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Original Research Paper

Manganese, nickel, lead, chromium and cadmium in the watershed Guir, impact on the quality of wells water in Tiykomiyne (Eastern Morocco)

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Water wells are used for drinking and irrigation. But the geological nature of soil in any region promotes metal contamination by metallic trace elements such as manganese, nickel, lead, chromium and cadmium found in that region. Tyikomiyne is located in the east of Morocco. An assessment of the water quality of the wells in Tyikomiyne was carried out to determine the environmental impact of these trace elements. The spatial variation of water contents of trace metals: manganese, nickel, lead, chromium and cadmium were studied during low water level of the five wells - Faryat (Well 1), El Masjid (Well 2), Hadi (Well 3), Hilla (Well 4), and Deppiz (Well 5)- in Tiykomiyne region of Talsint. A complete diagnosis of the current situation of the metal pollution, and rigorous monitoring of its evolution were studied to judge the quality of the water and its impact on the environment. Survey results show that the concentrations of metallic elements studied (except lead) analyzed during low water are well below the norms fixed for power and irrigation. By against lead levels, exceed the standard for portability in all measurement points, but they remain below the standard set for irrigation. The high levels of lead found can be explained by the regional geological context. At the end of this study, it was concluded that the use of the Tiykomiyne wells water without treatment could pose as significant health risk.

Key words*:* Pollution, Heavy metals, Oued Tislit-Talsint

INTRODUCTION

The Talssint region belongs to mountainous area of high eastern atlas part of the great chain of the Moroccan Atlas. This stretches over 800 km from west to east, from Agadir to Figuig (Azelmat and Ben ,2009).

It is further divided into two units: to the west; the high eastern Atlas Mountains, with elevations exceeding 2000 m. The highest of which are: Jbel Falchou (2303 m), Jbel Skendis (2173 m) and Jbel Mechkakour (2122 m).

In the centre and east of the country, the area of the highlands cover two-thirds of the area of the eastern ; with altitudes between 1000 and 1650 m. The average annual pluviometry is around 244.9 mm for the period 1983/2007, and 500 mm for the period 2008/2010; with large interannual gaps and range of 61 mm in 1998/99 and 684.5 mm in 2009/2010 (Taouil et al.2012) . Thus, the region is characterized by pre-Saharan and Saharan environments and high temperatures in summer and very cold winter. The average minima of the coldest month (January) are -5°C and maxima of the warmest month (July) is 47° C.

In the area Tyikomiyne, water wells are used for drinking and irrigation. But the geological nature of the soil in the region promote metal contamination by the metallic trace elements such as lead, which can migrate and reach groundwater, accumulate in the food chain and pose risks to human health (Jourdan et al.2005). A complete diagnosis

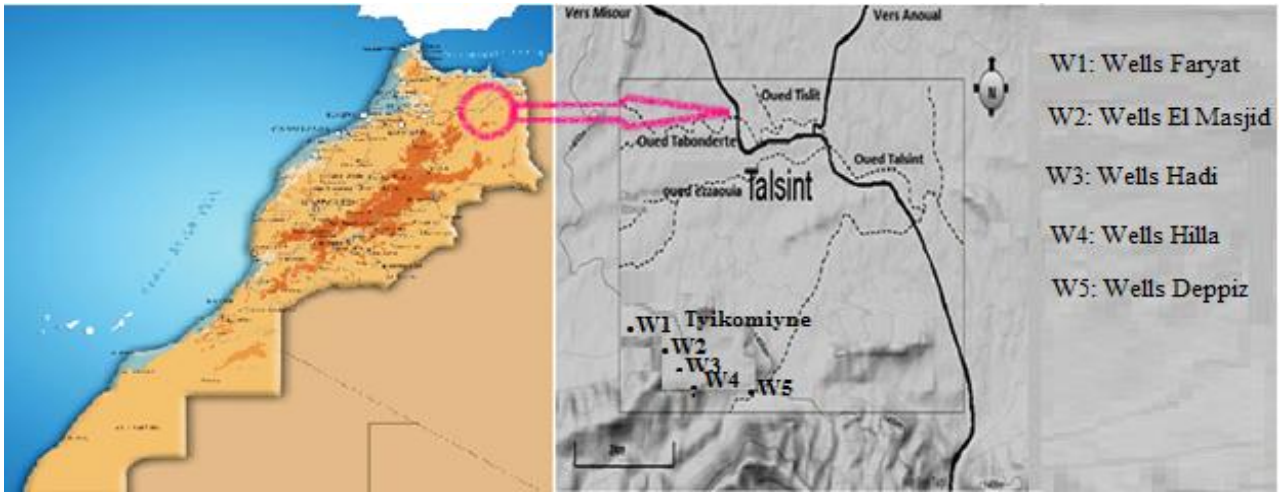

Figure 1:Geographical situation of Tyikomiyne wells, Talssint region.

of the current situation of the metal pollution and rigorous monitoring of its evolution are necessary to judge the quality of the water and its impact on the environment. In this work, we analyzed the content of metallic trace elements namely: Mn, Pb, Ni, Cd and Cr. Water wells Tyikomiyne, to this study's knowledge have never been studied.

