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A Determining and comparing lead and cadmium concentration in Sediments of the Coast of Benghazi – Libya

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ABSTRACT

This study was designed to measure the content of lead and cadmium in coastal sediments in the coastal city of Benghazi as an indicator of the pollution of these areas with these metals. The study included measuring the average concentration of lead and cadmium metals in the study areas, which included each Sidi Khalifa, Galiana, and Garyounis, at different distances. The obtained results showed that the average concentration of lead and cadmium is 1.263 ppm and 0.304 ppm, respectively, in all study areas. The results of the statistical analysis (SPSS-26) show that there are significant differences at a probability level of less than 0.05, indicating that the studied sediments contain lead and cadmium in all study areas, and the lowest concentration of lead and cadmium was present in the sediment samples collected at a distance of 2 m. From the coast of the city of Benghazi.

تحديد المعادن الثقيلة (الرصاص والكادميوم) في رواسب ساحل بنغازي – ليبيا

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قسم الصحة والسلامة المهنية ، المعهد العالي لتكنولوجيا الهندسة ، بنغازي ، ليبيا

الكلمات المفتاحية:
المعادن الثقيلة
التلوث
الرواسب

الملخص

صممت هذه الدراسة لقياس محتوى الرصاص والكادميوم في الرواسب الساحلية في مدينة بنغازي كمؤشر على التلوث هده المناطق بهذه المعادن. اشتملت الدراسة على قياس متوسط تركيز كلا من معدني الرصاص والكادميوم في مناطق الدراسة والتي شملت كل من سيدي خليفة وجليانه وقاريونس وعلى مسافات مختلفة. أظهرت النتائج المتحصل عليها أن متوسط تركيز الرصاص والكادميوم هو 1.263 جزء في المليون و0.304 جزء في المليون على التوالي في جميع مناطق الدراسة. يظهر من نتائج التحليل الإحصائي (SPSS -26) عن وجود فروقات معنوية عند مستوى احتمالية أقل من 0.05 والدي يدل على إن الرواسب المدروسة تحتوي على الرصاص والكادميوم في جميع مناطق الدراسة، وكان أقل تركيز للرصاص والكادميوم موجود في عينات الرواسب التي جمعت على مسافة 2 م من ساحل مدينة بنغازي.

1.Introduction

Heavy metal contamination of the aquatic environment has become a global issue in recent years, mainly due to their indestructibility and the fact that the majority of them have hazardous effects on living organisms [1]. It has been recognized for decades that the concentrations of metals determined in coastal areas are in the dissolved or undissolved phase and can be from various anthropogenic and natural sources [2]. Heavy metals are deposited, combined, or absorbed in sediment, water, and aquatic organisms, which leads to heavy metal contamination [3, 4]. Pollutants from industrial, sewage, air deposition, agricultural, urban, and mining regions build up the contaminations to dangerous levels in sediments [5]. Sediments play an important role in replenishing pollutants in aquatic systems and using them to monitor aquatic ecosystems [6, 7]. This study was designed to determine and compare lead and cadmium concentrations in areas separated by different distances and compare them to each other in Benghazi Coast Sediments-Libya, positive result is an indicator of the extent of the pollution of the Benghazi coast with these minerals.

2. Materials and methods

2.1 Study area

The study focused on the coast of the city of Benghazi, which extends from the eastern coast (Sidi Khalifa region) and the central region (Galiana) to the western coast (Garyounis region) according to the map of the port in Figure 1.

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Sidi Khalifa: It is on the eastern coast of the city of Benghazi, through a field survey of this area to find out the sources of pollution in it. It turns out that it contains a sponge factory, a plastic factory, and a pipe factory.

Galiana: the central coast of the city of Benghazi, where there are many factories located on the coast in this area, and these factories are the bitumen factory, the textile factory, marble factories, industrial workshops, and there are tourist hotels, the Benghazi seaport, and the Galiana power station.

Garyounis: It is on the western coast of the city of Benghazi, where there are tourist resorts and a sewage treatment plant where wastewater is disposed of in the sea.

