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Distribution of Manganese and Iron in the Two Compartments of Wadi Tislit-Talssint, Descriptive Study and Variance Analysis

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ABSTRACT

In order to assess the distribution of manganese and iron contained in the two compartments of Wadi Tislit-Talssint, sampling campaigns were carried out weekly during May 2011 and an approach is represented by descriptive study and variance analysis. The results of these analyzes have shown the existence of a fairly high content of Mn in the stations so and SC1, the levels measured are markedly higher than the potability standard. Thus, the total average Mn concentrations in all stations in the studied waters are significantly different. On the other hand, the total average Mn concentrations in all the sediment stations studied are not significantly different; the total average Mn concentrations in all the stations of the mixture (water + sediments) studied are highly significant. In addition, no significant difference in metal accumulation was observed between the two compartments, manganese is more abundant at the station SO in water (1434 μg / L) than in the sediment. However, the origin could be natural and that contributes to this contribution in manganese, since the formation of the watershed is rich in Mn (limestone and marl). In addition, iron with a distribution similar to manganese, it abounds in all study stations, but with higher levels by than those found in manganese

Keywords: ANOVA, manganese, iron, distribution, oued Tslit-Talssint.

INTRODUCTION

Some metallic elements, such as iron and manganese present in the state of traces, are essential for organisms, but in low doses[1]. However, increasing concentrations in the environment cause toxicity. These two chemical elements are often encountered together in nature. The presence of iron in water can have various origins: natural by the leaching of clay or industrial soil[2]. But the presence of manganese, at the industrial level, can be linked to metallurgy, the electrical industry and the chemical industry[2]. The presence of manganese at high levels in soils, sediments and metamorphic and sedimentary rocks can be a source of natural pollution. In addition, the manganese accumulated by the plants can be found in solution in runoff water or at ground level after decomposition of the vegetation cover[3]. The use of manganese in the manufacture of fertilizers, feeds, fungicides, pharmaceuticals, dyes, paint desiccants, catalysts and wood preservatives[4,5] , May also contribute to the contamination of surface waters by this metal. Iron mills and steel mills can also release manganese into the atmosphere, which is then redistributed by precipitation[6]. In addition, iron is the most abundant metal in the earth's crust, where it represents about 5%. Because of this, it can be released naturally, mainly from igneous rocks and sulphide minerals as well as sedimentary rocks. In addition, the increased use of iron in several industrial processes can constitute a major source of pollution in rivers. The main industries are mining and processing, chemicals, metallurgy, textiles, canning and titanium oxide production[4]. In addition, wastewater can be loaded with iron due to corrosion phenomena in the pipes or manufacturing equipment, the phenomenon of leaching of soils, rejects industries, etc[7-9]. Thus the evaluation of contamination by heavy metals (Al^{3+}, As^{2+}, Cd^{2+}, Cr^{3+}, Cu^{2+}, Fe^{2+}, Mn^{2+}, Ni^{2+} and Pb^{2+}) in the Beht wady has been studied[10]. On the other hand, the contamination of surface waters and sediments by heavy metals was studied by Taouil *et al*[11-14]. The presence of these metals even at low concentrations in surface waters can have significant ecological and health impacts[15]. Thus the chemical elements Fe and Mn may be at the origin of the degradation of water quality. They are distinguished from other chemical pollutants by their low biodegradability and high bioaccumulation potential along the trophic chain. It is for this reason that we investigated the distribution of manganese and iron in the two compartments (waters and sediments) of Wadi Tislit-Talsint of the watershed of Guir in Morocco.

Study environment

The Talssint region belongs to the eastern high Moroccan Atlas area, forming part of the eastern region, bringing it into contact with the regions of Tafilalt-Meknes and Fes-Boulmane. Thus the Talssint region can be divided into two units: In the west, the mountains of the high eastern atlas, with altitudes above 2000 m, the highest of which are: Falchou mount (2303 m), Skendis mount (2173 m), And Mechkakour mount (2122 m). In the center and east of the country, the highland area covers two thirds of the eastern region with altitudes between 1000 and 1650 m. Talssint belongs administratively to the province of Fig.1, to the south of the region of the oriental. Its surface covers

