International Journal of Management and Humanities (IJMH)
ISSN: 2394-0913, Volume-3 Issue-10, June 2019

Groundwater of the Tanoubart Water Table in the Region of Rabat-Salé-Kenitra

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Abstract: Environmental concern presupposes a certain fundamental dynamism aimed at protecting ecosystems from all types of pollution and improving environmental management. The objective of our work is to determine the degree of pollution of the water table of Tanoubart of Rabat -Salé -Kénitra region (Morocco). During the period March 2017 / June 2018, two companions of groundwater sampling were carried out at the level of the wells located in rural areas, these samples were analyzed according to the water quality assessment techniques described by Rodier (1978, 2009) and the recommendations of the World Health Organization (WHO). The physicochemical analysis has shown that the wells studied have high concentrations to the standards recommended by WHO (1994) and by Morocco (Moroccan Standard, 1991) and poses a serious problem of direct consumption.

Index Terms: Groundwater, Quality, Wells, Physico-chemistry, Polution

I. INTRODUCTION

The water resource is without doubt the one that most directly conditions the development of the country. It is about this vulnerable resource that drastic choices must be made to deal with immediate and future challenges, including issues of availability, access and quality.However, quantifying the risk of pollution remains a problem that is difficult to grasp. The word risk has always been associated with the word "randomness" (probability) among other parameters and this is how risk is opposed to certainty [1]. For concepts relating to environmental risks, different methods have been proposed as the case study [2,3]. And the risk was considered a cross between two dimensions: the hazard and vulnerability [4]. Groundwater is an important part of Morocco's water resource. They have the advantage of their regularity, their low mobilization costs and their good spatial distribution. It is also a resource less vulnerable to climate hazards and pollution. In certain southern regions, this resource is unique, which gives it exceptional value.

On the national territory, there are 32 deep layers and more than 48 surface layers. The former are difficult to access with a relatively high cost of mobilization and exploitation; but they can be richer and more durable; the latter are more accessible but also more vulnerable to pollution and drought [5].

Revised Manuscript Received on June 09, 2019.

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II. MATERIAL AND METHOD

II.1. Sample Rate

A monthly sampling frequency was conducted at the well during two study companions,2017-2018

II.2. Study Method

The samples collected in polyethylene bottles were transported as quickly as possible to the ONEP Kenitra laboratory to undertake the analyzes, where we studied the following parameters: Wastewater samples for other physico-chemical analyzes

And also the heavy metals were carried out in the laboratory : The Office national drinking water, in Kenitra. These Samples were kept according to the general guide for the preservation and handling of samples according to ISO 5667/3 (1994).

III. RESULTS OF PHYSICOCHEMICAL PARAMETERS WATER WELLS OF THE SLICK TANOUBART

II. 1. Temperature

The results obtained from the temperature analyzes carried out are illustrated in the figure 1 :

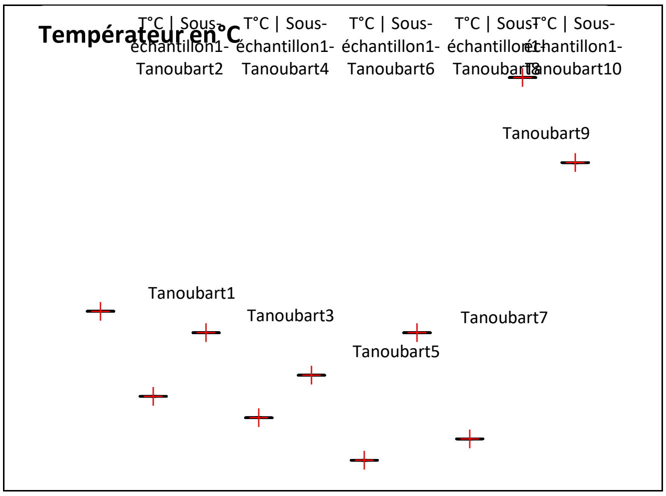

Figure 1: V ariation of the temperature according to the wells of the Tanoubart aquifer

The extreme value is lower than 30°C , The values obtained are of average value of 20,61 mg / l , then by referring to Moroccan norms for drinking water.

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In fact, the groundwater of the Tanoubart aquifer does not require a temperature correction that could be a human overload.

I I. 2. Potential hydrogen

The results obtained from the analyzes carried out are illustrated in the figure 2 . Typically, pH values range from 6 to 8.5 in natural waters [7,8]. It decreases in the presence of high levels of organic matter and increases during periods of low water, when evaporation is important [9].

