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Mercury in Zahedan ground water

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ABSTRACT

Mercury contamination in drinking water is a potential risk on human health and environment. This article explains the status of mercury in Zahedan aquifer that lies in southeastern of Iran. We have measured the mercury concentration of 10 random wells by Cold Vapor Atomic Absorption Spectroscopy method. The minimum and maximum concentration of mercury was 0.39 and 2.32 ppb in these samples. Standard limit of mercury in water is 1 ppb, so we conclude the magnitude of mercury in some regions are more than the standard limit. Isoconcentration contours were drowning on geological map of the area to find out the sources of this contamination. We have defined the origin of ground water pollution by comparing information about industrial, geological, geochemistry and other pollution factor.

Key words: Groundwater, contamination, mercury, Zahedan.

INTRODUCTION

Study and elimination of water pollution is very important for health because the health of human depend on the availability of safe drinking water supply. Zahedan, the capital city of Sistan and Baluchistan province, is located close to Pakistan border . Water pollution has many sources but in this study we mention about mercury that can be consider one of the most important heavy metals[1-4]. Being a potent neurotoxin, mercury is particularly hazardous to developing fetuses, infants and young children, with resulting effects including delays in learning and motor functions (walking, talking and speaking). Mercury builds up in the body over time, causing impaired peripheral vision, disturbances in sensations (tingling, numbness) usually in the hands and feet and sometimes around the mouth, impaired speech, hearing, walking, writing, as well as mental disturbances. If additional exposure does not occur, it can be excreted from the body over a period of four to five months[5]. Mercury are dangerous because it tend to bio-accumulate that means is increase in concentration in biological organism over time[6].

Mercury is a heavy metal which is liquid at ordinary temperatures Elevated concentrations of Hg in ground water have been linked to industrial contamination or mining activities .

Reports of concentrations of Hg in ground water in non-industrial developed areas are few[5].

This element combined with several metals to form alloy that called amalgams. Recent studies of Hg in soils, streams, lakes, and wetlands have advanced the understanding of the mobility and transformations of Hg in natural systems where aqueous concentrations of Hg commonly are >30 ng/L[5].

Mercury has many uses for example in barometers, manometers, thermometers and recovery gold from its ores. Mercury also used as electrode in electrolysis called polarography, as switches and rectifiers in electrical gear, and industrial catalysis. Calomel is one of mercury compound that used as standard in electrochemical measurement and as purgative in medicine. Mercury compound are also used in rat poison and disinfectant as insecticide. Other uses are skin ointment, catalyst in organic chemistry, pigment and detonator. Mercury rarely found as free form in nature and mainly we occur in cinnabar ore. We can found this element as metal form, as mercury salts and organic compounds. One way that mercury enters to our environment is the breakdown of minerals in rocks through exposure to water.

There are several analytical methods that we can determine mercury concentration in water. Cold Vapor Atomic Absorption Spectroscopy (CVAAS),inductively coupled plasma–atomic emission spectroscopy (ICP-AES), inductively coupled plasma–mass spectrometry (ICP-MS), microwave-induced plasma, atomic emission spectrometry (AES), neutron activation analysis(NAA), gas chromatography(GC), atomic fluorescence spectrometry and high- performance liquid chromatography (HPLC) have been used for determination of mercury in aqueous sample but most time CVAAS are used because this method has high sensitivity and reliability .So in this study we used CVAAS technique .

The effects of mercury on human are disruption of the nervous system and damage to brain function that can cause degradation of learning abilities, personality changes, tremors, vision changes, deafness, muscle, muscle incoordination and memory loss. Other effect on human health are DNA damage and chromosomal damage that cause mongolism, allergic reaction, skin rashes, tiredness, and headaches, negative reproductive effects such as sperm damage , birth defects and miscarriages. Mercury is a neurotoxic substance, infants and children are susceptible for this effect. Other toxic effects of mercury are autism, Alzheimer, ALS, multiple sclerosis, Parkinson, other neurodevelopment problems, nephrotoxicity, cancer, Dieses in the kidney, the developing fetus and liver, respiratory, cardiovascular, gastrointestinal l, hematologic, immune, and reproductive systems.

EXPRIMENTAL

The water samples were randomly collected From 10 wells in different geographical directions and places in Zahedan to measure concentration of mercury in ground water. This sampling has done ten times. Map of this area and the wells locations are shown in figure (1). This figure is drawn by use of surfer software.

The methods of experiment have been adopted from National Exposure Research Laboratory, U.S. Environmental Protection Agency, Athens, GA(7)

Analysis of the samples has been done based on “Standard Methods for the examination water and wastewater” book (8).

We used plastic bottles for sampling. First, the bottles were washed carefully and then the samples were collected. We reached a pH of two for each sample by adding immediately the concentrated nitric acid to stable samples.

These measurements have been done by the flame atomic absorption spectrometer, SpectAA-22o that is made in Varian Australia. The flame atomic absorption method was used to measure lead and cobalt concentrations and cold vapor generation method was used to measure mercury concentration.

RESULTS AND DISCUSSION

We have shown the results of measured elements concentrations in the histogram diagrams (fig (2)) and compared these measures. These figures have been drawn by use of Excel software.

