Groundwater Pollution by Trace and Secondary Elements in Alton Kupri Basin. N. Iraq

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Abstract

The secondary group (Nitrate NO3, Boron B and Fluoride F) with group of Trace elements (Cadmium Cd, Lead Pb, Manganese Mn, Iron Fe, Cupper Cu, Zinc Zn, Nickel Ni and Chromium Cr) of Inorganic category are tested in water wells of Alton Kubri Basin to get suitability for human and agricultural consumption. Result shows the concentration of No3 is more than recommended limits at Nabi- awa, kuchuk bibani, qalwazi and Buyuk-hisar groundwater wells. The concentration of Boron in water wells of Nabi-awa and Zardic shows enrichment above the recommended limits in some months of year. The concentration of Nickel is also higher than the recommended limit in water wells of Dobozni, Qalwazi and Buyuk-hisar wells. Study is illustrated enrichment in the concentration as above reputation of water wells at local area only. The source of enrichment for Nitrate NO3, Boron B and Nickel Ni is originated from the agricultural activities and the natural occurrence of these elements in the rocks consists aquifer.

Key words: Groundwater Pollution , Trace Elements , Alton Kupri Basin

تلوث المياه الجوفية بالعناصر النادرة والثانوية في حوض التون كوبري- شمال العراق

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الخلاصة:

درست مصادر تلوث المياه الجوفية في حوض التون كوبري (شمال العراق) وتم التركيز على الملوثات غير العضوية، حيث حللت المجموعة الثانوية (النترات، البورون والفلورايد) ومجموعة من العناصر النادرة (الكادميوم، الرصاص، المنغنيز، الحديد، النحاس، الخارصين، النيكل والكروم) وذلك لغرض بيان مدى صلاحيتها للاستهلاك البشري والزراعي. وجد إن تركيز النترات أعلى من الحد المسموح به لكل من آبار نبي آوه، كوجك بيباني، كلوازي وبيوك حصار، وكذلك زيادة في تركيز البورون عن الحد المسموح به لكل من آبار نبي آوه وزاردك. أما بالنسبة للعناصر الشحيحة فان تركيز عنصر النيكل أعلى من الحد المسموح به لكل من آبار دوبزني، كلوازي وبيوك حصار. أما تراكيز المجموعة الثانوية ومجموعة العناصر النادرة لكل من آبار دورمان، كالور،مفرق شوان وساقزلي فهي اقل من الحد المسموح به لأغراض الشرب والزراعة.

إن سبب زيادة تراكيز بعض عناصر المجموعة الثانوية والنادرة لفترة معينة من الزمن يعود إلى أشهر الزيادة المائية حيث يتم غسل التربة بالمياه السطحية وإزاحة بعض العناصر إلى المياه الجوفية ويحدث ذلك موقعيا لبعض الآبار ذات الاتصال المباشر مع المياه السطحية، مضافا إليها (التواجد الطبيعي) لهذه العناصر في رسوبيات الخزان نفسه.

كلمات مفتاحية: المياه الجوفية ، العناصر النادرة ، حوض التون كوبري

Introduction

The aim of study is estimation the concentration of trace elements (Cd,Pb,Zn,Fe,Cu,Mn,Ni,Cr) and secondary group(NO_3,B,F) in ground water for eleven wells at studied areas (fig.1). Pollution in ground water is depending on the relationships between irrigation water, canyon, hill down surrounding area (fig.2), Moreover fertilizers, insecticides and the waste during agricultural activities in the area (1) as shown at (fig.3).

The elements and the compound in the ground water can be controlled the using of these water for different purposes.