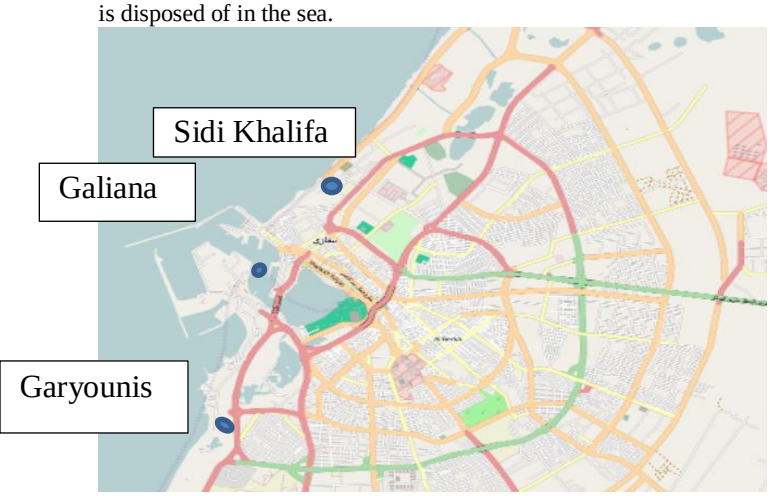

Fig 1: A map of the coast of the city of Benghazi, showing the study areas

2.2 Sampling and sample preparation

The sediment samples were collected from three sites, four times, from the coast of the city of Benghazi in December 2021. The samples were taken from three different locations using grab samplers. The sediment samples were brought to the lab and air-dried at room temperature in the lab. Sediment samples were pulverized and sieved using a 160 mm sieve after being air-dried. Prior to the examination, the samples were sealed in a plastic bag and kept at temperatures below 20 °C. Sediment samples were weighed and placed in digestion bombs containing 10 mL of HNO_3/HCl (1:3 v/v) and digested in a microwave digestion device [8]. The sediment samples were now ready to be analyzed using atomic absorption spectrophotometry.

Atomic absorption method utilized to measure lead and cadmium using a Philips PU 9100X spectroscopic atomic absorption spectrophotometer (A. A. S) equipped with a unit called Slotted Tube Atom Trap (STA T) under the following operating conditions:

Operating conditions	Lead	Cadmium
Wavelength nm	217	228.8
Lamp current M A	10	8
Slit width nm	0.5	0.5
Flow Rate Fuel/Air Acetylene/L	0.9- 1.2	1 - 1.3

2.3 Statistical Analysis

The statistical program (SPSS-26) was used to analyze the variance to find out what was the effect of the sampling areas, as well as what were the significant differences between the sampling distances in terms of the concentration of heavy metals. As well as using the correlation coefficient to find out the relationship between the concentration of heavy metals and the distance of sampling. Calculate the standard deviation (SD) of the mean.

3. Results and discussion

3.1 Lead content in sediments

Table 1: The average level of lead in the sediments (ppm) on the coast of the city of Benghazi

Study areas	The sampling distance from the coast of Benghazi			
	0.5 m	1m	1.5m	2m
Sidi Khalifa	3.175±0.600	4.980±0.747	1.265±0.095	0.377±0.145
Galiana	1.040±0.100	1.765±0.260	0.300±0.182	0.115±0.017
Garyounis	0.615±0.083	1.240±0.159	0.160±0.095	0.135±0.045
Average	1.610±0.216	2.661±0.388	0.575±0.124	0.209±0.079

It is clear from the results in Table 1 that the average concentration of a lead element in the samples is 0.209 ppm at 2 m, 0.575 ppm at 1.5 m, 2.661 ppm at 1 m, and 1.610 ppm at 0.5 m from the coast of the city of Benghazi. The statistical analysis shows that there are significant differences between the study areas in terms of the level of heavy metals at a distance of 2 m at a level of probability less than 0.01, while there are high differences between the study areas in terms of the concentration of lead at a distance of 1.5 m, 1 m and 0. 5 m at a probability level less than 0.001. Table 1 shows that the highest concentration of lead in the samples that were taken at a distance of 1 m from the eastern coast of the city of Benghazi (Sidi Khalifa) was 4.98 ppm and the lowest concentration of lead in the sediments was at a distance of 2 m in samples taken from the central region (Galiana) 0.115 ppm. These moral differences between the study areas may be due to the different sources of pollution from these minerals in the three study areas, where the eastern coast of the city of Benghazi is characterized by the presence of many factories that may be a source of pollution with these elements, such as the sponge factory, the plastic factory, and the pipe factory. It also appears from the results in Table 1 that the average level of lead in the sediments for all distances from all study areas is 1.263 ppm. The results of the statistical analysis confirmed that the different distances from which sediment samples were taken from all study areas showed highly significant differences at a probability level of less than 10.00 in terms of lead content. That is, the different distances for sediment sampling differ significantly in terms of their ability to accumulate lead. The Pb contents found in this investigation were less than the 35 ppm suggested limit for Pb in sediment [9]. Industrial wastes, plastic stabilizers, solder, pigments, cable sheathing, alloys, rust inhibitors, and lead acid batteries are all possible sources of Pb in sediments [9]. The maximum Pb level detected in this study (4.98 ppm) was lower than the 38.98 ppm recorded in Rift Valley lakes by (Ochieng et al., [10] and what Ochieng et al., [11] discovered in Lake Kanyaboli (153.90 ppm) and Winam Gulf (66.05 ppm).

