



Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Baseline

Ecological risk, source and preliminary assessment of metals in the surface sediments of Chabahar Bay, Oman Sea

Homira Agah, Abolfazl saleh, Kazem Darvish Bastami*, Neda Sheijooni Fumani

Iranian National Institute for Oceanography and Atmospheric Science (INIOAS), No. 3, Etemadzadeh St., Fatemi Ave., 1411813389 Tehran, Islamic Republic of Iran

ARTICLE INFO

Article history:

Received 29 December 2015

Received in revised form 15 March 2016

Accepted 19 March 2016

Available online xxx

Keywords:

Metals

Sediment

Chabahar Bay

Oman Sea

ABSTRACT

In this study, concentrations of Aluminum (Al), Iron (Fe), Chromium (Cr), Copper (Cu), Nickel (Ni), Vanadium (V), Zinc (Zn), Arsenic (As), Cobalt (Co) and lead (Pb) in the surface sediments from Chabahar Bay were studied to assess the degree of heavy metal pollution as a consequence of natural and anthropogenic sources. Metal contents in the sediments were observed in the order of: Al > Fe > Cr > V > Ni > Zn > Cu > As > Pb > Co. According to enrichment factor (EF), Arsenic was higher than 1.5 at some sites, indicating anthropogenic inputs. Contents of Ni, As and Cr in the some sampling sites were higher than sediment quality guideline implying adverse impacts of these metals. Based on potential ecological risk (PER), the Chabahar Bay had low ecological risk.

© 2016 Elsevier Ltd. All rights reserved.

Metals, such as arsenic, cadmium, lead, chromium and nickel, are important environmental pollutants, particularly in areas with high anthropogenic pressure (Islam et al., 2015). Some properties of these contaminants such as being toxic or carcinogenic to humans (Fu and Wang, 2001), persistence, bioaccumulation and non-biodegradable cause a significant concern, especially in coastal and marine environments worldwide (Idris et al., 2007; Ruilian et al., 2008; Cao et al., 2015). Their negative effect on marine ecosystems by reducing species diversity and abundance (Bastami et al., 2014b) and through accumulation of metals in living organisms and food chains is well known (Hosono et al., 2011). In addition to these metals, copper, iron, and zinc are also important heavy micronutrients (Paramasivama et al., 2015). Natural sources, industrial and other anthropogenic activities are the dominant sources of heavy metal pollution (Idris et al., 2007; Fu and Wang, 2001).

Capacity of sediments to accumulate compounds makes them one of the most important tools to assess the contamination level and evaluation of continental aquatic ecosystems. More than 90% of heavy metals load in aquatic systems have been found to be associated with suspended particulate matter and sediments (Zheng et al., 2008; Amin et al., 2009). Hence sediment analyses play a crucial role in assessing the degree of heavy metal pollution resulting in health risk associated with impaired food chain.

Oman Sea is the input path of fresh water flows to the Persian Gulf via Arabian Sea and Indian Ocean; it is also a vital shipping route for the oil-producing countries in the Persian Gulf. Chabahar Bay, which is situated on the Makran Coastline in Sistan and Baluchestan Province,

Southeast of Iran, is a free port and industrial zone on the coast of the Gulf of Oman. The special importance of Chabahar Bay is due to its Ω shape and limited water circulation. The Chabahar Bay has humid climate, hot summers and moderate winters. Fishing and marine commerce are the main activities in the study areas. Due to the increasing trade and industrial activities in the recent decade in this area, it is expected that these activities influence the accumulation of anthropogenic pollution on coastal and marine sediments.

Very little information is available on extend of metals pollution in the North-West of Oman Sea and also in recent years petrochemical industries have started their activities in the Chabahar Bay. Hence, understanding the pollution levels of the region is an important step towards its protection and sustainable development.

The main objectives of the present study were 1) To investigate toxic heavy metals distribution in surface sediments from the Chabahr Bay, Oman Sea and 2) Discover relationships between the elemental levels and sediment characteristics, 3) Detect pollution source(s) and 4) Compare pollution level with other marine ecosystems.

