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USING ^{18}O, ^{2}H ISOTOPES TO STUDY THE EFFECT OF FISH LAKE ON SURFACE WATER IN AL-AZEZEYIA, KUT GOVERNORATE, IRAQ

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ABSTRACT

The interaction between surface water represented by Tigers River, Fish Lake, drainage and groundwater was examined in this study. Samples were collected from Al-Azezeyia city for stable isotope (^{2}H and ^{18}O). Samplings of water were taken during January – September 2016 during the period of breeding fish. Two samples were taken from a fish lake, three samples from Tigers River and one sample from water drainage. The aim of this research is to assess the interaction of a fish lake on surface water by using isotopic techniques. The values of stable isotopes of ^{18}O range -7.78 – 8.10‰, -7.43 – -8.11‰, -3.2 – 3.3‰ and -6.0 – 6.2‰. The values of Deuterium range -45 – 45.56‰, -46.7 – -45.72‰, -37.87 – 37.98‰ and -28.4 – -29.7‰ in the fish lake, Tigris river, groundwater and water drainage, respectively. The results show there is no effect of interaction between the fish lake and Tigers River due to a short distance between the river and the lakes, lack evaporation effects and high flow rate.

Keywords: Isotope; Deuterium; ^{18}O; Al-Aziziyia city; Fish Lake

INTRODUCTION

Isotope technology plays an important role in the water assessment, management and the protection of water resources. It is an important tool for studying different types of water and behavior of water represented by the following points: **1)** The use of stable isotopes (^{2}H, ^{18}O) as a tracer which identifies the source and quality of water. Such as the concentration measurement of stable isotopes (^{2}H, ^{18}O), the rainwater and keep track of the concentration of these isotopes through the Rainfall. **2)** When the water change from phase to anther the isotopic concentration will change too, this is known as Isotope Fractionation. This fractionation gives us an idea of the geochemical and hydrological

process that took place as an example the different isotopic concentration of (^{2}H, ^{18}O) in rain depending on the latitude and altitude, climate and time annually. **3)** Calculate the age of the water by using the radioactive isotopes decay such as (^{3}H, ^{14}C). Measuring (^{2}H, ^{18}O) in different water sources is one of the possibilities to measure different water sources and this ratio is variable depending on the geographical location and time. The change in the ratio isotope of isotopes of hydrogen and oxygen in the water $^{2}H/^{1}H$ as well as $^{18}O/^{16}O$, which is named δ18O, δ2H which measured relative to the reference model (VSMOW2) Vienna2, Standard Mean Ocean water, gives an idea of the source of the water and the quality (IAEA, 2007).

$$\delta = \left(\frac{R_{Sample}}{R_{Reference}} - 1\right) * 1000 \text{ (per mil, or ‰)}$$

This percentage depends on latitude and elevation change and the relationship between (δ18O, δ2H) universally known as a map of stable isotopes for rain, which concludes them an additional variable is another hyper-deuterium ($d = \delta^{2}H - \delta^{18}O$), which reflects the effect of evaporation of water sources. By taking a large number of rain samples from different regions of the world and measuring the content isotopic stable isotopes (^{2}H, ^{18}O) in a number of international laboratories, in coordination with the International Atomic energy Agency (IAEA) agreed that global rainfall line equation (GMWL) is:

$$\delta^{2}H = 8 * \delta^{18}O + 10(1) \text{ ……..…. } 1$$

This relationship in a comprehensive global environmental isotope study, which called global rainfall Line Global Meteoric Water Line (GMWL). The change in (d) up to 10‰ globally, so that the change in this ratio effect is considered as (tracer) of water. Obviously, the isotopic composition of isotopes suitable for rivers related to this relationship over a small drainage and the change of $\delta^{18}O$ of rainwater is equal to the change in the precipitation which in this case are identical to the Tigris and Euphrates rivers in Iraq. Kattan (2008) and Al-Naseri (2013) studied isotope concentrations ^{2}H in the world rivers. They noted that there is seasonal change in $\delta^{2}H$ for large rivers, due to seasonal changes for rain fail (Mook, 1982).

