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Study of Sawa lake fauna, Holocene deposits, Al-Muthanna Province, Southern Iraq

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Abstract - Sawa Lake is an abnormal lake in Iraq. It was characterized by the high degree of salinity among the Iraqi marshes. It is a euhyline water body of no inflow and outflow. The lake is an elongated closed basin with no channel of surface water available to it. The results of the present study are showed three types of fauna, the biggest numbers of fauna belong to Ostracods. The other fauna are represented in type of algae (Charophyta) and one genus of Gastropods. The SEM analysis indicated that the organisms are affected with water lake chemistry, the element S exists in the wall of Charophyta and Ostracoda, while the gastropods does not contain this element. They concluded that these organisms were affected with the salinity except gastropods genus which transport by bird feet from Caspian Sea. There are many fauna that occurred in Sawa Lake, these are reflect of fresh water sources enter to the lake.

Key words: Sawa Lake, SEM, Ostracoda, Charophyta and Gastropods.

Introduction

Sawa Lake considered as the only one of its type in Iraq, it is an important lake for its scientific, ecologic and biodiversity worth. Sawa Lake is located in the southwestern part of the Muthanna Province, about 25 kilometers west of Samawa city, west of the Euphrates river and about 4 km to the west of Al-Atshan river (branch of the Euphrates river). The overall area of Sawa lake is 10 km^2, with length 4.75 km and it's width ranged from 0.5-1.75 km. It surrounded between longitudes (44° 59 29 and 45° 01 46.61) and Latitudes (31° 17 42 and 31° 19 49.8) (Awadh, 2016) (Fig. 1). There isn't any surface water entrance pouring in the Sawa Lake and no outlet as well. The supply of its water may possibly be the ground water merge between the deep and shallow aquifers in the bottom of the Lake; especially the Euphrates, Dammam and Umm Er Radhuma aquifers through system of joints and cracks (Al-Rawi, 1975; Jamil, 1977; Al-Muqdadi, 2003).

Materials and Methods

The field work includes reconnaissance trips to determine the suitable sampling sites. Consequently, 5 sites were chosen for sampling with shallow depths (Fig. 1), (Fig. 2) (Table 1). Surface samples have been taken to study its contents of organisms. For determine the organisms, a simple extraction method were used, the weight of each sample was 50 gm. The samples were washed by using 75µm sieve and tap water then dried in vacuum oven with 60 °C, the organisms content were examined and picked up under binocular microscope.

Three selected organisms were chosen to examine by scanning electronic microscope (SEM), the type of SEM is Gemini-Zeiss (Supra 55VA) at the laboratories of the Pharmacy College-University of Basrah, these are Charophyta,

Gastropods and Ostracods genus, to determine the total elements that formed the shells, according to the availability of the sum of species.

Geological Settings

Sawa name was altered from the English word "Sour" to the Arabic word Sawa by changing the letter R to A (Naqash *et al.,* 1977). Tectonically, Sawa lake lies at the border between Salman zone and Mesopotamian zone, beside of the system faults of Abu Jir, these faults are controlled the hydrology regime in the area (Buday and Jassim, 1987), and according to Numan (1997) the study area lies at the border between the Sagged basin of the Mesopotamian zone of the quasi platform foreland and Salman zone (Fig. 1).