The existence of trace elements and secondary group in ground water is a natural occurrence or a result of human activity (1)

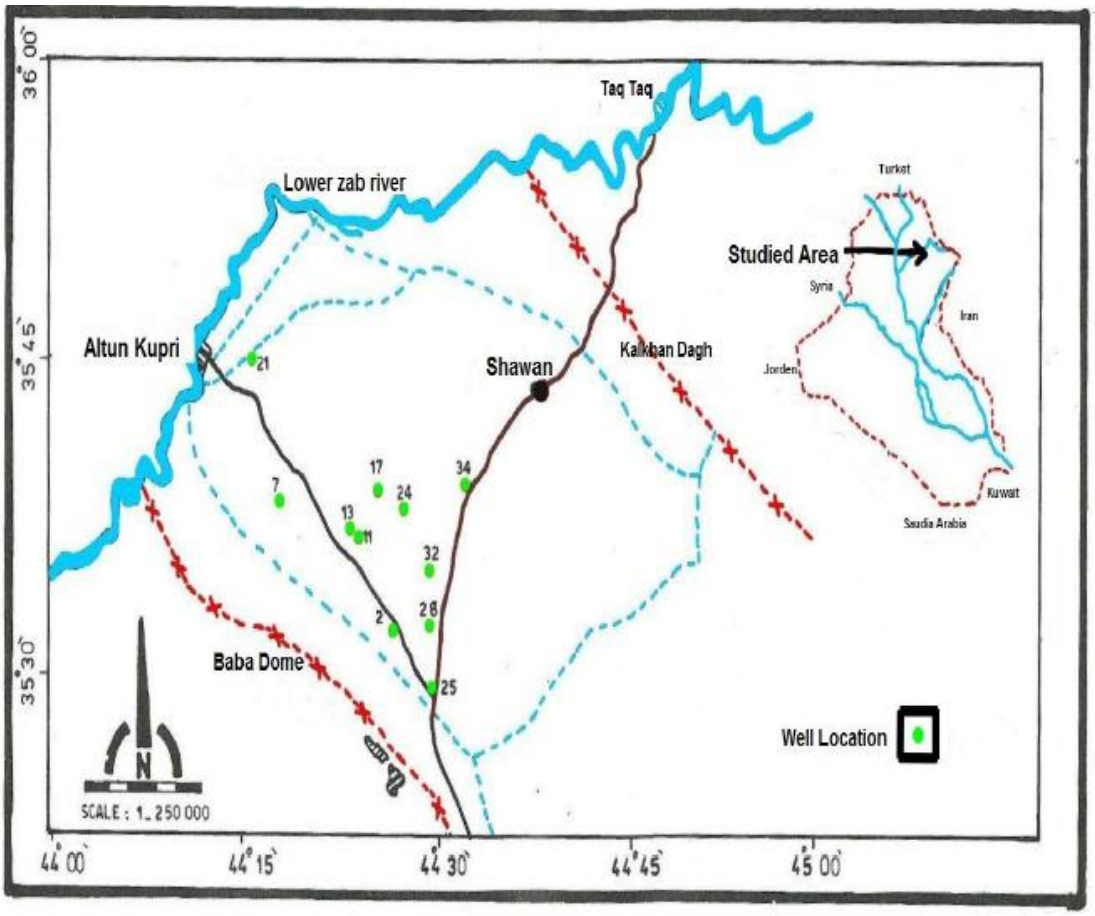

Figure.1- Location of groundwater wells at studied area.