This change is slight in small rivers and for the speed of the water renewal in these rivers, which led to the use of technology isotopic monitoring (Gat and Carmi, 1970). The study of the isotopic composition of the rain for the Mediterranean area. Kattan

(2008) Published a study to estimate the amount of evaporation and the amount of water drainage in the Euphrates River, as well as an isotopic study of the waters of the Euphrates River in Syria. In 2012 a study was published by Al-Naseri (2013), to determine the local rainfall line to the city of Baghdad by measuring the concentration of stable isotopes ^{18}O, ^{2}H samples of rainwater to different areas of Baghdad City which are:

$$(\delta 2H = 8\ \delta 18O + 15.16)\ \text{(Al-Naseri, 2013)} \ldots\ldots\ldots\ldots\ 2$$

It occurs in tandem with other efforts by Al-Paruany (2013) to identify the equation of a rainfall line to the north, central, and south of Iraq which is:

$$(\delta 2H = 8\ \delta 18O + 11.97)\ \text{(Al-Paruany, 2013)} \ldots\ldots\ldots\ldots\ 3$$

The study area is located in Al-Aziziyah, Wasit City, about eighty km south of Baghdad. It is located on the banks of the Tigris River (Fig. 1) and surrounded by a number of villages with fertile soil, one of them is Alder-alaust north of the city. These villages provide city economic bumper production of agricultural crops such as wheat, cotton and animal production diverse. The selected farm in the village containing fish-lake fields, which is an area covered of hundred acres divided into twelve large fish lakes Separated by a sand barrier with a width of five m. Electric pumps supplied water to fish-lake from the Tigris River through a small canal connects lakes across outlets controlled by gates and disposal of water to control irregular derange back to the river directly by a pump.

The study aims to find solutions to agricultural problems facing Iraq, which is an agricultural sector in the most major role in the national product, is about Iraq strategy focused on insurance necessary laboratories and equipment to carry out the appropriate application and the rehabilitation of the appropriate human resources to reach that goal. The interaction between fish lakes and water resources (groundwater, surface water) in Wasit Governorate southern Iraq is a study target.