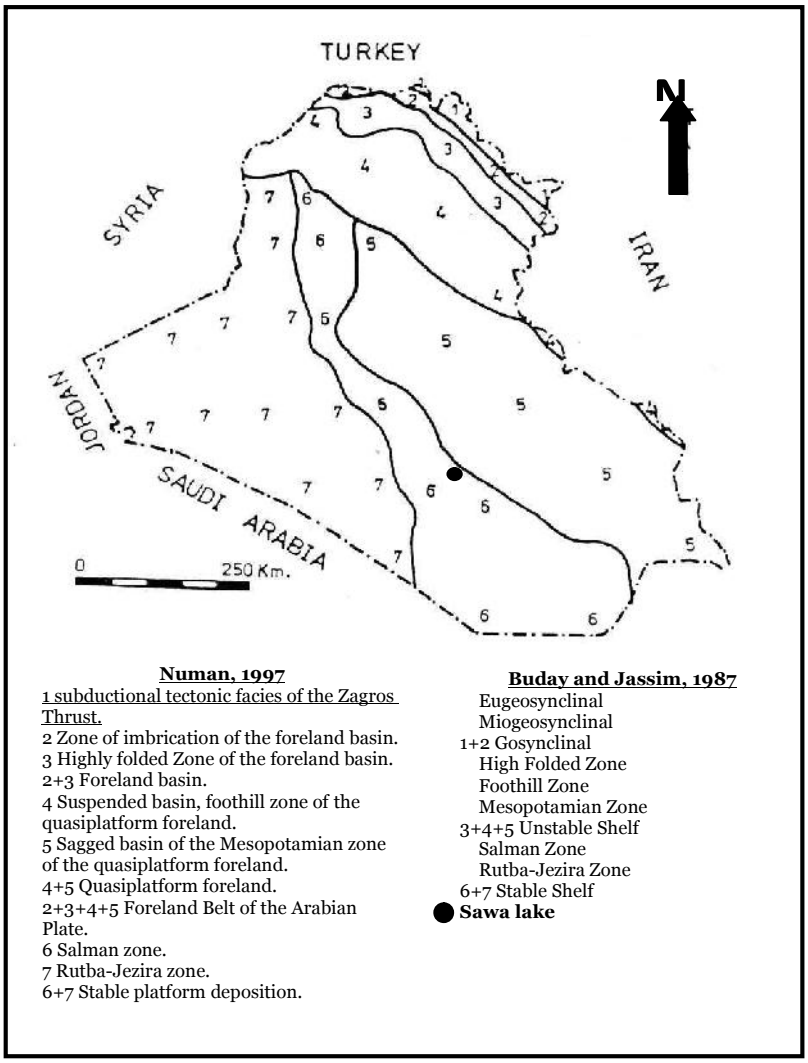

Figure 1. Tectonic map of Iraq modified by Numan (1997) and Buday and Jassim (1987).

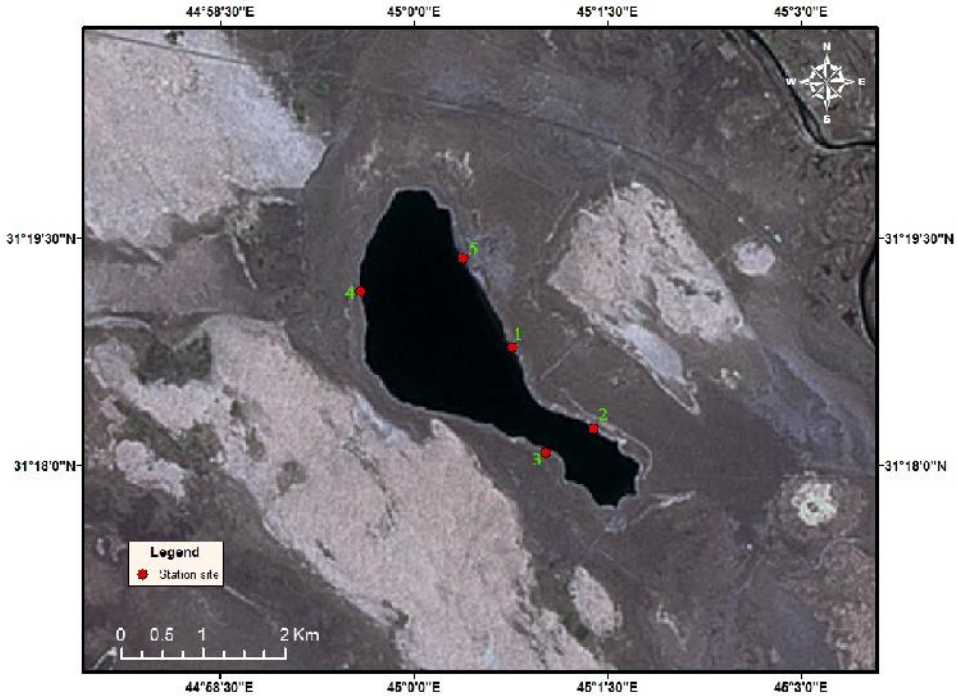

Figure 2. Satellite image of Sawa Lake with the sites of sampling, Al-Muthanna Province, Iraq.

