

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

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ARTICLE INFO

Vol. 2 No. 2 Dec, 2020

Pages (21 - 25)

Article history:

Revised form 31 October 20

Accepted 22 November 20

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Keywords:

Al Sabri area, Environmental
geochemistry, Surface costal water.

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.

المخلص العربي

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. حيث 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 التأثير. أخيراً نوصي بأن مياه بحر الصابري غير مناسب للسباحة.

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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 coastal water.

(Fig. 1) shows the location map of the surface coastal 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 coastal water in Al Sabri area are insufficient.

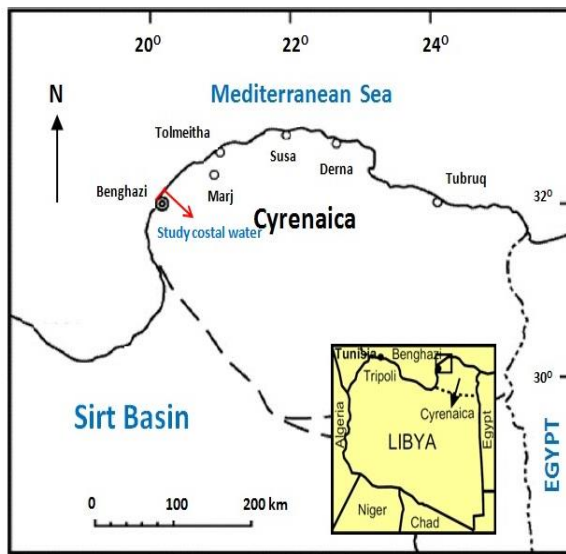


Figure 1. Location map of the coastal water in Al Sabri area.

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 HCO₃ and Cl, whereas SO₄ 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 coastal water samples.

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

Parameters	Sample No.		Average
	1	2	
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, SO₄, NO₃, Cl and HCO₃) is the basis of understanding the geochemical characteristics of surface coastal water (Table 1). The origins of dissolved solids in waters mainly come from marine, anthropogenic and terrigenous (El-Omla and Aboulela, 2012). According to Shaltami (2014) the calculation of none sea salt sulphate (nss-SO₄) values is based on equations as follows:

If Cl/Na ratio > 1.17

$$nss-SO_4 = [SO_4]_{sample} - [Na]_{sample} \times [SO_4/Na]_{seawater}$$

If Cl/Na equivalent ratio < 1.17

$$nss-SO_4 = [SO_4]_{sample} - [Cl]_{sample} \times [SO_4/Cl]_{seawater}$$

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-SO₄ indicates an anthropogenic origin, waters

with a Cl/Na ratio larger than 1.17 may have not only marine and terrigenous 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).

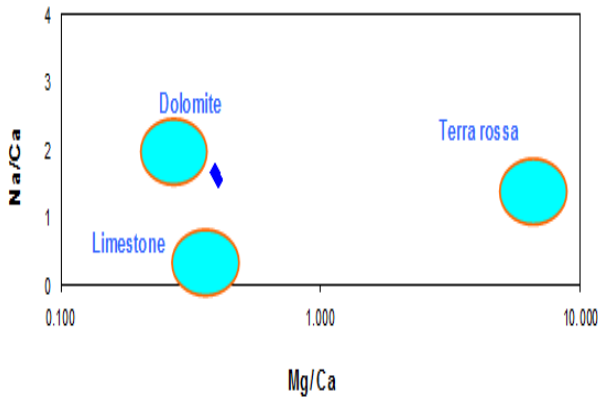


Figure 2. Plots of Mg/Ca versus Na/Ca ratios of the studied water samples (modified after Han and Liu, 2004).

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).

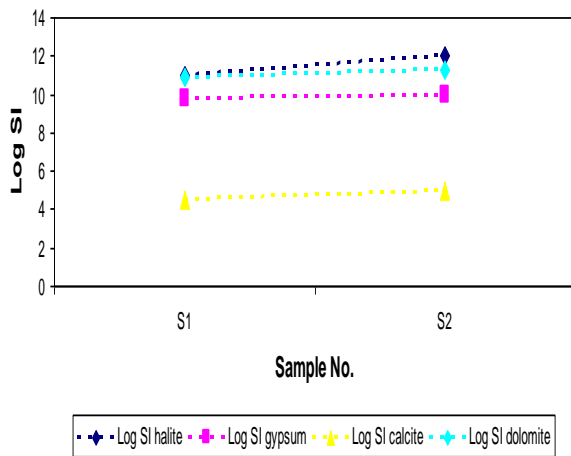


Figure 3. The mineral saturation indices of the studied water (Shaltami et al., 2017).

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).