3.2 Cadmium content in sediments

Table 2: The average concentration of Cadmium in the sediments (ppm) on the coast of the city of Benghazi

Study areas	The sampling distance from the coast of Benghazi			
	0.5 m	1m	1.5m	2m
Sidi Khalifa	0.645±0.078	0.612±0.450	0.440±0.132	0.190±0.139
Galiana	0.230±0.045	0.320±0.094	0.252±0.196	0.175±0.097
Garyounis	0.225±0.092	0.350±0.161	0.145±0.096	0.067±0.008
Average	0.366±0.071	0.427±0.235	0.279±0.141	0.144±0.081

Table 2 shows the average concentration of cadmium in sediments from different distances from the eastern, central, and western coasts of the city of Benghazi.0.144 ppm, 0.279 ppm, 0.427 ppm, and 0.366 ppm. The statistical analyzes of these results confirmed that there were no significant differences between the study areas in terms of cadmium concentration in sediments at different distances at a probability level of less than 0.05. While there are highly significant differences in terms of the accumulation of cadmium in the sediments at a distance of 0.5 m from the coast of Benghazi at a probability level less than 0.001. Table 1 shows that the highest concentration of cadmium was in the sediments that were taken at a distance of 0.5 m from the Sidi Khalifa area (0.645 ppm), and the lowest concentration of cadmium in the sediments was at a distance of 2 m from Garyounis (0.067 ppm). The average cadmium concentration for all study areas is 0.304. The results of the statistical analysis also showed significant differences at a probability level of less than 0.01 between the study areas in terms of their cadmium content. According to the United States,

Environmental Protection Agency (US EPA) classifications the concentration of Cd more than 6 was heavy pollution [12]. The highest level of Cd from the coast of the city of Benghazi was less than 6 which means less pollution. Cadmium concentration in sediments from the Sidi Khalifa area at a distance of 2 m was 0.19 ppm, which is the same result obtained from Laizhou Bay, China sediments [13]. The results of the cadmium concentration in the sediments (0.23 ppm) from Al-Khobar, Arabian Gulf were close to the cadmium concentration in the sediments from the Garyounis area at a distance of 0.5 m (0.225 ppm) [14]. Cadmium (Cd) is a heavy metal that is used in the steel industry, plastics, and batteries, and it is discharged into the environment through wastewater, fertilizers, and local air pollution. The primary sources of cadmium in the atmosphere include the combustion of fossil fuels such as coal or oil, as well as municipal garbage incineration [9]. In a study conducted on corn leaves and seeds in Iran, it was found that the average concentration of cadmium in the leaves was 0.0003 ppm, but in the seeds, it was -0.002 ppm. It is clear that the average concentration of lead in corn leaves was 0.0030 ppm and in corn seeds, the average concentration was -0.020 ppm [15]. These results are less than the results obtained in this study.

4. Conclusion

The results also showed a significant correlation at a probability level of less than 0.5 between the level of lead in the sediments from the coast of Benghazi and a distance of 1.5 at which the sample was taken, while there was no significant correlation at a probability level of less than 0.05 between the distance of sampling (0.5 m, 1 m, and 2 m). It is also clear from the results that there is a significant correlation between the concentration of cadmium and the distance of 0.5. There is no significant relationship between the level of cadmium and the distance of 1 m, 1.5 m, and 2 m. From this study, there is a close relationship between the extent of pollution in the study area and the content of heavy metals in the sediment samples, and therefore the coast must be protected from pollution.

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