The general direction of faults is NW-SE, as well as there is another type of faults with direction N-S and E-W, the latest one extends to 15 km near Sawa lake (Al-Hashimi, 1973), the pattern of the major strikes of the trends NE-SW, N-S, NW-SE directions (Naqash *et al,* 1977).

Sawa lake is situated at a height of 18-20 m above sea level, it is covered by recent sediments such as alluvial, dune (aeolian deposits) and evaporites, the thickness of the sediments is reached to 10 m (Jamil, 1977). From oldest to youngest three geological formations are located underlain these sediments. Rus Formation (E. Eocene) consists of anhydrite, marl, limestone, and dolomite which deposited in lagoon environment. Dammam Formation (E-L. Eocene) is consisting of karstified limestone, dolomitic limestone, nodules chert with chalky and marly limestone which deposited in shallow neritic environment (Jassim and Goff, 2006). Unconformity boundary between Dammam and Euphrates Formations, the formation with this succession is Euphrates (L. Miocene) consists of three units, from top to bottom, conglomeratic marl and limestone; limestone and marly limestone with marl which deposited in the Carbonate inner shelf (Naqash *et al.,* 1977), (Jassim and Goff, 2006). The suggested age of the Sawa lake is the beginning of the Holocene approximately (10000 years) (Awadh, 2016).

The lake water has been studied by many researchers in hydrology field, it has been concluded that this water is alkaline with pH 8.5, the average of the TDS is 33500 mg/l, and the maximum value of the rainfall in winter season was 5.9 mm in October to 17.0 mm in May (Al-Quraishi, 2013).

Results

Microfauna Assemblages:

The following fauna are represent most of organisms that exist in the Sawa Lake Charophyta, Ostracods and Gastropods. They found in all the five studied sites with varied numbers (Table 1).

Table 1. Distribution of organisms in the studied area.

Station No	Depth	Charophyta	Gastropods	Ostracods
1	0.2 m	Rare	Common	Common
2	0.4 m	Rare	Common	Common
3	0.2 m	None	Common	Common
4	0.2 m	Common	Rare	Rare
5	0.4 m	Rare	Common	Rare

1-Charophyta is derived from two Greek roots that mean joy-khara and plant-phyto, which mean "joy of the water" (Bold and Wyne, 1985). Charophyta (Characeae, Charophyceae) usually famous as stone worts, are earliest monophyletic group with preservedtype in their morphology (Caisov and Gąbka, 2009). The current Charophyta occurs in multiple places for example quiet shallow of fresh or brackish water. It favour the quiet environment. The presence of charophyta at first time in the Devonian age, it was lived in the fresh water environment (Peck, 1957). Sawa's Charophyta is characterized by transparent oogonia sometimes thick calcified or black, two species were classified in studied area these are *Chara canescence* and *Nitella tenuissma,* SEM analysis of their shell contains many elements like Ca, Mg and Na, with weird percent of S element, about 0.13 % (Table 2) (Fig. 3).

The authors take another sample for charophyta from recent water from Al-Faw coast to determine the differences between Sawa's Charophyta and modern one. The result indicated that the Charophyta avoid from the sulphur, as well as the percent of other elements are different (Fig. 4).

Table 2: the chemical composition of Charophyta wall in Sawa lake.

Element	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error (3 Sigma)
Oxygen	K-series	38.96	75.42	87.42	13.89
Calcium	K-series	10.00	19.35	8.96	1.14
Sodium	K-series	0.75	1.45	1.17	0.23
Magnesium	K-series	0.99	1.92	1.47	0.25
Sulfur	K-series	0.32	0.62	0.36	0.13
Chlorine	K-series	0.39	0.75	0.39	0.14
Potassium	K-series	0.25	0.48	0.23	0.13
Total		51.66	100.00	100.00	