The values obtained are close to neutrality, while referring to Moroccan standards (pH between 6.5 and 8.5) for drinking water.

In fact, the groundwater of the Tanoubart aquifer does not require a pH correction which could be a human overload.

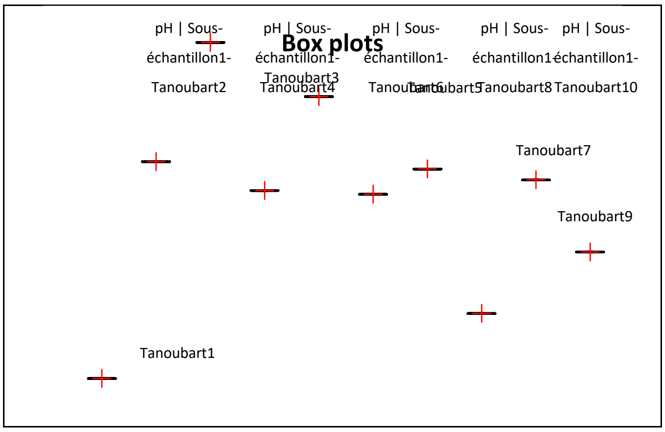

Figure 2 : V ariation of hydrogen potential versus wells the tablecloth Tanoubart

I I. 3 . Conductivity

The results of analyzes are shown in Figure 3:

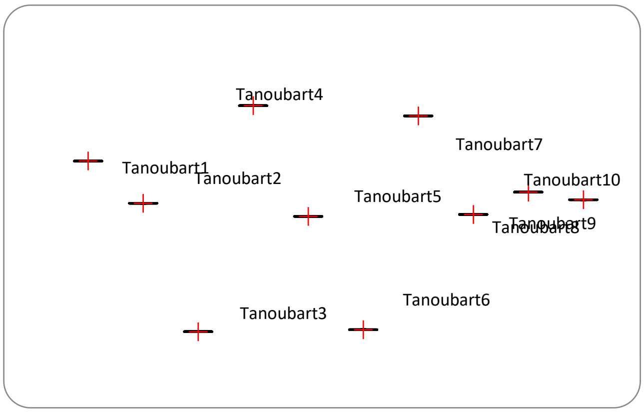

Figure 3 : Variation of the conductivity versus wells of the tablecloth of Tanoubart

Electrical conductivity refers to the ability of the water to conduct a current. During our study the values of the conductivity vary between 407 to 3 380 µs/cm. The maximum allowable value (VMA) is set at 2700 µs /cm according to Moroccan standards of potability.

According to this study, these values are always stable and lower than the maximum admissible value, so the high content of this parameter is explained by the high content of chloride ions (Cl-), and the high mineralization due to the contact of these underground waters with rock formations [10].

It is also noted that the values of the raw water are generally confused with those of the treated water, so it can be said that the treatment by oxidation followed by filtration does not influence the conductivity.

II.4. Calcium (Ca^{2+})

The results obtained from the analyzes carried out are illustrated in the figure 4:

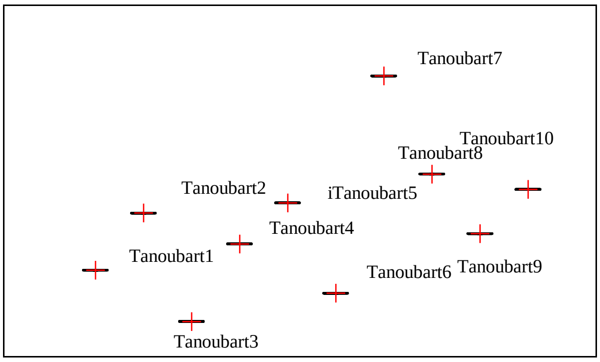

Figure 4 : Calcium variation according to the wells of the Tanoubart aquifer

In our study the calcium hardness values ranged from 52.2 to 204.8 m g / l with an average of 11 e 4.54 m g / l . This high content of Ca 2+ can be explained by the high total hardness (TH).

II.5. Magnesium (Mg 2+)

The results obtained from the analyzes carried out are illustrated in the figure 5 , During our study the magnesian hardness values vary from 16 , 52 at 85, 66 m g/l. This strong in Mg 2+can be justified by the total hardness (TH) that elevated [11,12].