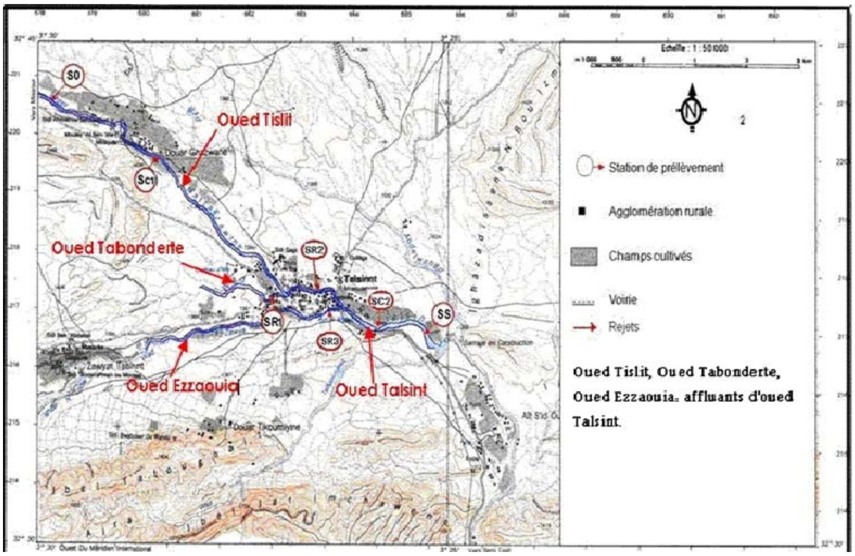

Fig. 1. Location of sampling stations

11,000 km 2, bounded to the north by Missour and Ouatat-L'haj, by Benitadjit to the south, Maatarka to the east, and by Gourrama to the west.

Bioclimatic plan

Bioclimatically, the region is characterized by pre-Saharan and Saharan atmospheres. Temperatures are high in summer and very cold in winter, the average of the coldest month (January) minimum is -5°C and the mean maximum of the hottest month (July) is 47°C. The annual average[16] rainfall was around 245 mm for the period 1983/2007 with significant inter annual variances, and is about 500 mm for the period 2008/2010:the recorded extremes were 61 mm in 1998/99 and 684.5 mm in 2009/2010.

Sampling and analytical methods

Water sampling was carried out during two surveys during a low-water period (May and June of 2011). In order to determine the average concentrations of heavy metals Fe and Mn, and thus their distributions in the two compartments of Tislit-Talssint wadis, samples were chosen on its main flow axis, their choices result from a compromise between The possibility of sampling and the need to account for the spatial organization of the wadi. The water samples are stored in polyethylene bottles washed thoroughly with a slightly acidified solution and rinsed several times with distilled water[17]. Water samples used for the determination of heavy metals are treated in the field with ultra pure HNO_3. Mn, Fe concentrations were determined using ICP-MS (Inductively Coupled Plasma Mass Spectrometry) at the National Science and Technical Research Center (CNRST) –Morocco Laboratory.

Table. 1: Distribution of Mn in the waters of Wadi Tislit-Talssint (µg/L)

		Average	Standard Deviation	Standard Error	Confidence interval for the 95% for the average		Minimum	Maximum	CV%	P
					Lower limit	Upper limit				
Mn	SO	1435,25	1,54	0,63	1433,63	1436,87	1434	1438	0,11%(g)	0,000**
	SC1	574,58	1,01	0,41	573,52	575,65	573	576	0,18%(f)	
	SR1	160,5	1,87	0,76	158,54	162,46	158	163	1,17%(d)	
	SR2	82	0	0	82	82	82	82	0,00%(b)	
	SR3	113,13	1,45	0,59	111,61	114,65	111	115	1,28%(c)	
	SC2	402,75	1,54	0,63	401,13	404,37	401	405	0,38%(e)	
	SS	64,25	1,54	0,63	62,63	65,87	62	66	2,40%(a)	
	Total	404,64	461,53	71,22	260,81	548,46	62	1438	114,06%	

Table. 2: Distribution of Fe in Wadi Waters Tislit-Talssint (µg / l)