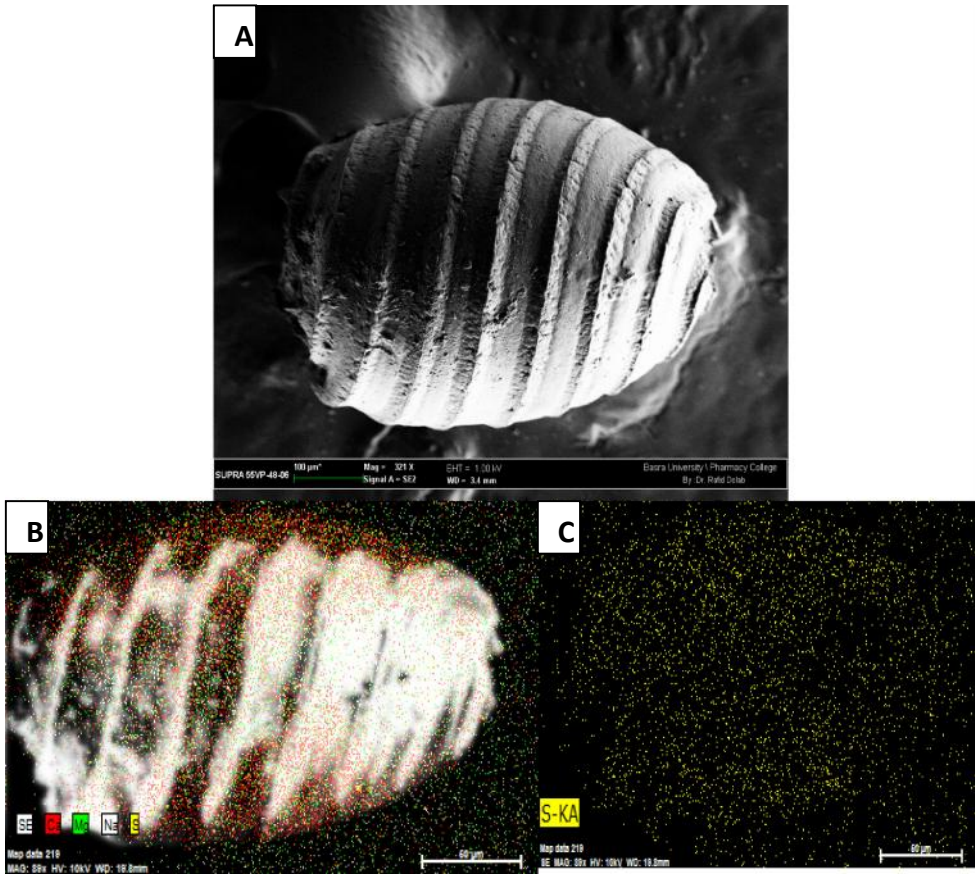

Figure 3. A. SEM photo to the Charophyta of Sawa lake, B. SEM photo with chemical dispersion for elements (Ca, Mg, Na and S), C. Sulphur element dispersion.

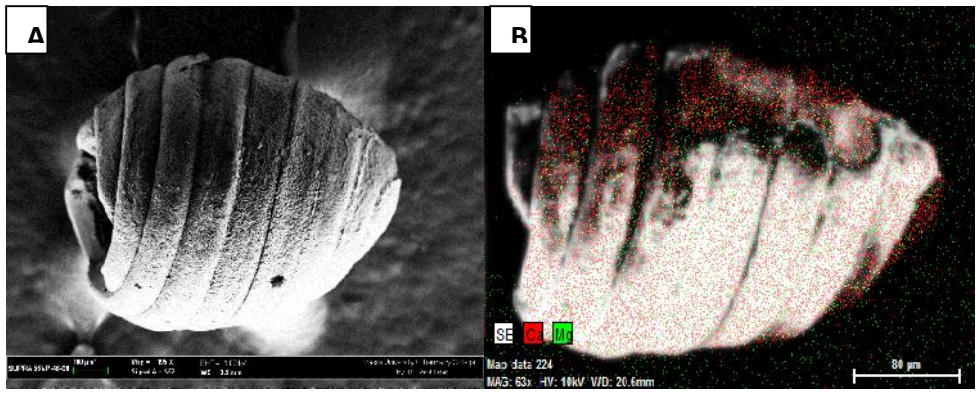

Figure 4. A. SEM photo to the Charophyta of recent Charophyta at Al-Faw coast, B. SEM photo with chemical dispersion for elements (Ca, Mg).