MATERIALS AND METHODS

Tyikomiyne area is limited by the Douar [Village] Ezzaouia in the south, the quarter Affia to the north, regional road RP601 to Beni-Tadjit in west and Jbal Alaajra in east (Taouil et al. 2013). Thus, five wells were selected from the study area (Figure 1): Faryat (Wells 1), El Masjid (Wells 2), Hadi (Wells 3), Hilla (Wells 4), and Deppiz (Wells 5).

The samples were stored in polyethylene flasks thoroughly cleaned beforehand by a slightly acidified nitric acid solution, and then rinsed several times with distilled water (AFNOR, 1972). The samples were treated in the field with ultra pure HNO_3 and then transported in a cooler in less than 48 hrs in the laboratory of the National Centre of Scientific and Technical Research (CNRST) Morocco. The concentrations of Mn, Pb, Ni, Cd and Cr were measured by ICP-AES: Atomic Emission Spectrometry Inductively Coupled Plasma Source.

RESULTS AND DISCUSSION

The results of some heavy metals in the waters of the studied wells are shown in Table 1.

Manganese

This is one of the most common elements in nature. It is a significant element of hardness, and it gives an unpleasant water taste (Bentouati and Bouzidi, 2011). The presence of high levels of manganese in the soils, sediments and in metamorphic and sedimentary rocks can provide a natural pollution source. In addition, the accumulated vegetable manganese can be located dissolved in runoff water or level of ground after decomposition of vegetation cover (McNeely et al., 1980). The use of manganese in the manufacture of fertilizer, animal feed, fungicides, pharmaceuticals, dyes, drying agents for painting, catalysts and wood conservation officers (Haguenoer and Furon, 1982; OMS, 1981), can also contribute to the contamination of surface water. The factories and iron mills can also release manganese into the atmosphere, which is then redistributed by precipitation (Foutlane, 1983).

The results in Figure 2 show that the average levels of manganese in all well water remains low. In fact, the average levels of manganese ranged from 2 µg/l (wells1 and wells 5) and 7 µg/l (wells 2). However in all the wells studied, manganese levels are much lower than the limit value of water for the production of drinking water (500 µg/l) (Moroccan standards), and they are also well below the imperative value of favourable water for irrigation (200 µg/l) (Moroccan standards).

Nickel

Nickel is in many alloys because of its hardness and resistance to corrosion. It is also used in the manufacture of battery cells. It is also used to protect the metal parts and the processing associated with cadmium chroming. It is used in the manufacture of kitchen utensils. Its use as a catalyst in the chemical industry is important.

The main anthropogenic sources of nickel are: the treatment of minerals, fossil, as well as surface treatment. Some of these sources emit directly from the nickel in

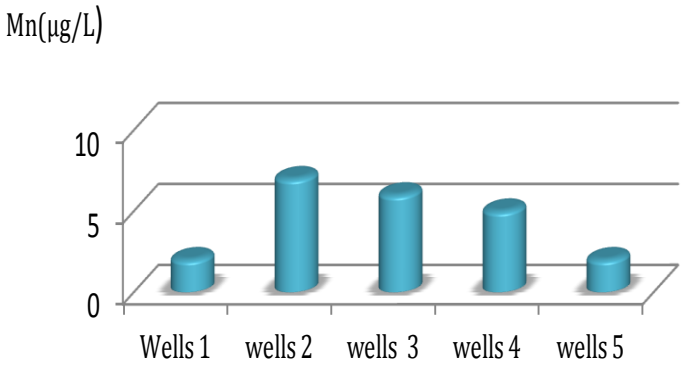

Figure 2:Spatial variation in the average level of well water manganese Tyikomiyne watershed

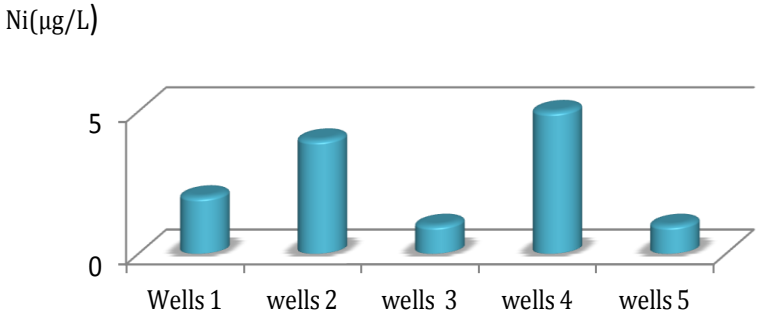

Figure 3:Spatial variation of the average level in nickel of wells waters (Tyikomiyne)

ground water, but others spew out and returned to aquatic systems by precipitation (Foutlane, 1983).

Since manganese, the average levels of nickel in all well water remained low. According to the results of Figure 3, the mean levels of the metal oscillate between 1µg/l (wells3, wells5) and 5µg/l (wells 4).

In all samples studied, the concentrations of nickel in water wells are less than the standard for drinking water (20µg/l). Note that these dosage levels are much lower than the binding nature of the support irrigation (0.2 mg/l) water (Moroccan standards).