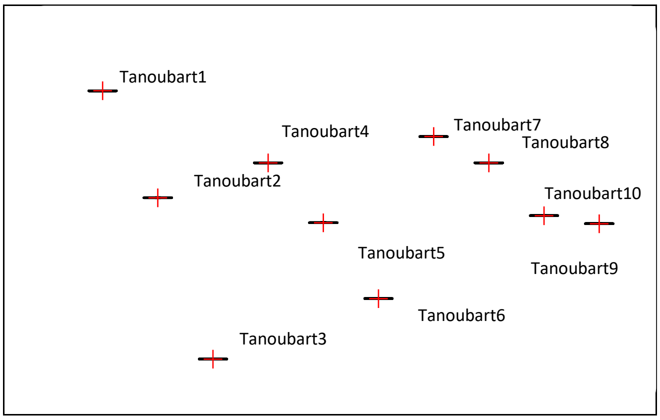

Figure 5: Variation Magnesi um based on web wells of the web Tanoubart

II.6. Hardness : (Ca^{2+}) + (Mg^{2+})

The results obtained during our study are shown in Figure 6. The stationary variation in the hardness of the well water in the Tanoubart aquifer,averages 156,345 ± 83,33 mg/l with a minimum value of 67,97 ± 83,33 mg / l and a maximum value of 350.77 ± 83.33 mg/l with a variance (n-1) equals 6944.45 ± 83.33 mg / l.

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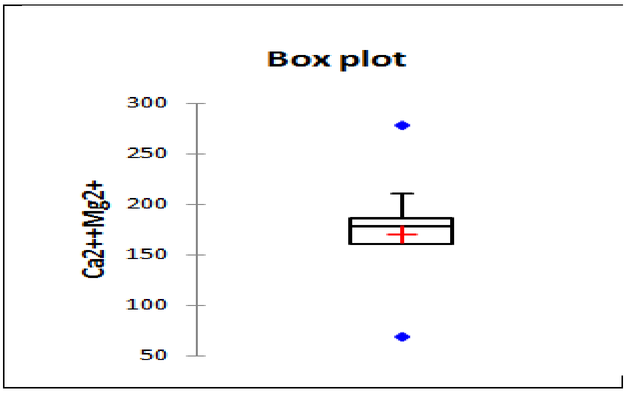

Figure 6 : Variation in hardness according to the wells of the Tanoubart aquifer

II-7-Sodium (Na +)

The mean annual value of sodium shown at the well level is 200 mg/l, the maximum concentration (310 mg/l) is recorded in T anoubart 2 wells (Figure 7).

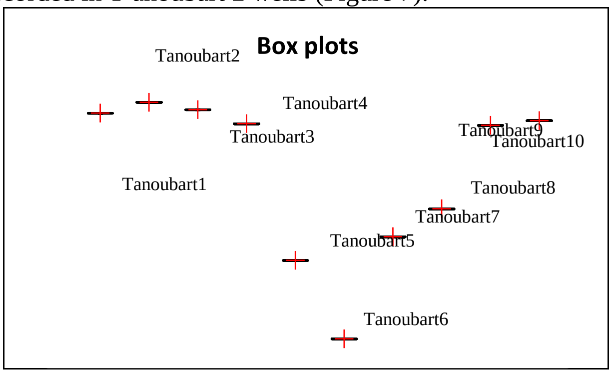

Figure 7: Sodium variation according to the wells of the Tanoubart aquifer

II.8. A mmonium (NH 4+)

Ammonium is the product of the final reduction of nitrogenous organic substances and inorganic matter in water and soil. It also comes from the excretion of living organisms and the reduction and biodegradation of waste, without neglecting domestic, industrial and agricultural inputs. This element exists in a small proportion of less than 0.1 mg/l of ammoniacal nitrogen in natural waters. In the superficial waters, it comes from nitrogenous organic matter, and gaseous exchanges between water and the atmosphere [14, 15, 16]. During our study the values in ammonium remains fixed and equal to 0 mg/l, its normal rate is fixed at 0.5 mg/l according to Moroccan standards of potability, so these values remain always lower than the maximum admissible value, that can be justified by the presence of a sufficient quantity of oxygen which favor the operation of nitrification (transformation of ammonium into nitrites then nitrates).