Fe	Interval Statistic	Minimum Statistic	Maximum Statistic	Sum Statistic	Average Statistic	Average std Error	Standard Deviation Statistic
S0	3,5	2040,0	2043,5	12250,5	2,041,750	0,5439	13,323
SC1	1330,5	145,0	1475,5	2210,5	368,417	2,214,174	5,423,597
SR1	4,0	415,0	419,0	2502,5	417,083	0,5833	14,289
SR2	4,00	426,00	430,00	2568,46	4,280,767	0,58242	142,663
SR3	4,00	255,00	259,00	1540,25	2,567,083	0,64684	158,443
SC2	4,00	103,00	107,00	630,76	1,051,267	0,59108	144,785
SS	4,00	28,00	32,00	180,34	300,567	0,58012	142,101

Table. 3: Distribution of Mn in wadi Tislit-Talssint sediments

		Average	Standard Deviation	Standard Error	Confidence interval for the 95% for the average Lower limit	Upper limit	Minimum	Maximum	CV%	P
Mn	SO	440,33	1,63	0,67	438,62	442,05	438,00	442,00	0,37%(f)	0,000**
	SC1	380,26	1,55	0,63	378,63	381,89	378,00	382,00	0,41%(d)	
	SR1	230,09	1,43	0,58	228,59	231,60	228,00	232,00	0,62%(a)	
	SR2	421,11	1,44	0,59	419,60	422,62	419,00	423,00	0,34%(e)	
	SR3	338,79	5,46	2,23	333,07	344,52	328,00	342,76	1,61%(c)	
	SC2	320,13	1,45	0,59	318,61	321,65	318,00	322,00	0,45%(b)	
	SS	590,42	1,74	0,71	588,59	592,25	588,00	592,50	0,30%(g)	
	Total	388,73	106,06	16,37	355,68	421,78	228,00	592,50	27,28%	

Table. 4: Distribution of Mn in the mixture (water + sediments)

		Average	Standard deviation	Standard Error	Confidence interval for the 95% for the average Lower limit	Upper limit	Minimum	Maximum	CV %	FISHER	P
Mn	SO	937,79	519,58	149,99	607,67	1267,92	438,00	1438,00	55,40%(b)	13,72	0,000**
	SC1	477,42	101,49	29,30	412,94	541,91	378,00	576,00	21,26%(a)		
	SR1	195,30	36,38	10,50	172,18	218,41	158,00	232,00	18,63%(a)		
	SR2	251,55	177,10	51,12	139,03	364,07	82,00	423,00	70,40%(a)		
	SR3	225,96	117,91	34,04	151,05	300,88	111,00	342,76	52,18%(a)		
	SC2	361,44	43,17	12,46	334,01	388,87	318,00	405,00	11,94%(a)		
	SS	327,33	274,79	79,32	152,74	501,92	62,00	592,50	83,95%(a)		
	Total	396,69	332,93	36,33	324,43	468,94	62,00	1438,00	83,93%		

Table. 5: Distribution of Fe in the mixture (water + sediments)

		Average	Standard deviation	Standard Error	confidence interval for the 95% for the average Lower limit	Upper limit	Minimum	cv %
Fe	SO	1032	1054,65032	30,445,132	3,619,072	17,020,928	20,12	102,19%
	SC1	2,077,525	40,232,674	11,614,173	-478,737	4,633,787	45,1	193,66%
	SR1	2,198,858	2,059,707	5,945,862	890,183	3,507,534	20,87	93,67%
	SR2	2,587,958	17,681,336	5,104,162	146,454	3,711,377	87,41	68,32%
	SR3	1,544,717	10,679,243	3,082,832	86,619	2,223,243	50,15	69,13%
	SC2	620,225	4,504,191	1,300,248	334,042	906,408	17,04	72,62%
	SS	262,725	4,187	120,868	236,122	289,328	20,64	15,94%
	Total	2,801,715	53,100,772	5,793,769	1,649,358	3,954,073	17,04	189,53%

RESULTS

Statistical Study

Station effect on the distribution of Mn

Distribution of Mn and Fe in the waters

The total average concentrations of Mn in the any of the water stations studied are significantly different (F = 740772,60; p = 0.0) with a total average of 404,64 µg/L (Table (1)) and standard deviation of 461,53 with 95% confidence interval for the average is 260,81-548.46 µg/L, in addition, the variance coefficient is of the order 114,06%. As well, the average concentrations of total Fe in all the stations of the waters studied are significantly different with a total average of 404,64 µg/L (Table. 2) and gap-type to the order 461,53 with 95% confidence interval for the average is 260, 81-548.46 µg/L, as well the coefficient of variance is of the order 114,06%. This results show that the average concentrations of total Mn and Fe in all the stations of the waters studied are significantly different.