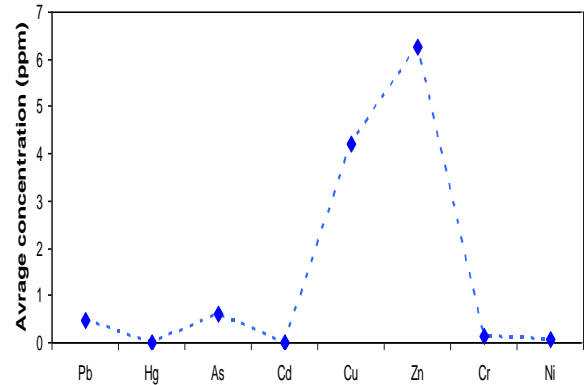
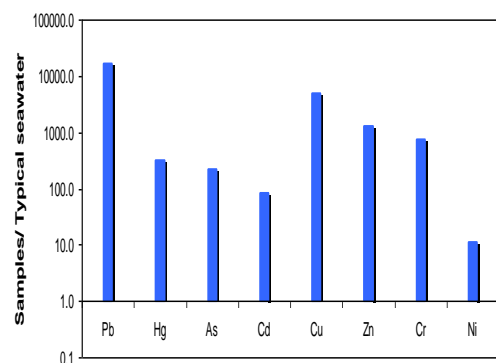


Figure 4. Distribution of heavy metals in the study area.

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.

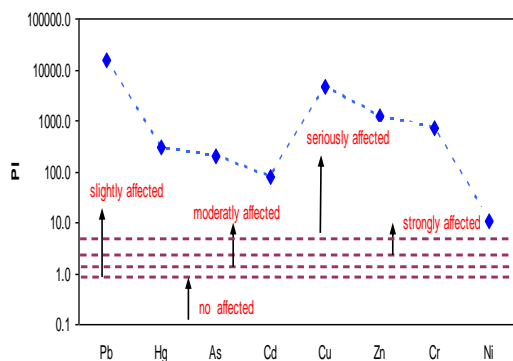


Figure 6. Pollution index classes in the studied water samples.

CONCLUSION

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

- 1-The Cl/Na ratio in the study surface coastal water is higher (> 1.17), suggesting that the

dissolved solid comes from marine, terrigenous 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.

REFERENCES

Caerio, S., Costa, M.H., Ramos, T.B., Fernandez, F., Silveira, N., Coimbra, A. and Painho, M. (2005): Assessing heavy metal contamination in Sado Estuary sediment: An index analysis approach. *Ecological Indicators*; 5: 155-169.

El-Omla, M.M. and Aboulela, H.A. (2012): Environmental and mineralogical studies of the sabkhas soil at Ismailia-Suez Roadbed, Southern of Suez Canal District, Egypt. *Open Journal of Geology*; 2: 165-181.

Han, G. and Liu, C.Q. (2004): Water geochemistry controlled by carbonate dissolution: a study of the river waters draining karst-dominated terrain, Guizhou Province, China. *Chemical Geology*; 204: 1-21.

Hasan, H.M. and Abdel-Halim, A.M. (2009): Major cations levels studies in surface coastal waters of Derna city, (Libya). *Egyptian Journal of Aquatic Research*; 35 (1): 13-20.

Millier, G. (1969): Index of geo-accumulation in sediments of the Rhine River [J]: *Geo-journal*, v. 2, p.108–118.

National Recommended of normal seawater Table (n.d.). Retrieved from: (<http://www.seafriends.org.nz/oceano/seawater.htm>).

Piersanti S., Shaltami O. R., Fares F, Fathi M. S and Muftah A M.(2017) : Geochemistry of Surface Coastal Water along the Mediterranean Coast from Tolmeita to Al Kuwifia, NE Libya. Venice 1st International Conference on “Engineering and Technology, Computer, Basic and Applied Sciences, Proceeding Book; pp. 111- 129.

- Rashed, M.N. (2004): Biomarkers as indicators as indicators for water pollution in rivers, seas and oceans. *Environment International*; pp: 27-33.
- Shahid A. and Saba I. (2018) :Water Pollution and its Sources, Effects & Management: A Case Study of Delhi', *International Journal of Current Advanced Research*, 07(2), pp. 10436-10442, Available at SSRN: <https://ssrn.com/abstract=3145289>.
- Shaltami O.R., Fares F. F., EL Oshebi F. O, Errishi H., Salloum F. M., Alemam H. A., Abulla A.A., Moftah S. M., Elghazal R. and Baayou M., (2019): Geochemical Evaluation of Surface Water Quality and Appropriateness for Drinking and Irrigation Purposes in the Ain Tifarut, Ghadamis City, SW Libya. *International Journal of Applied Science* | ISSN: 2208-2182. 243-260.
- Shaltami, O.R. (2014): Major ion and rare earth element concentrations in rain waters from Ajdabiya, Benghazi and Al Marj, NE Libya: Natural and anthropogenic sources. *Journal of Benghazi University*; 1: 41-56.
- Shaltami, O.R., Fares, F.F., Salloum, F.M., Elghazal, R. and El Feituri, M.A. (2017): Assessment of surface water quality for drinking and irrigation purposes in Ain Apollo, Shahat City, NE Libya. 2nd Libyan Conference on Chemistry and its Applications (LCCA-2), Benghazi, Libya, Proceeding Book; pp. 127-134.
- Wafi, H.N. (2015): Assessment of heavy metals contamination in the Mediterranean Sea along Gaza Coast – A case study of Gaza fishing harbour. Unpublished MSc Thesis, Institute of Water and Environment, Al-Azhar University-Gaza, 106p.