J. Mater. Environ. Sci. 5 (1) (2014) 177-182
ISSN : 2028-2508
CODEN: JMESCN

Evaluation of metal pollution: Aluminum, Zinc, Iron and Copper of Tiykomiyne well water (East Morocco)

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Received 11 June 2013, Revised 25 Sept 2013, Accepted 25 Sept 2013
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Abstract
In order to give an assessment of metal pollution of water wells in the area of the Tiykomiyne of Talssint common the eastern coast of Morocco, samples of water from five wells were made during two samplings campaigns during a dry period (May and June of 2011). The analysis results presented in this work showed that the levels of trace elements metals, Aluminum, Zinc, Iron and Copper are below the standards for the power and irrigation.

Keywords: Evaluation, Water, heavy metals, Tiykomiyne Well, Morocco

1. Introduction
Potential sources of groundwater pollution have increased in the last century [1-4]. Heavy metals, particularly lead, zinc and copper are among of pollution cases representing a major environmental problem. And anthropogenic sources of emissions of metallic substances are multiple and are mainly due to the intensification of urban, agricultural and industrial applications. These intensive activities generate high concentrations of heavy metals (Cu, Zn, Pb, Cd) and organic pollutants in the soil that can then be accumulated by the plant [5].

Generally, the majority of metal pollutants which are likely to reach the groundwater transit through the ground. In this way, they may undergo transformations bio-physico-chemical properties, which have the effect of either the immobilizing or delay, or favor their solubilization and transport by infiltrating water [6]. However, the risk of groundwater contamination is not only due to human activities and their intensity, but also in the overexploitation of the resource. And ground water are subject more intensively, to deliberate discharges of polluting effluents, wastewater or storm water runoff in an urban environment [7, 8]. In Marrakech, groundwater plays an important role in the development of irrigation and drinking water and industrial, whether for urban or rural centers.

In the area of Tyikomiyne (6 people), we use the well water for consumption and irrigation. But the geological nature of the soil in the area is likely to cause metal contamination of these waters by the lead element. For this, we are interested in the study of heavy metal contamination of water wells in the Tiykomiyne area of watershed Guir in Eastern Morocco have to our knowledge never been studied; Some work on the Evaluation of the water quality in this region have been studied by our group [9-12].

2. Materials and methods
2.1. Study medium
Tiykomiyne area is a rural area belong to the region Talssint (Figure 1), it is the capital of the rural commune of Talsint, caïdat under the same name and the circle of Beni-Tadjit, which is part of Figuig province, eastern Morocco region [13]. The average annual rainfall was about 244.9 mm for the period 1983/2007 and 500 mm for the period 2008/2010, with large inter-annual variations, with extremes of 61 mm in 1998/99 and 684.5 mm in 2009/2010.

The region is characterized by pre-Saharan and Saharan ambiances. The temperatures are high in summer and very cold in winter. The average minimum of the coldest month (January) is -5 °C and maximum of the warmest month (July) 47 °C.

