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Geochemistry of Surface Costal Water In Al-Sabri Area, Benghazi City, Libya

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ABSTRACT

In this study we conducted a geochemistry assessment of surface costal water in Al Sabri area, Benghazi city. The chemical analysis data showed the plot of Mg/Ca vs. Na/Ca ratios is closed to carbonate rocks of the area. The water samples are found to be oversaturated with carbonate and evaporate minerals. The heavy metals values in the studied costal water are above than typical composition of seawater due to anthropogenic pollution, therefore the heavy metals are classified as seriously affected.

جيوكيمياء المياه الساحلية السطحية في منطقة الصبري ، مدينة بنغازي ، ليبيا

أسامة ر. شلتامي، فارس ف. فارس، فرج محمد العشبي، هويدي عريشي

في هذه الدراسة أجرينا تقييماً جيوكيميائياً لمياه السواحل السطحية في منطقة الصابري بمدينة بنغازي. أظهرت بيانات التحليل الكيميائي أن علاقة النسب Mg / Ca مقابل النسب Na / Ca متأثرة بتجوية الصخور الكربونية في المنطقة. حيت ان عينات مياه الدراسة تكون مشبعة بمعادن الكربونات ومعادن المتبخرات. ان قيم العناصر الثقيلة في عينات الدراسة في منطقة الصابري أعلى من التركيب النموذجي لمياه البحر بسبب التلوث البشري، لذلك تصنف المعادن الثقيلة على أنها شديدة التأثر. أخيرًا نوصي بأن مياه بحر الصابري غير مناسب للسباحة.

INTRODUCTION

Coastal waters pollution is generally accompanying with the discharge of effluents from sewers or wastewater treatment plants, drains and workshops to the water body of rivers, seas and harbours. The addition of metals in a marine environment has direct consequences to human being and to the ecology (Millier, 1969 and Wafi, 2015). Metals have many sources from which they can flow into the water body, (Rashad, 2004 and Shahid A. and Saba I.2018) these sources including the following:1) Natural sources 2) Industrial sources 3) Domestic wastewater 4) Agricultural sources 5) Mining runoff and solid waste disposal areas 6) Atmospheric pollution. The objectives of this current work to characterize the geochemistry of the surface coastal water in Al Sabri area and to determine the pollution level of the surface costal water.

(Fig. 1) shows the location map of the surface costal water in Al Sabri area of Benghazi city between longitude 20° 07′ 00″ and latitude 32° 13′ 46″, which characterized by sandy beach and rocky beach. Hasan and Abdel-Halim (2009) and Piersanti S *et al*., (2016) studied the geochemistry of coastal waters in neighbour areas. They reported polluted by human activities. As far as the authors aware, the published chemical data on the surface costal water in Al Sabri area are insufficient.

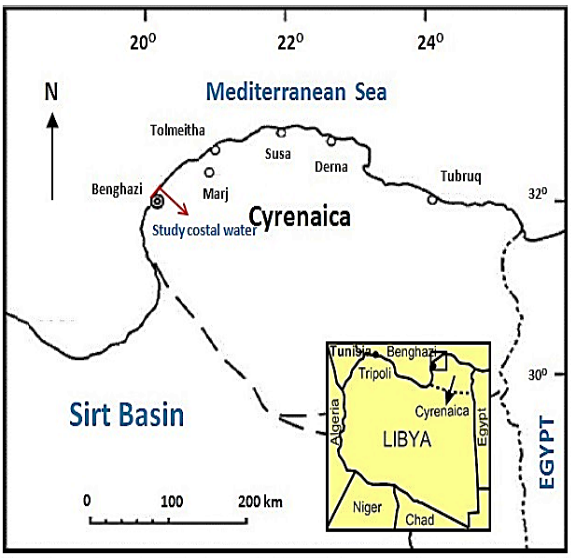


Figure 1. Location map of the costal water in Al Sabri area.

MATERIALS AND METHODS

In this study, we selected two surface water samples during August (2019). The samples were taken from a depth of 50 cm below the surface using polythene bottles (500 ml). The following are the techniques used in the current work:

The Electrical Conductivity (EC) and Total Dissolved Solids (TDS) were determined by means of Denver Instrument, Model 50. Titrimetric methods were used for the determination of HCO_3 and Cl, whereas SO_4 was determined gravimetrically.

Major ions and heavy metals were determined by inductively coupled plasma-optical emission spectrometry (ICP-OES), and inductively coupled plasma-mass spectrometry (ICP-MS).