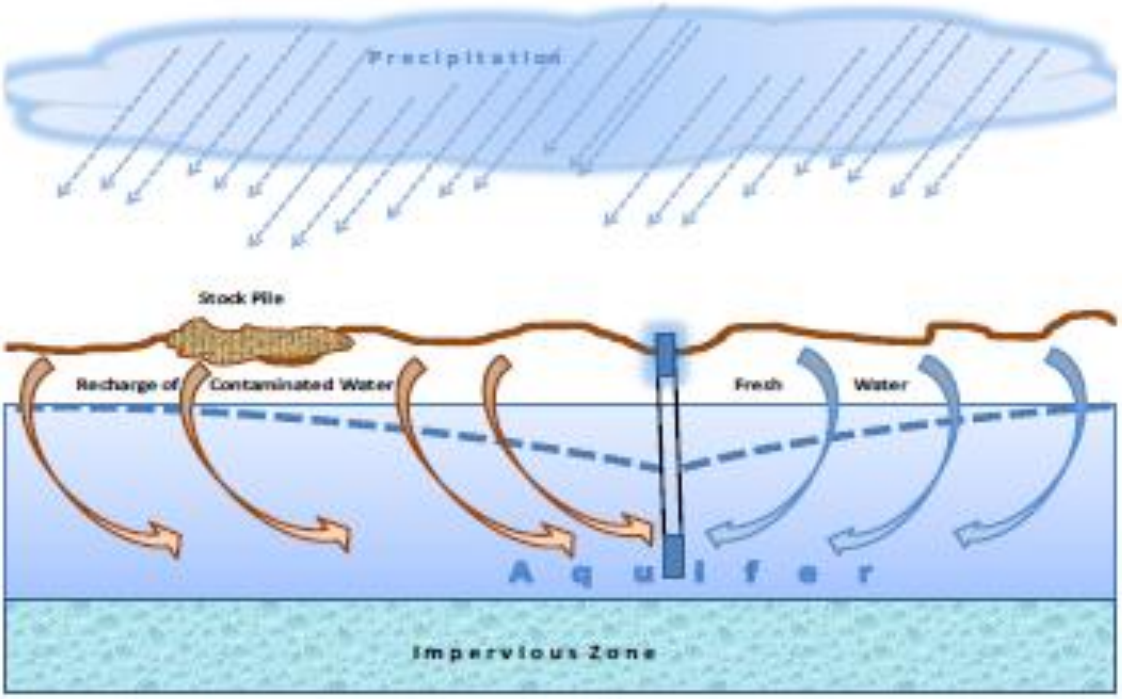

Figure.2-Groundwater Pollution in open Aquifer (4).