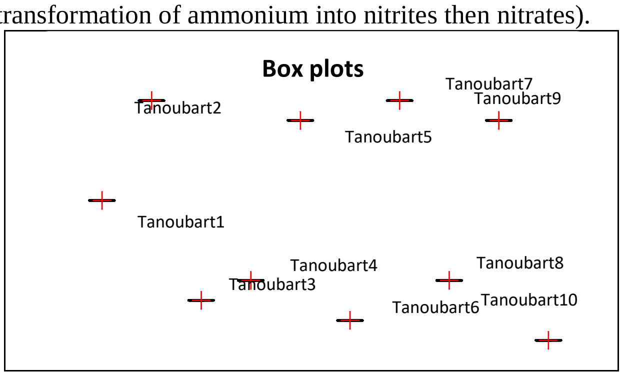

Figure 8 : Ammonium variation according to the wells of the Tanoubart aquifer

II.9. Chloride (Cl-)

The results obtained from the analyzes carried out are illustrated in the figure 9 .

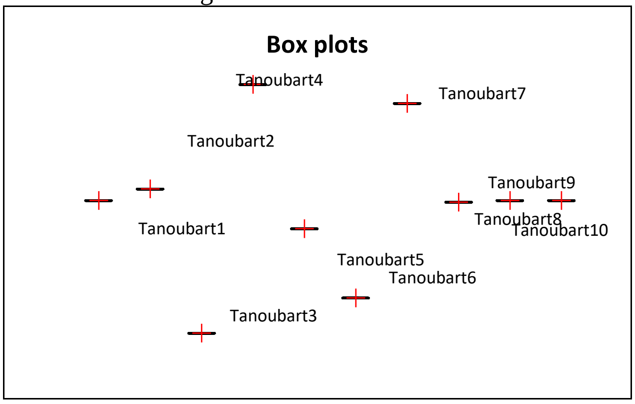

Figure 9: Variation of the chloride concentration of the Tanoubart aquifer

During our study the values of the chloride ion concentration oscillate between 85.2 to 685 mg/ l with an average of 373 mg/l for the water of the Tanoubart aquifer , the normalchloride level is fixed at 396.52 mg/l according to the Moroccan standards of potability, these values remain lower than the maximum admissible value except in the well M6 their annual average chloride content equal to 845mg/l as the well is in close river s e bou or she is the filtration of water to the water Tanoubart [18,19].

II.10. Nitrates (NO 3 -)

The results of analyzes are shown in Figure 10.

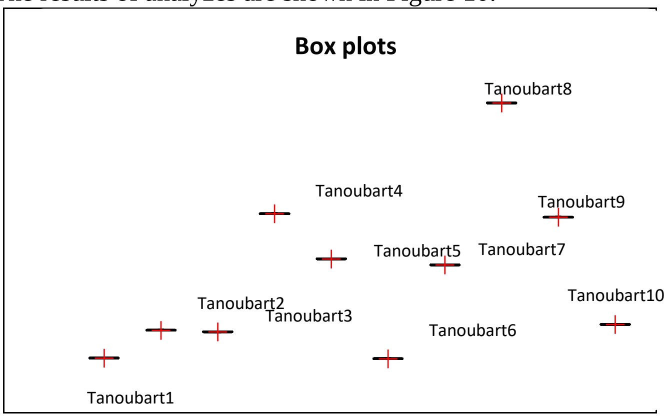

Figure 1 0 : Variation in the concentration of nitrate tablecloth Tanoubart

Nitrates are the most dominant nitrogen form in streams and groundwater. They generally come from the decomposition of organic matter by bacterial oxidation of nitrites and thus constitute the ultimate product of nitrification. In the wild, its concentration rarely exceeds 0.45 mg / l. Higher values indicate wastewater discharges into shallow and subterranean aquatic environments, and especially excessive use of agricultural fertilizers [20,21].

The nitrate content varies during the study of 4, 82 6,8 mg / l for the water of the wells of the tablecloth of Tanoubart , the normal rate is set 50 mg/l depending Moroccan standards of potability of water while the web Tanoubart Respect standards for nitrate levels.

II.11. Sulfate (SO42-)

The results obtained from the analyzes carried out are illustrated in the figure 11, During our study the sulphate concentration values range from 14 to 223 mg/l with an average of 104,58 mg /l. The normal rate is fixed at 400 mg/l according to the Moroccan standards of potability, these s values remain always sands and lower than the maximum admissible value except for the well M9 , so this water at this parameter is recommended to the feeding human poses no risk to the health of consumers [22,23].