Isoconcentration contours are drown on a map of this area by Surfer software to study distribution system of concentration and recognize the pollution origins, by using geological map of the area, the geographical information system (GIS) of the sampling wells, and the concentration amounts of these elements.

Figure (2) shows mercury concentrations in the sampling wells. Minimum of the measured mercury concentration was in the well w45 (0.39 ppb) and the maximum was in the well w4 (2.32 ppb).

According to the standard of the world health organization (1993), mercury standard authorized limit is 1ppb for drinking water (9) . This means that mercury concentration is more than standard authorized limit in some area.

Figure (3) shows mercury isoconcentration contours. Study of the figure illustrates a sudden increase in mercury concentration in the well w4 (located in the city center) which is two times more than standard allowable limit .

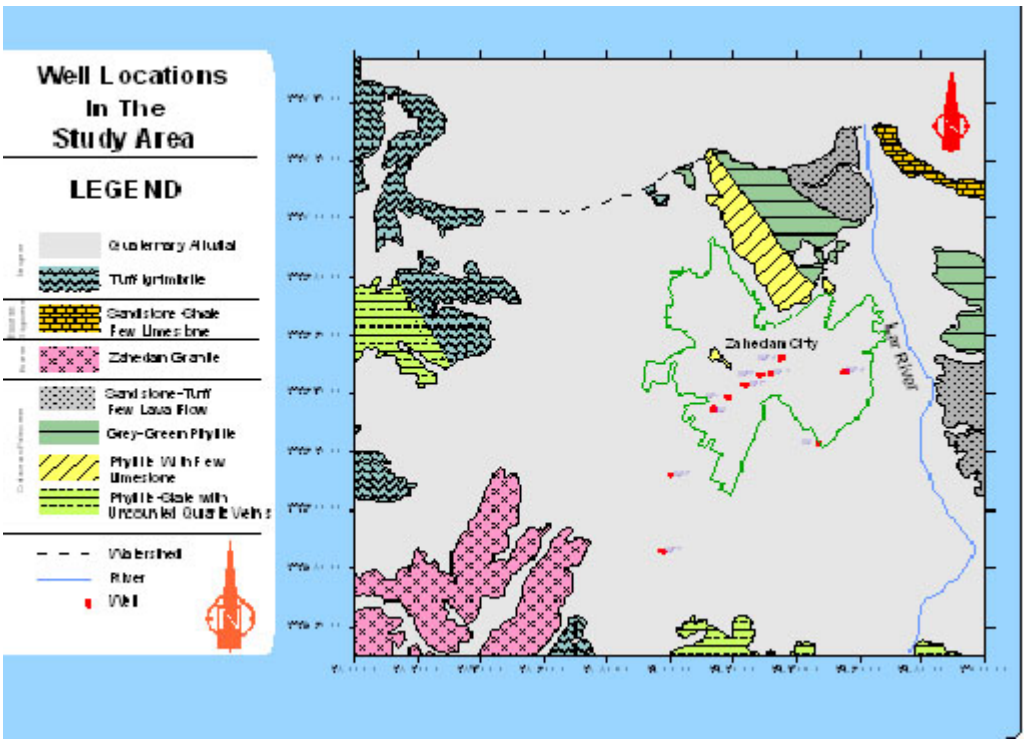

Fig. 1: Zahedan and well locations in the study area

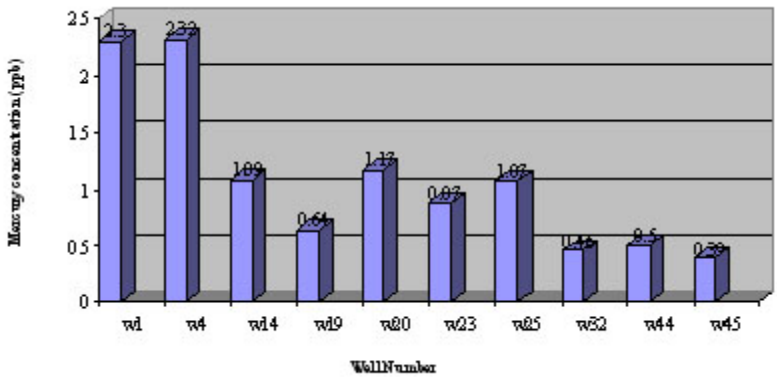

Fig. 2: Comparing the mercury concentration in sampling wells

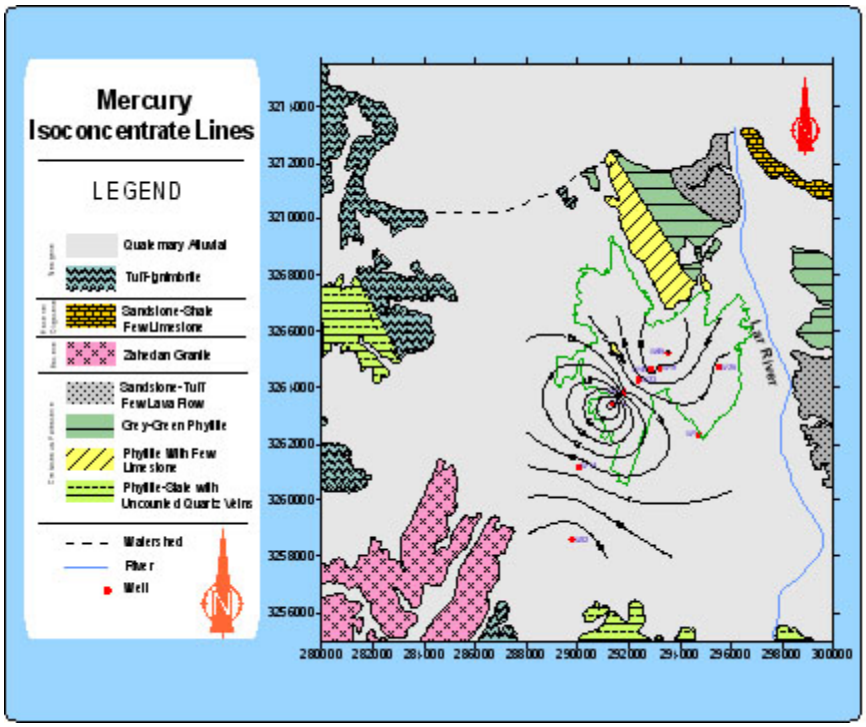

Fig. 3: Mercury isoconcentration contours (ppm) in the region

Increase in concentration of this element around the well w4 and pollution expansion to the nearby areas cause the regions located in the city center, south, southwest and southeast become known as polluted regions. Out of these regions, mercury concentration is less than standard authorized limit. In some certain regions mercury concentration was due to industrial town located in Mirjaveh road and the waste burying place in southeast of city. There is not any other pollutant agent. Around the well w4 has not been observed any pollution center. Therefore, increase in concentration can be interpreted as a mercury hydrothermal vein exists. This theory is not far from the mind with respect to the geological situation of the area and Taftan and Bazman volcanism activities.

CONCLUSIONS

Concentration of mercury concentration in the center and south of the city is more than the standard authorized limit.

Studies show that the main source of pollution is around the wells w20 and w4 in the center of the city (Behdasht and Janbazan Boulevard). Not any other pollution resources have been observed in this part of the city; therefore, the origins of pollution are geological and existence of these elements ores in this region. In this area, places where pollutions have human origins are Mirjaveh industrial town, Workshop industrial town and the waste burying place of the city. These industries are small; consequently they do not play much role in these pollutions. However, Mirjaveh industrial town and the waste burying place of the city have much more pollutant share due to Workshop industrial town. Although this effect is very little now, but it causes that pollution increase in this area an anomaly around the well w1.