RESULTS AND DISCUSSION

Table (1) presents the values of different parameters for the analyzed costal water samples.

Table 1. Chemical analysis data (major ions and heavy metals in ppm) of the studied coastal water samples

Parameters	Sample No. 1	Sample No. 2	Average
pH	8.18	8.2	8.19
EC	2209	2220	2214.5
K	50	47.46	48.73
Ca	270.78	273	271.89
Na	450	429.23	439.615
Mg	106	109.4	107.7
Cl	981.8	987.07	984.435
Fe	1.89	2.13	2.01
HCO_3	125.21	120	122.605
SO_4	307.7	310.35	309.025
TDS	25020	25111	25065.5
Pb	0.45	0.49	0.47
Hg	0.006	0.006	0.006
As	0.65	0.6	0.625
Cd	0.008	0.008	0.008
Cu	4.14	4.25	4.195
Zn	6.45	6.09	6.27
Cr	0.12	0.17	0.145
Ni	0.06	0.09	0.075

Major ions chemistry:

The analysis of the major ions (Na, Mg, Ca, K, SO_4, NO_3, Cl and HCO_3) is the basis of understanding the geochemical characteristics of surface costal water (Table 1). The origins of dissolved solids in waters mainly come from marine, anthropogenic and terrigenic (El-Omla and Aboulela, 2012). According to Shaltami (2014) the calculation of none sea salt sulphate (nss-SO_4) values is based on equations as follows:

If Cl/Na ratio > 1.17

nss-SO_4=[SO_4]sample− [Na]sample × [SO_4/Na]seawater

If Cl/Na equivalent ratio < 1.17

nss-SO_4= [SO_4]sample − [Cl]sample × [SO_4/Cl] seawater

The Cl/Na ratio is 2.2 in average, which is higher than the average seawater value (Cl/Na =1.17) Since the existence of the abundant nss-SO_4 indicates an anthropogenic origin, waters with a Cl/Na ratio larger than 1.17 may have not only marine and terrigenic but also anthropogenic origins. HCO3/Cl ratio of study area is about 0.12, which is much higher than the average seawater ratio (0.004). We believe that the high HCO3/Cl ratio is due to the weathering of carbonate rocks that exposed in the study area (Fig.2).

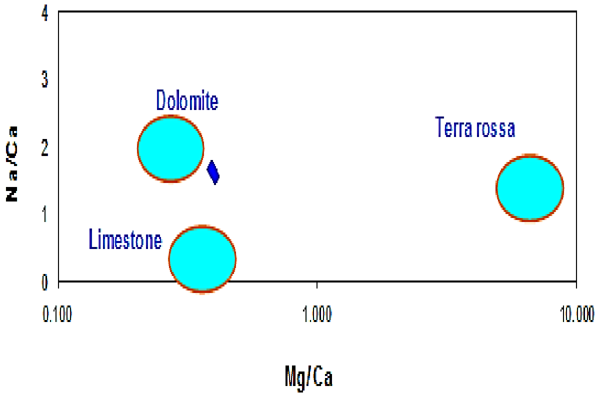


Figure 2. Plots of Mg/Ca versus Na/Ca ratios of the studied water samples (modified after Han and Liu, 2004).

Saturation index (SI):

The saturation index (SI) was calculated using PHREECQ version 3 in order to evaluate the potential chemical reactions of groundwater with respect to mineral phases. Log SI in the studied samples are more than zero in all minerals, which indicate the costal water is supersaturated with halite, gypsum dolomite and calcite (Fig. 3).

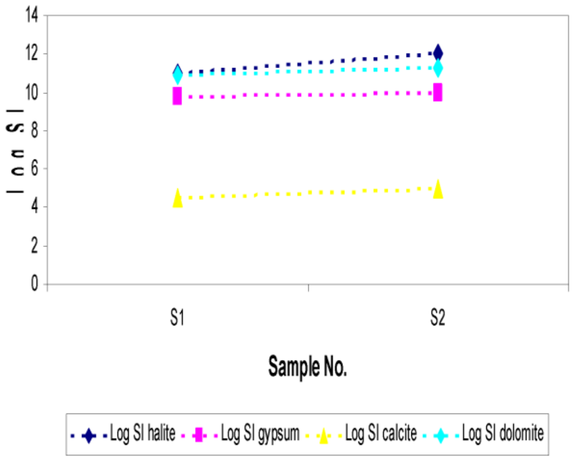


Figure 3. The mineral saturation indices of the studied water (Shaltami et al., 2017).