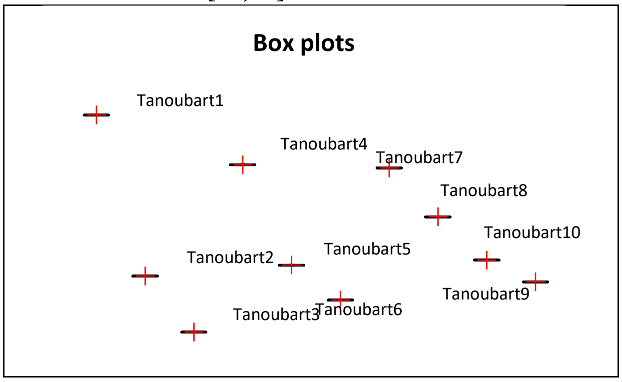

Figure 11: Variation de la concentration du sulfate de la nappe de Tanoubart

II.12.Titre alcalimétrique complet (TAC)

Les résultats obtenus des analyses réalisées sont illustrés dans la figure 12, Le TAC de l'eau varie au cours de l'étude de 6,05 méq/l à 6,8 méq/l pour l'eau de puits. Les valeurs obtenues sont généralement stable, et en se basant sur les valeurs de pH qui sont toujours inférieur à 8,3 (TA=0), alors les valeurs de TAC ne représentent que les concentrations en bicarbonates [24].

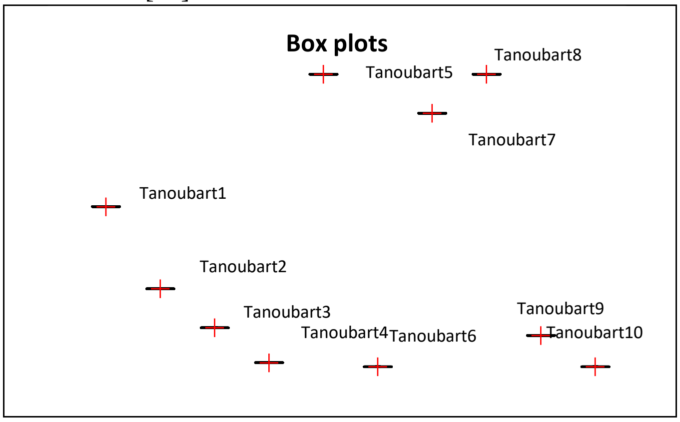

Figure 12 : Variation in TAC based on water withdrawal from wells the tablecloth Tanoubart

III. Statistical Analysis of Physicochemical Parameters in Principal Components (PCA)

III.1. Descriptive statistics

Table 1 : Statistics descriptive of the web Tanoubart

Variable	Minimum	Maximum	Average	Ecart-type
T	20	21,8	20,611	0,611
pH	7,05	7,98	7,541	0,285
C.E	407	2380	1407,111	636,1
O2	0,7	0,76	0,730	0,019
Ca2+	52,8	144	104,511	30,476
Mg2+	16,520	85,66	53,666	20,176
Ca2++Mg2+	69,32	211,07	158,177	44,153
Na+	200	310	279,944	38,961
K+	4,096	21,95	13,038	5,548

HCO3-	4,39	15,02	11,600	3,400
Cl-	85,2	685	369,578	169,569
SO42-	14	223	97,089	66,086
NO2-	0	0	0	0
NO3-	4,820	56,8	21,364	17,533
SiO2	0	6,616	5,658	2,134
NH4+	0	0,12	0,056	0,047
TAC	6,05	6,8	6,306	0,309

The results of the study parameters presented in Table 20. We statically studied the physicochemical data of the wells of the tanoubart aquifer by principal components analysis (PCA). The criterion of Kaiser led us to remember the first two components, since they alone absorb 74, 04% of the total inertia. The axis F1 with an inertia percentage 55,19, the axis F2 with a percentage inertia 18,19 (Table 1).

III .2. Projection of the physicochemical variables on the two axes F1-F2

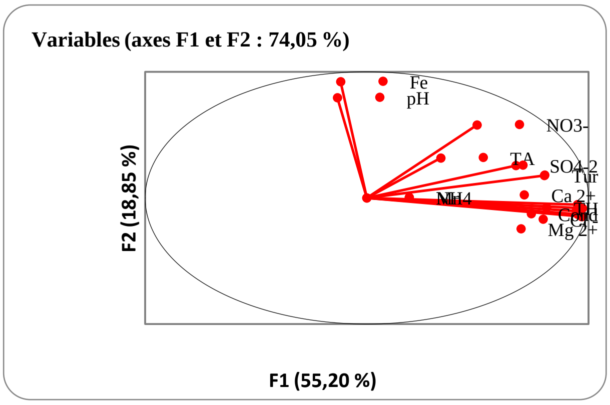

Figure 13: Projection of the physicochemical variables on the two axes F1-F2

According to the component diagram in the space after rotation, the two groups of opposite variables (Figure 13) C that they contribute positively to the axis 1 Ca2 +, Cl-, Mg2 +, Cond rod uc tiv is strongly positively correlated with axis F1.

