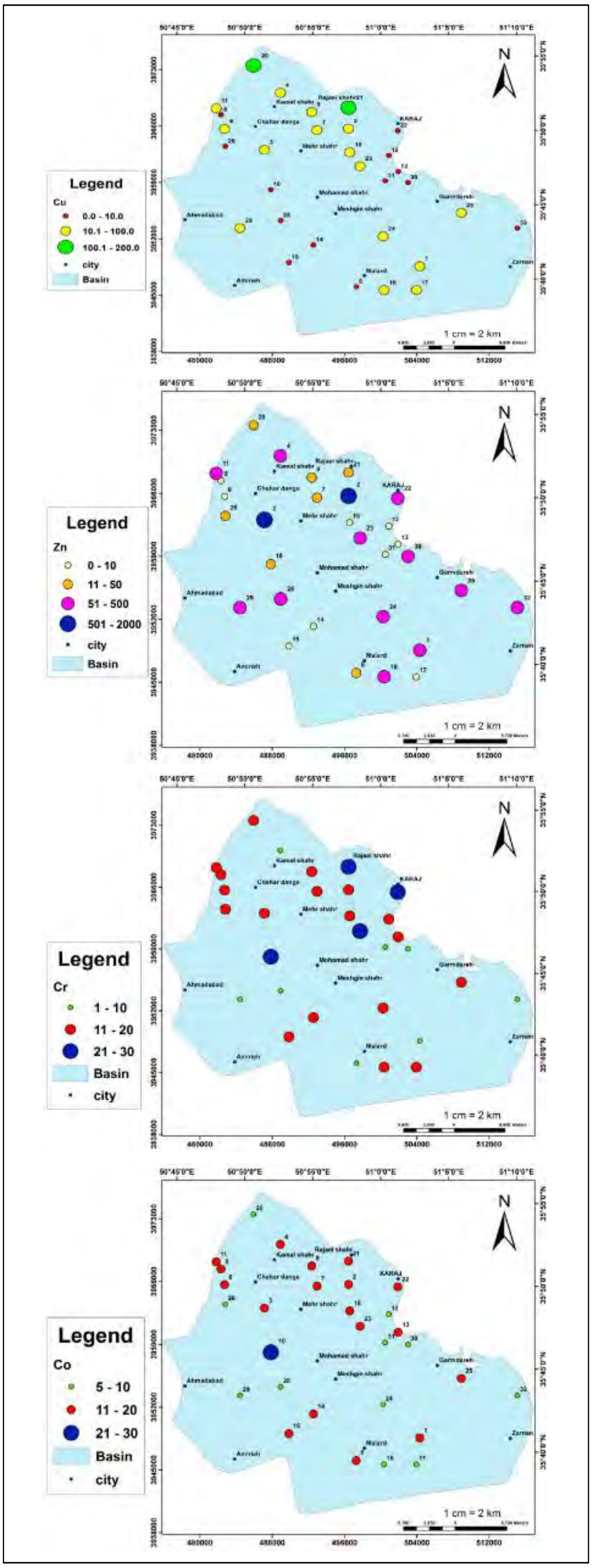
Figure 2: Heavy Metals Concentrations in the Karaj Aquifer



RESULTS AND DISCUSSION

In studies of groundwater, issue of quality like quantity is important and until qualitative conditions of the aquifer are not analysed in different dimensions such as quantitative issues, one cannot explain general view of aquifer. According to the fact that most cities of Iran are located on alluvial aquifers, in addition to natural factors,

Figure 2 (Cont.)



human activities influence quality of groundwater in different dimensions, as well. The more extensive is range of activities, the more effects are on quality of aquifer; and the richer is the aquifer, the limited effects there are. The results of the analysis of the samples and the concentration of each of the elements specified in terms of micrograms per litter and in figure summarized and presented.

CONCLUSION

- Lead is measured in the sample with the highest level of lead in the area probably caused by the effects of urban sewage transmission channel is Hesarak to Qezelhesar and in addition to surface runoff wastewater that has passed the city so lead contamination from gasoline and fuel influence surface water with groundwater resources.
- The aquifer pollution to mercury is clear and definite. Given that almost the entire region is much higher than permitted levels of mercury pollution factors such as the use of fungicides in agriculture all gases emitted from industrial, municipal and hospital waste pollution are effective.
- The maximum amount of copper measuring less than allowed according to international standards WHO (2000 micrograms per litter) and EPA (1000 mg L).
- Zinc compared with international standards WHO (maximum 3000 micrograms per litter) and EPA (the maximum allowed of 5,000 micrograms per litter) in the groundwater in the aquifer below the limit of this healthy and free from contamination. The main resource of zinc is the resources of city and municipal wastewater injected into the aquifer. Drainage channel crossing from Hesarak to

Ghezelhesar could be polluting the aquifer important is this element.

- according to the results of water quality laboratory water and wastewater the minimum and maximum amount of nickel in drinking water wells in the city, at least less than 0.1 and a maximum of 4.552 micrograms per litter lower than the WHO standard (20 mg L).
- In measuring the amount of chromium in drinking water wells Water and Wastewater Company minimum and maximum concentrations of chromium 02/0> to 13.573 micrograms per litter have been reported to total groundwater and aquifers to excessive chromium contamination is not permitted.
- Groundwater is neutral in terms of pH and absorbing particles absorb heavy metals such as chromium and cobalt, as expected, is not very high concentrations of this element. However, there is no certain amount in the country and international standards for it compared in this case.

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