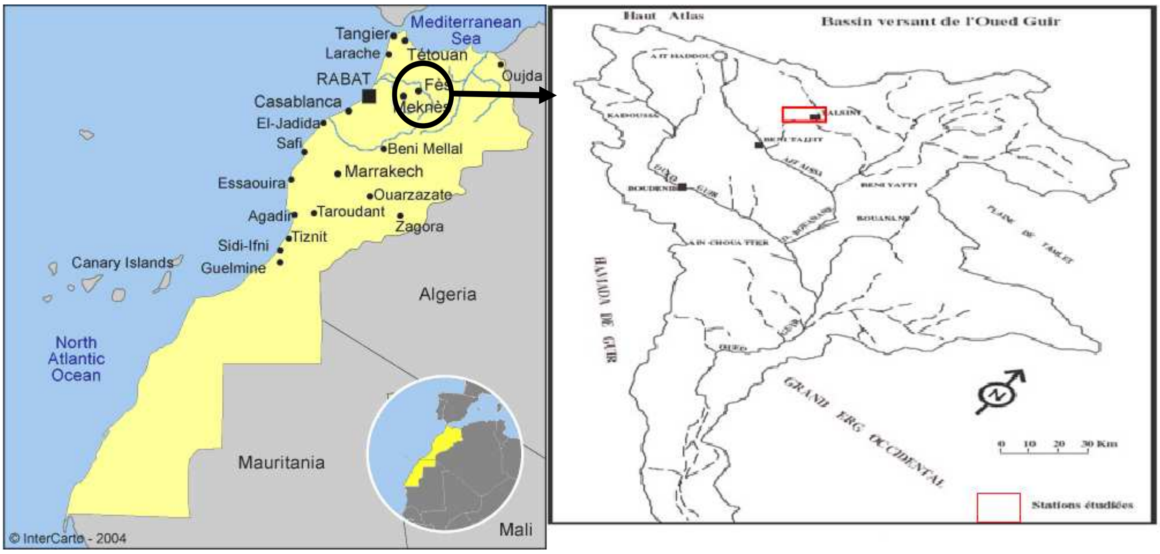

Figure 1: Location of the study area in the watershed of the Guir river

The Tyikomiyne is limited by douar Ezzaouia in the south, the district Affia in the north, Regional Road RP601 to Beni-Tadjit in the west and Jbal Alaajra in the east. In order to determine the average concentrations of metallic elements of water wells in the Tyikomiyne area. Sampling stations consist of five wells were identified on the study area. These stations are marked as shown in the following tables.

Table 1: wells names in the Tyikomiyne area

Wells 1	Wells 2	Wells 3	Wells 4	Wells5
Faryat	El Masjid	Hadi	Hilla	Deppiz

And these stations are shown in Figure 2, which shows the geographic location of wells and sources Tyikomiyne, Talssint region (Eastern Morocco).

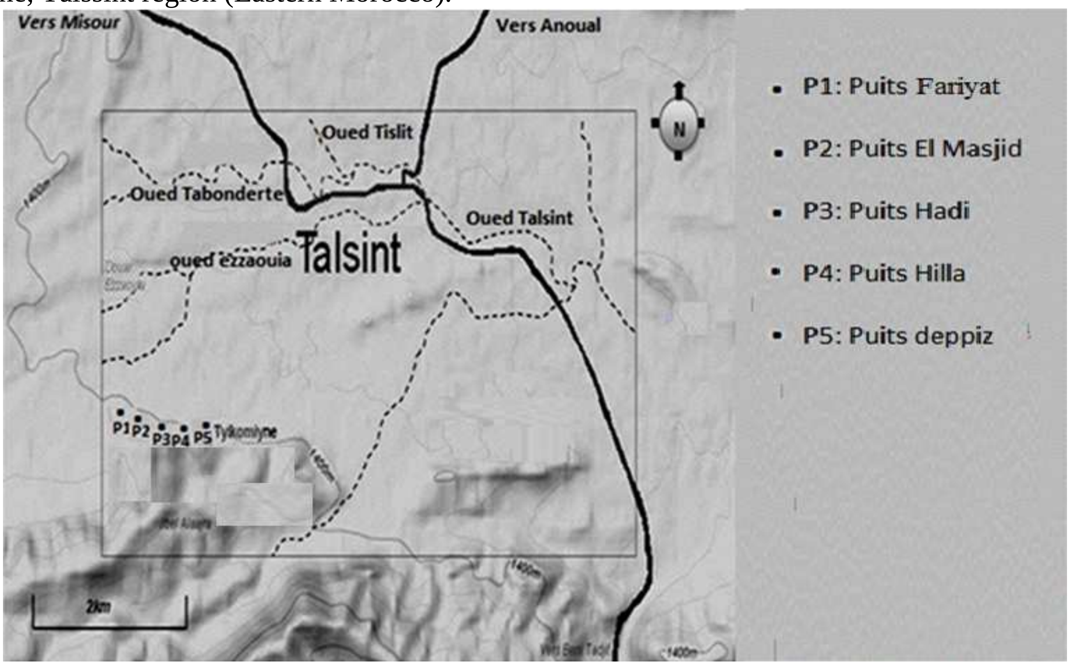

Figure 2: Geographical situation of wells Tyikomiyne, Talssint region

2.2. Technical analysis

The water samples were stored in polyethylene bottles washed thoroughly in previously with a slightly acidified solution, then rinsed several times with distilled water [14]. Water samples used for the determination of heavy metals are treated in the field with HNO_3 ultra-pure.

The concentrations of Al, Zn, Fe and Cu were analyzed using ICP-MS (Inductively Coupled Plasma Mass Spectrometry) in the Laboratory of Centre National of Scientific and Technical Research (CNRST)-Morocco.

3. Results and Discussion

The results of analyzes of heavy metals in water wells studied are shown table 2.

Table 2: Mean concentrations in (µ g/l) of some heavy metals of Tyikomiyne.water wells Tyikomiyne.