Lead

Lead is classified among the most toxic metals to humans and animals (Roony and Mclaren, 1999). It has no known role in biological systems (Kalay and Kanli, 2000). And in natural waters contain only trace amounts of lead concentrations up to 40µg/l. Lead is present in nature as a main origin of hydrocarbons burning motor vehicles, consuming tetraethyl and tetramethyl lead as additives. Its discharge into the aquatic ecosystem is due to the use of this metal in various industrial processes (Foutlane, 1983 and Rodier, 1984).

- The paint industry: Lead is used as a drying agent. White paint lead monoxide is prohibited by law for use inside buildings.
- Lead-based compounds are used in the glass industry, and for coating ceramic.
- Some salts and lead oxides are used as pigments in paints, varnishes, enamels and plastics.
- Lead is in the composition of several insecticides.
- Manufacture of accumulator batteries.
- Lead pipes.
- Recycling of lead products in the industry. Lead represents significant levels in all study stations.

However, the maximum levels were recorded at Wells 5 (44µg/l) (Figure 4.) rich in this element. Moreover, the

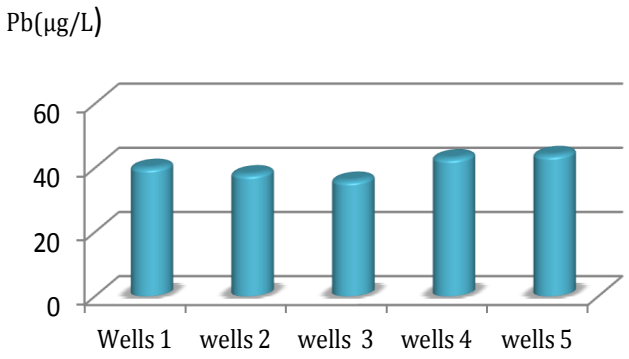

Figure 4: Spatial variation of the average level of lead from the well water (Tyikomiyne).

Table 1. Mean concentrations in (µg/l) of some heavy metals from water wells Tyikomiyne.

	Pb	Mn	Ni	Cd	Cr
wells 1	40	2	2	<2	<2
wells 2	38	7	4	<2	<2
wells 3	36	6	1	<2	<2
wells 4	43	5	5	<2	<2
wells 5	44	2	1	<2	<2

levels of lead in water wells Tyikomiyne far exceed the average levels of uncontaminated soft natural water: 0.2µg/l (Friberg et al., 1980). But these levels found are lower than those found by Boughrous (2007) in water wells in the two arid regions of Morocco - Tafilalet and the Marrakech region. However, the water wells of our area are favourable for irrigation (levels <5 mg/l), but exceed the limit value of production of drinking water (10 µg/l) (Moroccan standards). The high levels of lead found can be explained by the regional geological context.

Chromium

Chromium (Cr) is a chemical element with relatively high mass, which is toxic even at low doses, especially if they have cumulative effect with repeated ingestion of food or continuous rise in the general level of pollution in food (Laurent ,1981). Chromium is generally present in natural waters at low concentrations ranging from 1 to 10µg/l (Friberg et al., 1980). The principal sources of pollution of continental waters superficial by chromium are the surface treatment workshops, tanneries and textile industries (Hammond and Foulkes, 1986). The use of chromium as a corrosion inhibitor also contributes to pollution. It is also present in some fertilizers and pesticides (Taylor et al., 1979). Discharges from tanneries are particularly significant source of water pollution by chromium. The volume of water discharged per day by a tannery is highly variable depending on the size of it. For example, a manufacturer of copper sole ejects 20-30 litres of waste water per kg of treated skin (Levesque, 1979). Thus, the concentration found in the element chromium (Cr) in all the measured points are at or below the detection limit (2µg / L) (Table 1.).

Cadmium

Cadmium (Cd) is a non-essential element to life that causes severe toxicity in aquatic organisms at very low concentrations (Sorensen, 1999). It is generally present in trace amounts in natural waters at concentrations below 1 µg/L. Higher concentrations can be attributed to different sources of contamination. The main sources of contamination of water sources by cadmium are metals cadmium electroplating workshops, production of fertilizers, insecticides and pigments. Cadmium is generally present in the diesel fuel, lubricants, tires and some engine parts cars. This metal is deposited on the roads; it is then driven by storm water. The use of galvanized pipelines and the use of cadmium-silver solder in the pipelines can also form a source of water contamination by this metal (Levesque, 1978). Thus, the concentrations found in the element chromium (Cr) in all the measured points are at or below the detection limit (2µg/L).

Conclusion

In order to determine the impact of water pollution in the wells of the area Tyikomiyne region, a metal study was conducted on the samples of five wells during low water. The results show that water wells are of good quality, with some heterogeneity in their metal concentration. It is interesting to note that the concentrations of metals (except lead) analyzed in this period are well below the standards set for power and irrigation. Therefore, these elements makes the water wells favourable for power and irrigation.Though, lead levels exceed the standard for portability in all measurement points; they are below the standard set for irrigation. However, in all the wells studied, dosage levels of lead qualify the waters wells in favour for irrigation.

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