Distributions of Mn in sediments

According to Table. 3, the analysis of variance shows a very highly significant deference, it is found that the mean total Mn concentrations in all the sediment stations studied are significantly different, with a total mean of 388.73µg / l and standard deviation in the order of 106.06 with 95% confidence interval, mean 355.68-421.78µg / l, thus the coefficient of variance Is of the order of 27.28%. So the Mn evolves in a comparable way during the period of study. As a result, there was a significant difference in metal accumulation in all the studied stations.

Distributions of Mn and Fe in the mixture (water + sediments).

The total average concentrations of Mn at all stations of the mixture (water + sediment) studied are highly significant (F = 13.72, p = 0.0) with a total average of 396.69µg / L (Table (4) and A standard deviation in the order of 332.93 with a 95% confidence interval for the mean 324.43-468.94 µg / L, thus the coefficient of variance is of the order of 83.93%.The total average Fe concentrations at all stations of the mixture (water + sediment) studied are highly significant, with a total average of 280.1715µg / L (Table. 5) and a standard deviation in the order of 531.00 with 95% confidence interval for the mean 164.9358-

Table. 6: Descriptive study and analysis of variance "Effect compartment" on the distribution of Mn

		Average	Standard Deviation	Standard Error	confidence interval for the 95% for the average		Minimum	Maximum	CV %	FISHER	P0
					Lower limit	Upper limit					
Mn	Water	404,6379	461,53	71,21	260,81	548,4621	62,00	1438,00	114,06%	0,05	0,83
	SEDIMENT	388,7329	106,05	16,36	355,68	421,7827	228,00	592,50	27,28%		
	Total	396,6854	332,93	36,32	324,43	468,9362	62,00	1438,00	83,93%		

Table. 7: Descriptive study and analysis of variance "Effect compartment" on the distribution of Fe

		Average	Standard Deviation	Standard Error	Confidence interval for the 95% for the average		Minimum	CV %	P
					Lower limit	Upper limit			
Fe	Water	521,0312	671,84063	103,66726	311,6709	730,3915	28	128,94%	0,65
	Sediment	39,3119	24,27364	3,7455	31,7477	46,8761	17,04	61,75%	
	Total	280,1715	531,00772	57,93769	164,9358	395,4073	17,04	189,53%	

395.4073µg / l, thus the coefficient of variance is of the order of 189.53%. Thus, on the other hand, these metals show that a large significant difference according to the studied stations.

Effect compartment on the distribution of Mn and Fe

From Table (6), which gives information on the distribution of Mn in the two compartments: water and sediment, we see that the probability is of the order P = 0.83, which means that there is no difference between the average value of Mn in sediments and in water, because the probability value P is greater than 0.05, so the difference is not significant. Thus, no significant difference in metal accumulation was observed between the two compartments. From Table 7, which gives information on the distribution of Fe in the two compartments: water and sediment, it is found that average is of the order 280.17 and a standard deviation at the order of 531, 00772 with a 95% confidence interval for the average 164.9358-395.4073µg / l, as well the coefficient of variance is of the order 189,53% and the probability is of the Order P =0.65 which mean that there is no difference between the average value of Mn in the sediment and in the water, because the value of the probability P is greater than 0.05, so the difference is not significant. Therefore no significant difference of the metal accumulation has been raised between the two compartments.

CONCLUSION

The distribution of manganese contained in the two compartments of Wadi Tislit-Talssint has been studied. The results obtained showed that, the total average concentrations of Mn in all stations of the mixture (water-sediment) studied are highly significant. In addition, no significant difference of the metal accumulation has been raised between the two compartments. On the other hand, the existence of a fairly high content of Mn in the stations SO and SC1 the measured contents are clearly superior to the drinking water standard. The waters of several stations have a very lower concentration of manganese than the sediment. Thus, these stations are considered to be favorable to irrigation since their levels do not reach the limit value established by the Moroccan standards. In addition to the iron with a distribution similar to manganese, it is abundant in all the study stations, but at high levels by contribution to those found in manganese.

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