	Fe	Zn	Cu	Al
Wells n°1	98	52	<2	56
Wells n°2	109	30	<2	68
Wells n°3	133	99	<2	104
Wells n°4	218	28	<2	173
Wells n°5	182	38	<2	119

Aluminum

Aluminum in drinking water may derived from natural origin sources and the use of salts such as aluminum or polyaluminum chloride as a coagulant in sewage treatment water to remove organic compounds, micro-organisms and particles [15]. European Directive No 98/83/CE on the quality of water intended for human consumption used for the aluminum concentration level guide to 50µg/L and set the admissible maximum concentration (AMC) to 200µg/L. Elevated levels are often the result of poor control of flocculation treatment made with aluminum salts to remove minerals and organic matter [15]. It was found naturally varying amounts of aluminum in groundwater and surface waters, including those used as sources of drinking water.

In our study, the concentrations of aluminum in all samples collected ranged from 56µg/l (Wells 1) and 173µg/l (Wells 4) (Figure 3). These values are well below the standard Moroccan value which is the order of 1 mg/l. However, in all the wells studied, dosage levels are much lower than the value of imperative water suitable for irrigation (5 mg/l). We emphasize thus metallic depollution in element Al for all measurement. Therefore the obtained concentration of Al didn't not disrupt aquatic life of the analysis studied media.

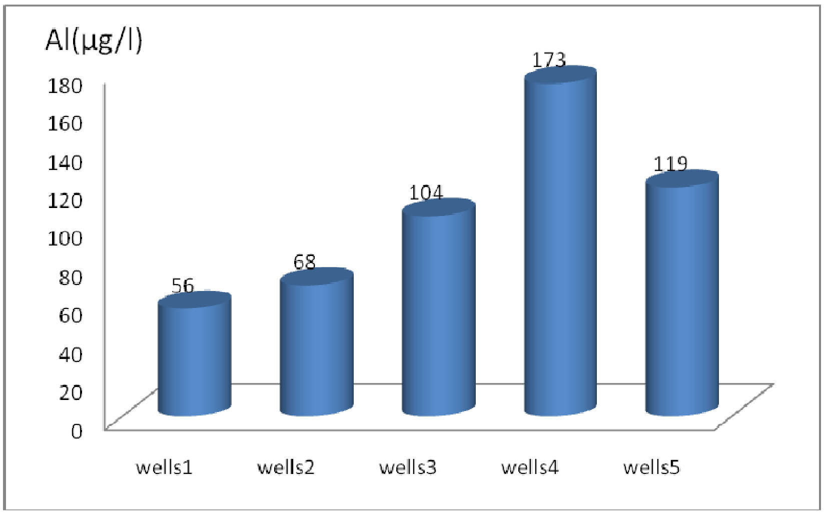

Figure 3: Spatial variation of the average Aluminum of water wells Tyikomiyne

Zinc

Zinc is known to be a favorable element, essential and beneficial for the Man [16]. It is an essential element in human metabolism. A zinc deficiency may have serious consequences on man health [17]. It enters into the composition of numerous enzymes such as carboxypeptidase [18, 19]. It is secreted by the digestive tract and the organism retains very little quantity.

However, gastrointestinal disorders and diarrhea may occur after regular ingestion of beverages in galvanized containers [17]. Zinc salts irritate the gastrointestinal walls. Although the toxicity of this metal is not such that it can act seriously on the health of humans. Its presence in drinking water of this element must be limited. At high concentration, it has a disruptive effect and gives drinking water a taste unpleasant.

In our study area the zinc concentrations in all samples collected were found between 28 µg/l (Wells 4) and 99 µg/l (Wells 3) (Figure 4). Note that these values are lower than those found by Ait Boughrous [20]. However, in all the stations studied, the levels dosed are much lower than at once: the standard of potability Tunisian is about 1 mg/l and the standard of potability Moroccan who is about 3 mg/l. Moreover, these levels are lower than that found for irrigation (2 mg/l) presented by Moroccan standards. However, the metallic element Al is not able to disrupt the aquatic life of studied medium.