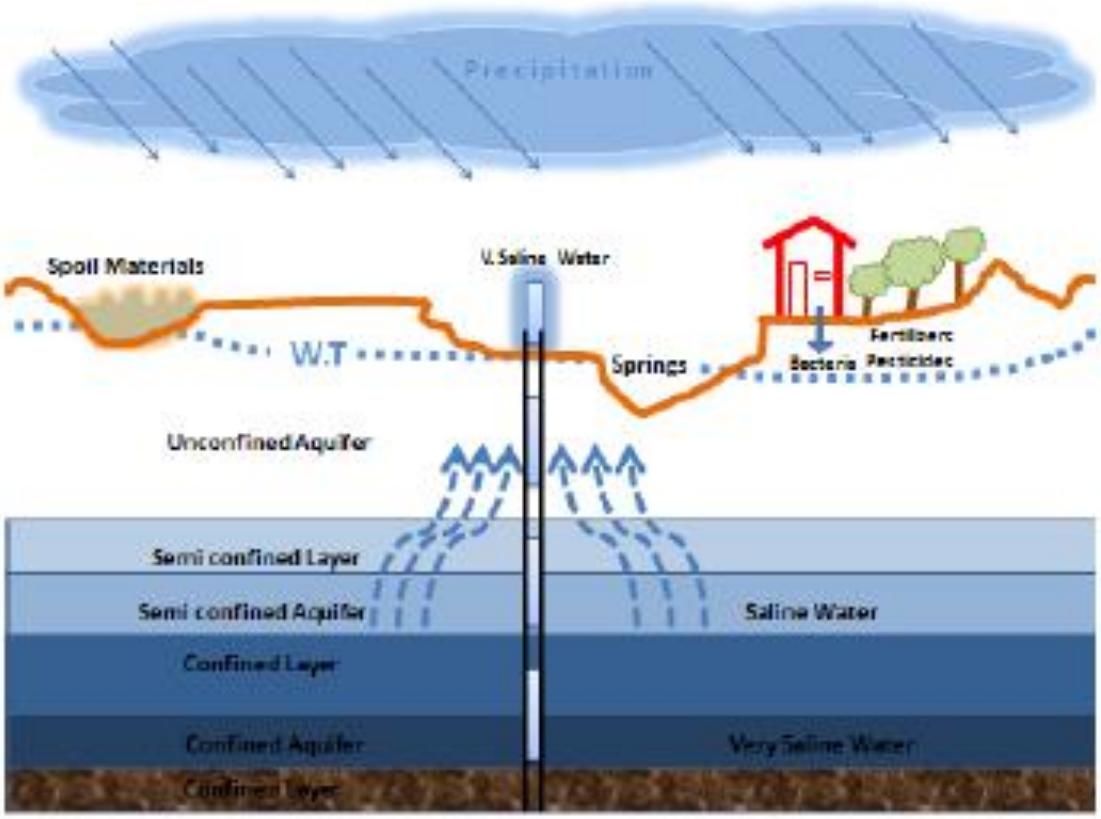

Figure.3–Pollution manner at Groundwater Aquifers (4).

Materials and Methods

The measurement of trace elements (Cd, Pb, Zn, Fe, Cu, Mn, Ni, and Cr) is done by SP Atomic Absorption Spectrophotometer – PYE UNICAM (2).

The measurement of Nitrate, Boron and Fluoride is done by UV Spectrophotometer– 220 – 275 nm and 520nm for Fluoride (2).

Results and Discussion

The results of chemical analysis for ground water at wells contains acceptable concentration for drinking and other purposes is shown at (table. 1), while (table. 2) is shown polluted wells.

Table. 1- Upper and lower limit for ions concentrations at acceptable water wells.

Name of well	NO3	F	B	Cd	pb	Mn	Fe	Cu	Zn	Ni	Cr
Doraman 2	41.9 5.9	0.71 0.11	o.91 0.24	0.006 0.0001	0.0151 0.0046	0.129 0.0005	0.127 0.004	0.0034 0.001	0.05 0.002	0.012 0.0021	0.004 0.001
Qal-war 11	45.0 5.2	1.0 0.12	0.93 0.3	0.0008 0.0001	0.009 0.0012	0.0086 0.001	0.0613 0.0012	0.0068 0.001	0.06 0.014	0.0069 0.0013	0.008 0.001
Mafrig- shwan 25	45.0 5.6	1.1 0.12	0.98 0.2	0.0005 0.0003	0.015 0.006	0.008 0.0032	0.084 0.015	0.006 0.001	0.025 0.001	0.0083 0.0027	0.009 0.003
Saqisiye 28	45.0 4.9	1.22 0.11	0.71 0.19	0.0008 0.0001	0.015 0.011	0.005 0.001	0.074 0.010	0.006 0.001	0.018 0.002	0.008 0.002	0.006 0.003
Standard/WHO 2007 (2)	45.0	1.4	1.0	0.05	0.05	0.05	0.3	1.0	5.0	0.01	0.1

Table. 2- Upper and lower limits for ions concentration at polluted wells.

Name of wells	NO3	F	B	Cd	Pb	Mn	Fe	Cu	Zn	Ni	Cr
Dobizni 34 ***px***	45.0 1.2	1.42 0.012	1.13 0.1 ***1***	0.0009 o.ooo1	0.058 0.002 ***1***	0.014 0.001	0.083 0.004	0.012 0.001	0.074 0.001	0.088 0.004 ***8***	0.005 0.001
Nabi-Awa 7	47.2 5.5 ***3***	0.88 0.11	1.4 0.48 ***3***	0.0007 0.0001	0.01 0.002	0.0096 0.001	0.127 0.003	0.007 0.011	0.0099 0.011	0.0099 0.001	0.009 0.001
Kuchuk Bibani 13	45.9 4.1 ***2***	0.92 0.12	0.95 0.15	0.0001 0.0005	0.005 0.001	0.0009 0.001	0.383 o.14	0.005 0.001	0.088 0.001	0.0078 0.003	0.006 0.001
Zardik 17	45.8 5.3	0.60 0.08	1.26 1.3 ***3***	0.0001 0.0002	0.0091 0.002	0.009 0.0016	0.0705 0.0041	0.0026 0.001	0.077 0.012	0.0085 0.0043	0.006 0.002
Qalwazi 21	45.8 6.2 ***2***	0.76 0.12	1.13 0.28 ***1***	0.0005 0.0001	0.009 0.002	0.008 0.0012	0.162 0.0035	0.009 0.001	0.036 0.008 ***3***	0.038 0.004 ***2***	0.009 0.001
Buyuk Bibani 21	45.0 5.3	1.26 0.12	0.51 0.25	0.0003 0.0002	0.0138 0.002	0.0063 0.0021	0.12 0.02	0.004 0.0015	0,078 0.011	0.069 0.005 ***1***	0.006 0.003
Buyuk Hisar 30	45.3 5 ***2***	1.48 0.12	0.88 0.14	0.0007 0.0001	0.082 0.003	0.010 0.0002	0.063 0.004	0.007 0.001	0.22 0.005	0.096 0.0013 ***6***	0.005 0.0016
Standard WHO/2007(2)	45.0	1.4	1.0	0.05	0.5	o.05	0.3	1.0	5.0	0.01	0.1