2- Ostracods: Depending on the view of the higher classification of Crustacea, Ostracods are classified as a subclass of the class Maxillopoda (Brusca and Brusca 1990). The Ostracods body was enclosed between two calcified valves that are connected in the dorsal part with simple chitinous, like in Cypridoidea, or complex calcite nonslip locking device (hinge), like in Cytheroidea. As in other crustaceans, the cuticle of the carapace is mineralized with low magnesium calcium carbonate in the form of calcite (Karanovic, 2012).

In the present study, *Cyprideis torosa* is the most common in Sawa Lake, sometimes the wall of this genus look more transparent. The species *Cypridies torosa, Cypridies* sp. *w*ere represented a marine taxa in euhaline zone within range 30-40 ‰ (Al-Jumaily, 1994),but also existence in the freshwater (Nazik *et al*., 2008). The SEM analysis to the Ostracod's carapace shows three elements, these are: Ca, S and Sr (Table 3) (Fig. 5).

Table 3. The chemical composition of ostracods carapace in Sawa lake.

Element	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error (3 Sigma)
Oxygen	K-series	18.55	88.22	94.93	6.97
Calcium	K-series	2.43	11.54	4.96	0.32
Strontium	L-series	0.01	0.05	0.01	0.08
Sulfur	K-series	0.04	0.20	0.10	0.09
Total		21.03	100.00	100.00	

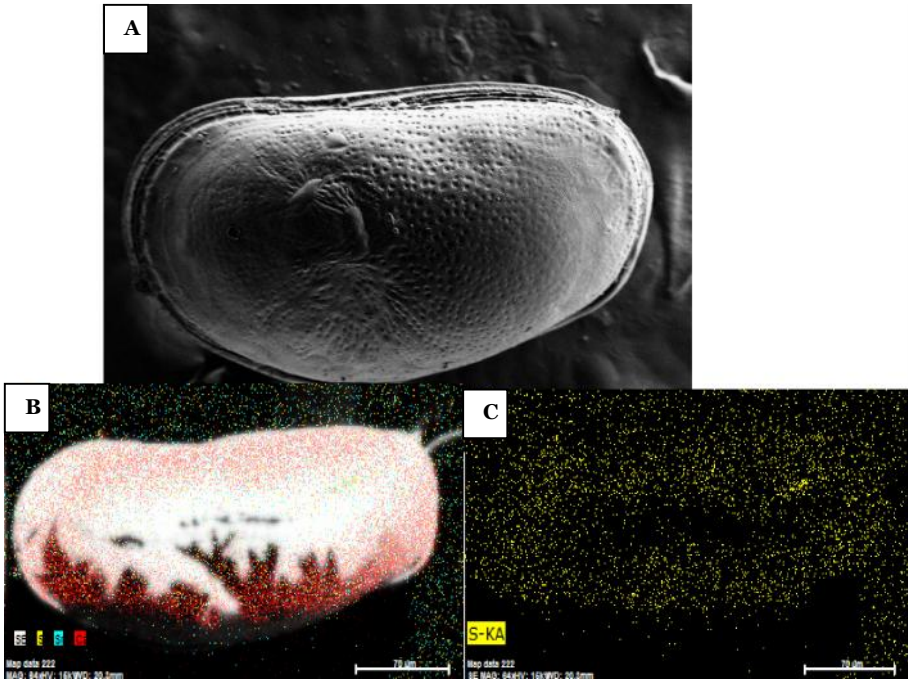

Figure 5. A. SEM photo to the Ostracods of Sawa Lake, B. SEM photo with chemical dispersion for elements (Ca, Sr and S), C. Sulphur element dispersion.

In spite of a little percent to the S and Sr, but if they compared with a recent carapace of Ostracods it free of these elements. It composed of Ca, Mg, Na and K. (Table 4) (Fig. 6).

Table 4. The chemical composition of ostracods carapace in Al-Faw coast.