Heavy Metals:

The heavy metals were analyzed to investigate the concentrations of the environment-sensitive elements such as Pb, Hg, As, Cd, Cu, Zn, Co, Cr and Ni. (Table. 1). The result shows there is a different distribution of heavy metals, which indicates the study costal water influenced by different contamination sources (Fig. 4).

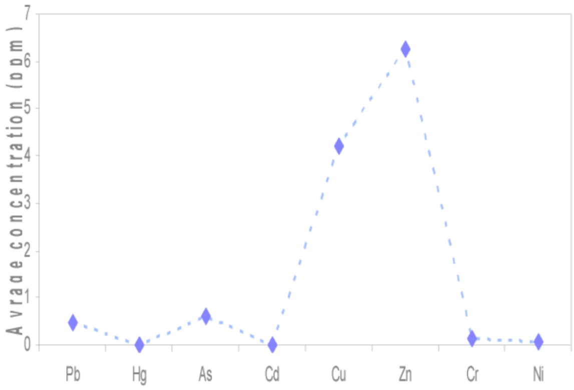
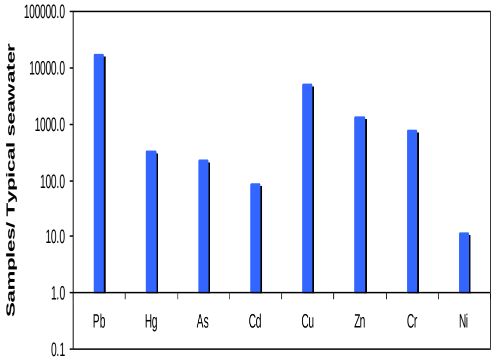


Figure 4. Distribution of heavy metals in the study area.

Normalization to typical composition of seawater:

The heavy metals content of the studied costal water samples are normalized to the typical composition of seawater data (Table.2). The result reveals the concentration of heavy metals exceed the desirable limits for the normal seawater, suggesting that the heavy metals are mainly come from anthropogenic sources (Fig.5).



(http://www.seafriends.org.nz/oceano/seawater.htm).

Figure 5. Heavy metal content of the studied water samples normalized to the typical composition of seawater

Table .2 Normalization of the analyzed heavy metals to typical composition of seawater

Metals	Samples	Seawater	Ratio
Pb	0.47	0.00003	15666.7
Hg	0.006	0.00002	300.0
As	0.625	0.003	208.3
Cd	0.008	0.0001	80.0
Cu	4.195	0.0009	4661.1
Zn	6.27	0.005	1254.0
Cr	0.145	0.0002	725.0
Ni	0.075	0.007	10.7

(http://www.seafriends.org.nz/oceano/seawater.htm).

Pollution index (PI):

The pollution index (PI) is used to determine the metal contamination. It is based on individual metal calculations. According to Caerio *et al.*, (2005) and Shaltami *et al.* (2019) the PI is calculated as: PI = $[(C_{max}/MAC)^2 + (C_{min}/MAC)^2]^{1/2}/2$. Where, C is the concentration of each element; MAC is the maximum allowable concentration. PI is classified into five classes: class I, no effect<1; class II, slightly affected 1-2; class III, moderately affected 2-3; class IV, strongly affected 3-5 and class V, seriously affected >5 (Caerio *et al.*, 2005). Fig (6) reveals that the studied samples are classified as seriously affected with Pb, Hg, As, Cd, Cu, Zn, Co, Cr and Ni.

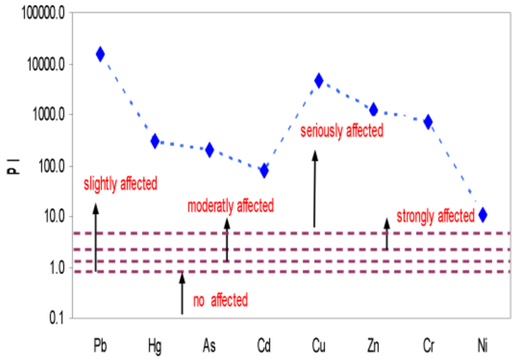


Figure 6. Pollution index classes in the studied water samples.

CONCLUSION

The main conclusions and recommendation of the present study are as follows:

1-The Cl/Na ratio in the study surface costal water is higher (> 1.17), suggesting that the dissolved solid comes from marine, terrigenic and anthropogenic origins.

2- The water samples are found to be oversaturated with halite, gypsum dolomite and calcite.

3- The pollution index (PI) values show that the samples are seriously affected in human health.

4- We recommend Al Sabri Sea is not suitable for swimming due to influence by anthropogenic pollution.

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