Px =Number of Months were Pollution observed.

The concentrations of Nitrate NO_3, Boron B, and Nickel Ni are exceeding the upper limit for drinking water (9).

Nitrate NO3

Nitrogen dissolving in ground water is leading to creation of nitrate NO3,Amoniun NH4, Ammonia NH3, Nitrogen oxide NO, Nitrogen gas N2 and organic nitrogen (3).

These kinds of Nitrate can be created and leached down with presence of wastes and fertilizers (fig 4). Nitrate may be created from ammonium (Nitrification) by way of ammonium oxidation (3). Nitrification is take place above water table by existence of organic materials and oxygen gas (3) (fig 5).

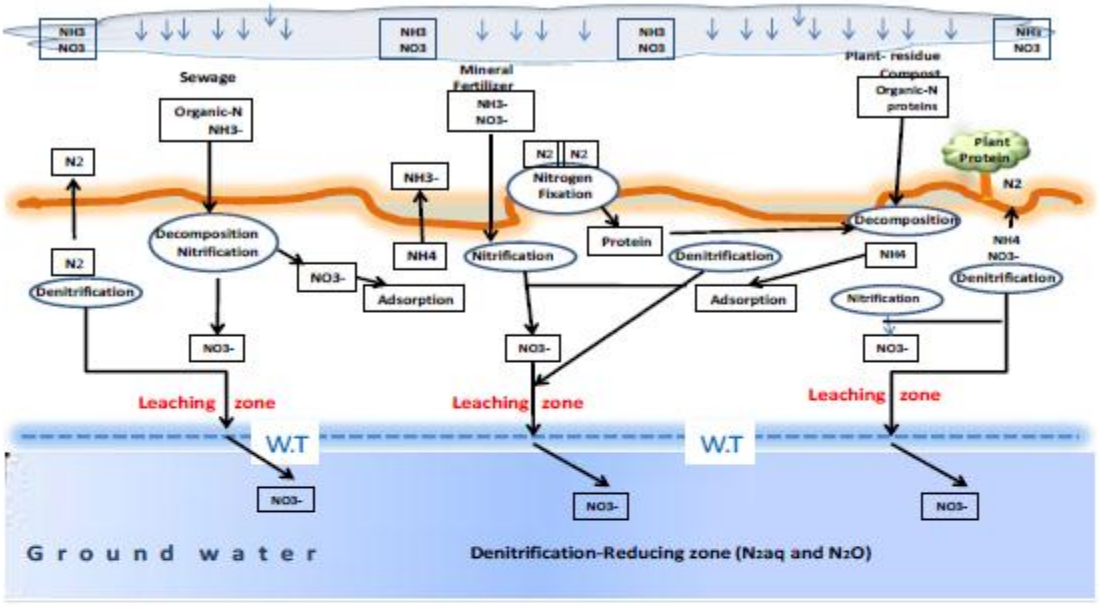

Figure.4- Nitrogen resources at ground water environment (3).