Generally, the effects of geology in heavy metals pollution observed in all parts of the region and human activities cause some of these pollutants enter aquifer locally. Industries do not treat their wastewater and let it to the environment.

Comments

- High concentrations of mercury make drink groundwaters in this area dangerous. Unallowable amounts of mercury, suggest that the water of aquifer first be treated and then used for drinking.
- To prevent more pollution of the aquifer, a general program performs the industrial and workshop wastewater treatment of the industrial towns. Moreover, strict supervision has to be done over the new plants for wastewater treatment in three industrial towns and out of these in Zahedan by Iranian department of environment. It is necessary to control industries.
- Generally, geological situation in Sistan and Baluchestan region causes the ore variety and multiplicity in this region. This variety is so much that makes Sistan and Baluchestan as a different and remarkable region in Iranian geology. Therefore, it is recommended that an expert group of economists, economical geologists, geochemists and hydrogeologists study the qualitive and quantitive effects of geology on the elements and especially existence of heavy metals in ground water in this region.

REFERENCES

1. Walter L., Handbook of Water Purification; McGraw-Hill, George. (1981).
2. Morrison H, *Crit. Rev. Anal. Chem.,* **8**: 283 (1979).
3. Forsyte K. W., Dennis M., Marvin C. H., *Water Qual. Res. J. Canada.* **39**(3): 190-206 (2004).
4. Sompongchaiyakul P. and Sirinawin W. , Asian J. of Water, Environment and Pollution, **4**(1) (2007).
5. Barringer J. L., Szabo Z., Schneider D., Atkinson W. D. , Gallagher R. A., *Sci. Total Environ*., **361**: 144 (2006).
6. Vargas V.M.; Migliavacca, S. B.; De Melo, A.C.; Horn, R. C.; Guidobono, R.R.; De Sa Ferreira I.C., Pestana M.H, *Mutat. Res*., **490**: 141 (2001).
7. Weber E.J., Washington J.M. 2000. Summary of the Environmental Fate of Organometallic Drying Reagents in Landfill Environments. Memorandum. Ecosystems Research Division, National Exposure Research Laboratory, U.S. Environmental Protection Agency, Athens, GA. (2000).
8. Apha A. W. ,, Standard Methods for the Examination of Water and Waste Water; 16th ed.; Washington D.C., (1999).
9. Richard A. . Statistics principles and Methods; Includes bibliographical references and index, 4th ed., 268-304 and 680-681 (2000).