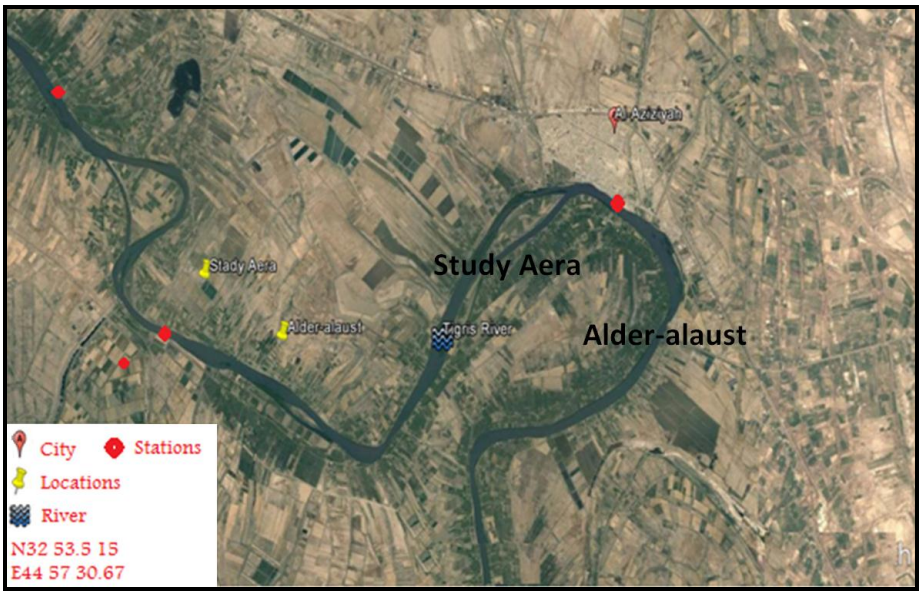

Fig. 1: Satellite image of the study area

MEASUREMENT AND SAMPLING

The samples were collected from the study area, which is located in a private farm, near Tigris River in Aldear-alosat village. The samples have been taken from four locations within the study area (Fig. 1); Tigris River north of the Al-dear Al-Osat village (3 sample), fish Lakes (3 sample), a well close to the fish lake (1 sample), and the Tigris River south of Al-Aziziyah town (3) sample. The period of collection start from April until September 2016 and after sampling chemical measurements (pH, Ec, TDS) were taken in field for the necessity to knowing the method of sample processing and preparation for measuring the concentration of stable isotopes (^{2}H, ^{18}O) in the laboratory of environmental isotopes using Liquid Water isotope Analyzer (LWIA) devise. The samples were taken by using a glass bottle of 50 ml for measurements of stable isotopes (^{18}O, ^{2}H) with a tag providing sampling date. The locations of samplings were located by using GPS device. Besides. The measurement of stable isotope concentration (^{18}O, ^{2}H) by using Liquid-Water Isotope Analyzer device (LWIA) from Los Gatos Research company, Model DLT100 in n the laboratory of environmental isotopes. The Standard solutions are used in the calibration device, three solutions of local Internal Standards set are available in the laboratories of environmental isotopes in the environment and water department, as in the Table (1) relative to the global standard solutions in the Table (2) which it has been calibrated in the 08.01.2015 to the

International Atomic energy Agency (IAEA), which has been certified reference samples used for comparison purposes, which are:

(V SMOW): a water sample was taken from the ocean water sample standard reference for all water on the surface of the ground. (SLAP2 Standard Light Antarctic Precipitation): a water sample was taken from the molten ice from the South Pole area.

(GISP) Greenland Ice Sheet Precipitation**:** a water sample was determined isotopic composition of several international laboratories

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Table 1: The isotopic content of stable isotopes (^{18}O, ^{2}H) local standard solutions

Standard Known Values	$\delta^{2}H$ (‰)	$\delta^{18}O$ (‰)
St 1(Fao southern Iraq, which represents a high concentration of stable isotopes)	-11.43	-2.70
St 2(Sulaymaniyah Northern Iraq which represents low concentration of stable isotopes)	-61.7	-10.87
St 3(Tigris River control)	-37.5	-6.54

Table 2: The isotopic content of stable isotopes (^{18}O, ^{2}H) World Records solutions

Standard Known Values	δ2H (‰)	δ18O (‰)
VSMOW2	0	0
SLAP2	-427.5	-55.5
GISP	-189.8	-24.85

RESULTS AND DISCUSSION

Through the results obtained for a set of the Tigris River samples from Al-Aziziyah city north east of Al-dear al-osat village, as shown in Table (3), the stable isotope values (^{18}O, ^{2}H) ranging from ‰ -45.72 to ‰ -46.78 for Deuterium and -7.43% to 8.1 ‰ - Oxygen-18, while water fish lake samples ranged up to ‰ -45.56 Deuterium ‰ -7.78 and Oxygen18-. Note that isotopes values (^{18}O, ^{2}H) of fish lake are the same

isotopic footprint for water of the Tigris River in Aziziyah area or approaching to it and this is due to the fact that supplying of water to Fish-Lake continuously and fast, and the proximity distance between the lake and the river up to three km so the water of the lakes do not has any influence to the river at the drainage point as shown by the relationship between oxygen-18 and deuterium (Fig. 2).