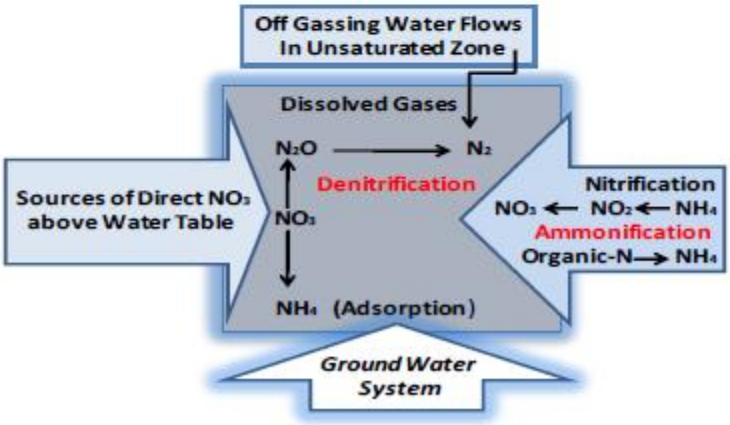

Figure.5 - Nitrogen Transference at Groundwater System(3)

Ammonium can be created in the ground water Biochemically. Most of ammonium is adsorbed by clayey sediments, while some of Nitrogen is responsible for reduction (3) (fig 5).

The field observation shows Nitrate source at studied area is from organic fertilizers (Nitrification). Nitrate is washed and leached from unsaturated soil layer to the ground water by rain fall and irrigate water. The pollution at studied area is only at January, June and august months. These months usually predate by plowing and fertilizing.

The continuity with quick drainage for ground water is control the quantity of Nitrate in ground water of studied area.

Boron

Boron concentration in ground water is depend on the kind of rocks consists aquifer. Boron is present in soil liquids as adsorbed boric acid (H3BO3) or borate (Bo3) on the outside surfaces of soil particles (4).

The relationship is converse between Boron and rain fall plus irrigate water during washing operation for Borate and leached it down to ground water (4). This is meaning, the concentration limit of Boron in the ground water will be increase to more than upper limit for different purposes at Alton kupri area.

The studied area is rainy region (400 mm/year) and it is separating between dry and humid zone. This rainy condition is meaning more washing and leaching for the soil bearing borate into ground water (5).

The concentration of Boron in the water wells of studied area is different from well to another. This difference is depending on whether the water bearing strata (aquifer) is open (unconfined aquifer), semi confined or confined aquifer (6).

Alton kupri area is large basin, so it contains unconfined and semi confined aquifers.

The upper limit for Boron concentration in drinking water is (1 ppm) (4). Two water wells contains Boron more than upper limit.

The first is Zardic well no-17. It contains boron more than upper limit at April, June, July, August and September only at 2002 year (table. 2).

The second is Nabi-Awa well no 7. It contains also more than upper limit at June, July and August only for the same year (table. 2).

The interpretation of pollution in ground water is the washing of Boron to soil bearing borate especially within dry seasons.

Plants are classified depending on Boron resistibility for three kinds (7):

1-Sensetive plants: Like apricots, figs, grapes, pears.

2-Semi resistant plants: Tomato, Wheat, sunflower, potato, olives.

3-Resistant plants: Onions, beans, carrots, red beet.

Zardik well no-17 is somewhat allowable for different purposes because the concentration of Boron (1.26- 1.3 ppm) is near the upper limit only at three months of year, while Nabi-Awa well no-34 is allowable for all using (0.48-1.4 ppm)(8).

Nickel

Nickel is a trace element. It is reaching to the ground water by dissolving sediments bearing Nickel salts (8). The upper limit of Nickel concentration is (o.o1ppm) (8).

The concentration of Nickel in many water wells is more than the upper limits within April, June, July, January, February, March months. So the water of these wells is not allowable for drinking at least at these months.

Recommendations

1-Watching the concentration of different salts every 5 years for evaluation the ground water type.

2-The ground water is not suitable (at some wells) for drinking and other

purposes because the concentration of Nitrate, Boron and Nickel is more than the upper limit, so we suggest a more pumping test at water wells for all basin wells to now the location of pollution sources.

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