Element	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error (3 Sigma)
Oxygen	K-series	36.03	77.99	89.10	12.99
Calcium	K-series	8.78	18.99	8.66	1.02
Sodium	K-series	0.62	1.33	1.06	0.21
Magnesium	K-series	0.63	1.36	1.02	0.19
Potassium	K-series	0.15	0.33	0.15	0.11
Total		46.20	100.00	100.00	

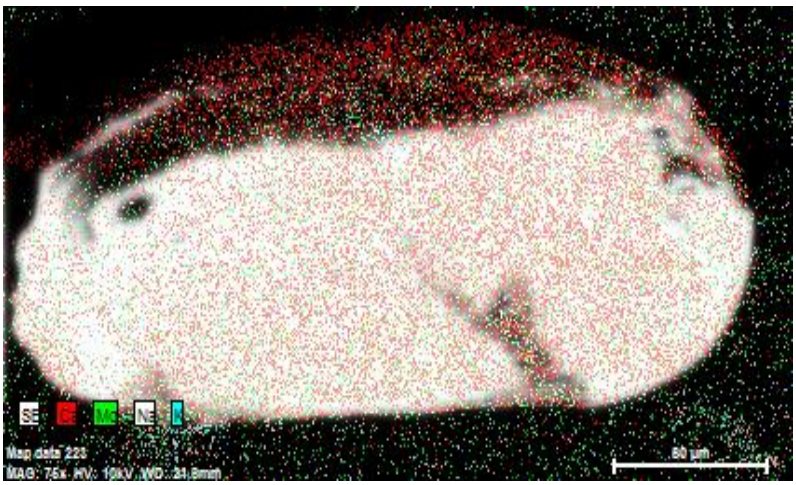

Figure 6. SEM photo to the Ostracod carapace of recent Al-Faw coast with chemical dispersion for elements (Ca, Mg, Na and K).

3. Class: Gastropods

The Gastropoda or Gastropods, more commonly known as snails and slugs, are a large taxonomic class within the phylum Mollusca. There are many thousands of species of sea snails and sea slugs, as well as freshwater snails, freshwater limpets, land snails and land slugs. Sawa lake has one genus of gastropods, that is *Ecrobia grimmi*, sometimes classified especially the Caspian Plover *Chara driusasiaticus* during autumn migrations (Del Hoyo *et al.,* 1996; Berthold, 2001; Haase *et al.,* 2010). Animals may get caught in the plumage, stick to the feet, or survive passage through the gut of these birds (Green *et al.,* 2002).

The chemical elements of gastropods shell are Ca, Mg and Na (Table 5) (Figs. 7 and 8), no evidence to the S, for some of Al and Si because of the soil remains on the surface shell.

Table 5: the chemical composition of gastropods shell in Sawa Lake

Element	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error (3 Sigma)
Oxygen	K-series	24.06	84.51	91.88	8.81
Calcium	K-series	2.80	9.83	4.27	0.42
Sodium	K-series	0.45	1.57	1.19	0.18
Magnesium	K-series	0.33	1.17	0.83	0.14
Aluminium	K-series	0.24	0.84	0.54	0.12
Silicon	K-series	0.59	2.08	1.29	0.17
Total		28.47	100.00	100.00	

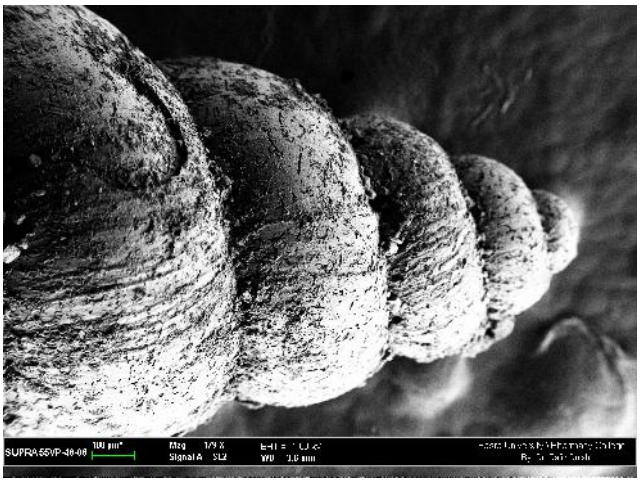

Figure 7. SEM photo to the gastropods shell (*Ecrobia grimmi*) at the Sawa lake.