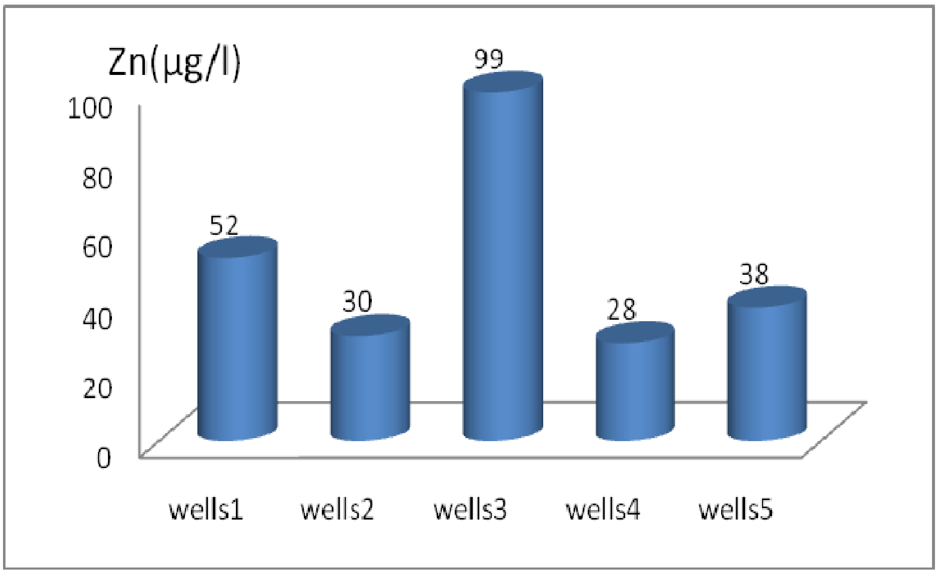

Figure 4: Spatial variation in the average level of Zinc in water wells Tyikomiyne

Iron

Iron is the most abundant metal in the Earth's crust, where it represents about 5%. Therefore, it can be released naturally, mainly among the igneous rocks and sulphide minerals and sedimentary rocks.

In addition, the increased use of iron in many industrial processes can be a major source of pollution of watercourses. These main industries are mining and ore processing, chemical industry, metallurgy, textile, canning and production of titanium oxide [21].

From Figure 5, the mean levels of the metal oscillate from 98 to 218 µg/l, there is a particularly high level of well 4 (218 µg/l). Water concentrations of iron that have been found are below standard Tunisian which is about 1 mg/ l. In addition, these levels are below the European standard for drinking water (200 µg/l), except four wells (Wells 4) (218 µg/l) rich in this element. These levels exceeding the natural fresh waters (<30 µg/l) [22]. However, in all the wells studied, iron levels are below the limit value of water for the production of drinking water (300 µg/l) (standard Moroccan). However, these levels are below the metered value imperative of water suitable for irrigation (5 mg/l) (Moroccan standards). However, we also note that the element Fe is not likely to disrupt the life of aquatic medium studied.

Copper

In natural waters, the copper concentration generally ranges between 1 and 5 µg/l [16]. In the copper industry and its alloys, pickling baths and plating baths are the main source of the presence of copper in industrial wastewater. Drainage water contains frequently high concentrations of copper. Copper refineries are capable of releasing it into the atmosphere this metal which then falls in surface waters. The copper concentration determined (Cu) in all measurement points are less than or equal to the detection limit of 2µg / l.

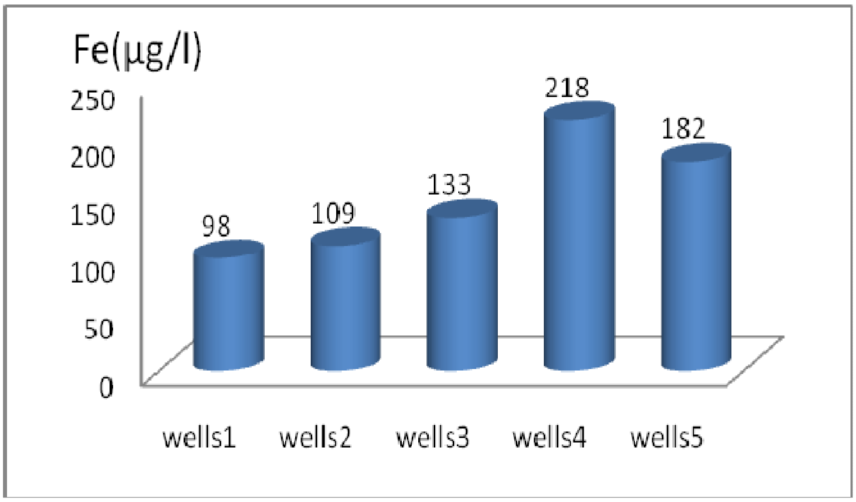

Figure 5: Spatial variation in the average level of Fe in water wells Tyikomiyne

Conclusion

In this study we have followed the concentration of heavy metals like iron, zinc, copper ans Aluminium in natural water of Tykomine centre part of the town of Talasint. In order to determine the impact of water pollution in this site wells in the region Tyikomiyne five wells during low flow periods have been pointed. The obtained results show that the water samples are of good quality. It is interesting to note that the concentrations of metallic elements analyzed in the indicated period are much lower than the standards for power and irrigation. Therefore these elements describe water wells favorable power and irrigation.

Acknowledgements-Thanks are due to the National Centre of Scientific and Technical Research (CNRST)-Morocco for analyzing samples

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