On the other hand, the potential of hydrogen and iron are strongly positively correlated with F2 axis.

On the other hand, NO $_3$ TA, SO_4^{2-} and turbidity are correlated with the two axis F1 and F2.

Table 2 : Matrix of components after rotation

	pH	Tur	Cond	Fe	Mn	NH4	TA	TH	Mg 2+	Ca 2+	Cl -	SO4-2	NO3-
D1	-0,168	0,792	0,956	-0,159	0	0	0,320	0,976	0,952	0,948	0,976	0,661	0,471
D2	0,788	0,213	-0,087	0,916	0	0	0,331	-0,038	-0,010	-0,061	-0,105	0,287	0,600

the cloud of individuals (wells) that contribute most to defining two axes 1 and 2. According to the factorial map of physico-chemical parameters on 'found two group 1 formed by M9 and M6 and the 2nd group consisting of s remains s wells except the M8 well.

The projection of the wells according to the annual average of the wells makes it possible to classify these wells in three groups , group 1 is composed of wells M1, M7 and M10 ; Group 2 composed of M2, M3, M4, M5 and M8 wells and the third group composed of M6 and M9.

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The hierarchical analysis, using the average of the studied parameters , makes it possible to classify the wells in three aggregations. The third category of wells M6 and M9 are characterized by high levels of mineral pollution.

Conclusion

The use of well water may nevertheless present potential risks to human health and the environment, although studies in this area are still too rare, particularly in Africa.

On the health front, the real problems with the use of well water are the lack of appropriate treatment and the informal setting that often accompanies this practice.

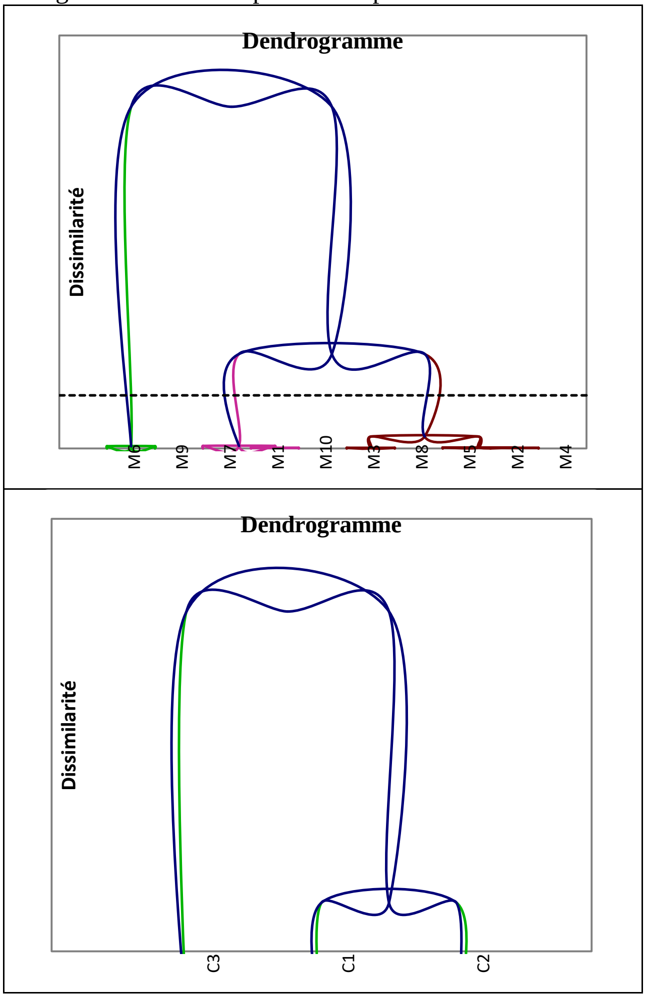

Figure 14: Hierarchical Well Analysis tablecloth of Tanoubart

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