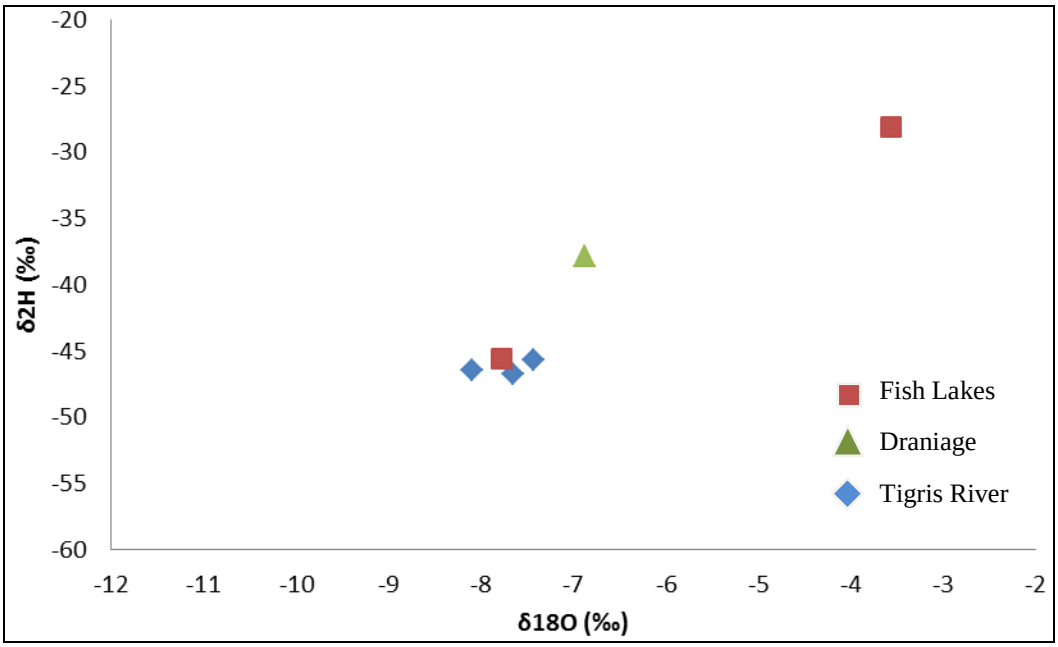

Fig. 2: The relationship between oxygen-18 and deuterium

While it was noticed that the value of environmental isotopes (^{18}O, ^{2}H) of water that for derange was up to ‰ 37.87- for Deuterium and ‰ 6.88- oxygen 18 Table (3), we compared this values with the lake water and river water values note the enrichment of the concentration of environmental isotope values which gives us index to the fact that there is mixing between derange water and groundwater because of the slow discharge of this water towards the river as the pump shutdown and the continuous evaporation due to high temperatures during the summer season led to an enrich the content of environmental isotope, note that through the obtained values of the study area. When surface water enters the fish lake, the general conditions change from a closed to an open system and the values of O and H is recorded to -3.57 and 28.6‰, while the more depletion can be observed on October (closed system), the values of isotopes were recorded as -7.43‰ and -45.56‰ for Oxygen and Deuterium, Respectivily. Due to the Time and the different recharge, there is a variation on the

isotopic values in this study depening on the residence time (45 day), it is clear indicator that the δ18O values between the open lake system and closed system are a bit more depleted. The results of isotopic values in the studied area are listed in Table (3).

Table 3: The results of stable isotope measurements

Sample No.	Sample Name	δ^2H Reportable Value (permil)	δ^2H Standard Deviation (permil)	$\delta^{18}O$ Reportable Value (permil)	$\delta^{18}O$ Standard Deviation (permil)	Sampling Date
1	Fish Lakes	-45.56	0.63	-7.78	0.10	16-1-2016
2	Derange water	-37.87	0.43	-6.88	0.13	
3	Tigris River Al-Aziziyah (1)	-46.78	0.33	-7.66	0.07	
4	Tigris River Al-Aziziyah (2)	-46.43	0.43	-8.10	0.09	21-01-2016
5	Tigris River Al-Aziziyah (3)	-45.72	0.33	-7.43	0.06	11-06-2016
6	Fish Lake	-28.06	0.51	-3.57	0.1	26-09-2016

CONCLUTION

The combination of both hydrochemical and isotopic investigations of surface and lake fish in the Al-Aziziyah city north east of Al-dear al-osat village. The general conclusions from this study are the following:

1. variations in concentrations of isotopes values (^{18}O and ^{2}H) of fish lake are the same isotopic footprint for water of the Tigris River in Aziziyah area or approaching to it and this is due to the fact that supplying of water to Fish-Lake continuously and fast, and the proximity distance between the lake and the river up to three km so the water of the lakes do not has any influence to the river at the drainage point as shown by the relationship between oxygen-18 and deuterium.
2. Time, recharging have played enrich isotopes in basin fish breeding because of the increased time of residence of the isotopes in the water.
3. The enrichment of the concentration of environmental isotope values which gives us index to the fact that there is mixing between derange water and groundwater because of the slow discharge of this water towards the river as the pump shutdown and the continuous evaporation due to high temperatures during the summer season.

This paper makes a recommendation to a continuous monitoring of quality water and to improve, protect and enhance the water quality in the Fish Lake.

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