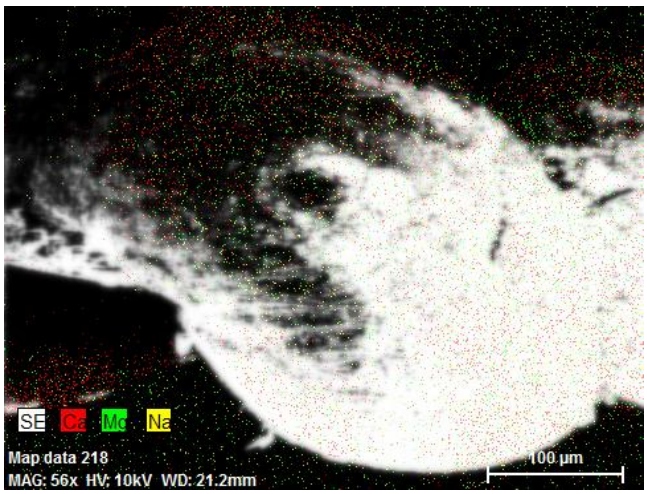

Figure 8. SEM photo to the gastropods of Sawa lake with chemical dispersion for the elements (Ca, Mg and Na).

Discussion

Sawa lake organisms are consider as a confused mystery, because of own two type of organisms, one is living in the freshwater and the other in the saline water, the TDS for Sawa lake is 33500 mg/l, therefore the existence of freshwater organisms could be impossible, the Charophyta and *Ecrobia grimmi* (Gastropods) are common in the freshwater, and there are many studies for others organisms indicate that the evidence to the freshwater source, such as Al-Hadndal (1994) he discover 60 species of diatoms belong to freshwater, Most of the freshwater taxa that reported are not known to occur in brackish habitats like that of Sawa lake (salinity up 13 ‰) particularly in European waters.

Hassan *et al.* (2006) determine 51 algal taxa dominated by diatoms (33 species), followed by blue green algae (12 taxa), greens (4 species), and 2 species of Euglenoid, these assemblages are Similar results were found in different lakes in Iraq, such as Al-Razazzah Lake, Al-Hammar Marsh, and Al-Qadisia lake, these lakes have freshwater source from rivers, and Sawa water shows hydrochemical characteristics similar to Al-Atshan river rather than the well nearby or sea water. Another suggestion is thought the freshwater organisms are transport from older formation like Euphrates and Dammam Formations, but these formation do not have these fossils they no contain from Charophyta and *Ecrobia grimmi* (Gastropods), The SEM analysis of the studied shells indicated to exist of sulfur element, and the Sulphate was the highest concentration in the Sawa lake followed by Cl^-, Na^+, Ca^+, Mg^+, and then K^+.

They conclude these organisms that lived in Sawa lake and affected with their salinity except gastropods genus which transport from Caspian Sea, and there is a subsurface source to the freshwater entrance to the Sawa lake, this source is diluted the water salinity of this lake.

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دراسة للمجاميع الحياتية في بحيرة ساوة للرواسب الحديثة (الهولوسين)، محافظة المثنى، جنوبي العراق

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المستخلص - تعد بحيرة ساوة من البحيرات الغريبة في العراق، إذ أنها تتميز بدرجات من الملوحة العالية تفوق ملوحة جميع الأهوار العراقية، وتصنف على أنها جسم مالح جداً حيث لا يوجد فيها لا مدخل ولا مخرج للمياه المغذية، وهي بحيرة طولانية مغلقة لا يصب فيها اي نهر. أظهرت الدراسة وجود ثلاث مجاميع مميزة تمثل النسبة الأعظم داخل البحيرة، وتلك الأحياء هي جنس واحد من الرخويات (بطينات القدم) والاستراكودا والكاروفايتا (الطحالب الذهبية)، تمثل الاوستراكودا النسبة الأكثر من بقية المجاميع. دلت تحاليل المجهر الألكتروني الفاحص لتلك الأحياء تأثر الاوستراكودا والكاروفايت بملوحة البحيرة وذلك لاحتواء جدرانها على

عنصر الكبريت وخلو جنس الرخويات من تلك النسبة، مما يدل على أن تلك الأحياء عاشت في البحيرة وتأثرت بتلك النسبة ما عدا الرخويات التي أنتقلت إلى البحيرة نتيجة تعلقها بأرجل الطيور قادمة من بحر قزوين، علما أن تلك الأحياء لها دلالية على وجود مصدر من المياه العذبة يدخل إلى بحيرة ساوة.