Sediment samples from nine sites (Fig. 1 and Table 1) were collected using a Van Veen Grab sampler from Chabahar Bay in April 2012. The selected sampling sites represent the most important harbors, desalination plant and industrial regions in Sistan and Baluchestan Province and also they represent coastal areas that are anticipated to have a relative higher pollution due to higher population.

The collected samples were placed in pre-cleaned polyethylene plastic bottles, labeled and were carried to the laboratory in ice-boxes for further treatment. The sediment samples were lyophilized, sieved and fractions smaller than 63 μm were transferred in pre-cleaned dark glass labeled bottles and kept frozen (at $-20\text{ }^{\circ}\text{C}$) prior to chemical

* Corresponding author.

E-mail addresses: darvish_60@yahoo.com, darvish.bastami@inio.ac.ir (K.D. Bastami).

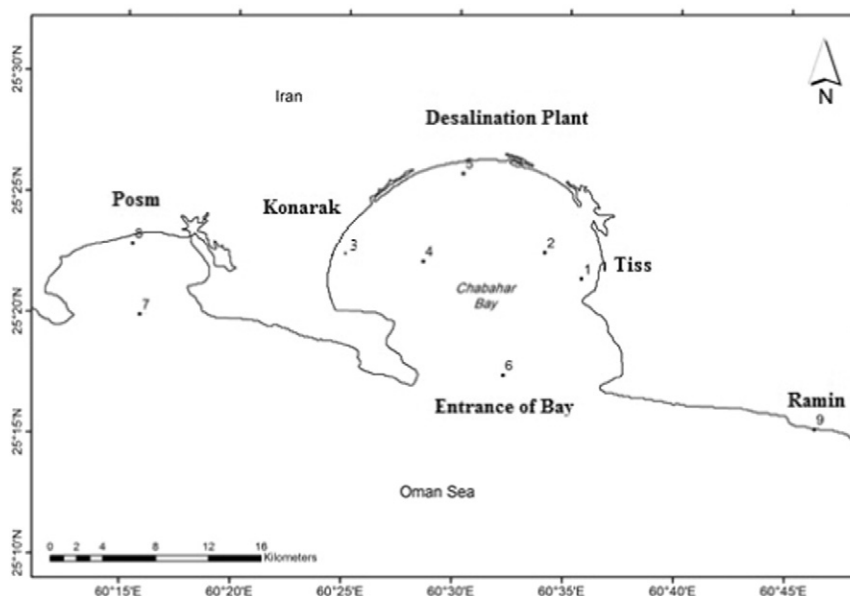


Fig. 1. The location of the sampling site in the Chabahar Bay.

analyses (Wolf-Welling et al., 2001). Sediment samples were subjected to wet sieving and Lazer Particle Sizing (HORIBA-LA950, France and Japan) determination.

Total organic matter was measured by heating sediment samples in an oven at 530 ± 20 °C for 8 h (Dean, 1974). Total organic matter was calculated by the following equation:

$$\text{Total organic matter (TOM, \%)} = [(B-C)/B] \times 100 \quad (1)$$

where B and C are the weights of dried sediments before and after combustion in the oven, respectively.

For digestion of sediment samples, 0.5 g of each sediment sample was added with a mixture of HCl–HNO₃–H₂O (with the ratio of 1:1:1 v/v) and heated at 95 °C during 1 h. Metal (Al, Co, Ni, Cu, Zn, As, Pb, Fe, Cr and V) analyses were performed using Inductively Coupled Plasma Mass Spectrometry inductively (ICP-MS) after acid digestion at ACME Lab., Canada which is under 17,025 standards. Quality assurance and quality controls were assessed using standard samples (Oreas 45 Pa, DS7 and DS8). The analytical results of the quality control samples show good agreement with the certified values (recoveries ranging 93.25–105.22%). The limits of detection were set as three times of the standard deviation on the procedural blanks (Table 2).

To predict detrimental biological effects and conservation of the organisms living inside or near the polluted sediments, sediment quality guidelines (SQGs) were used. In order to classify the sediment, NOAA provides two values for each substance: (1) sediments with rarely adverse biological impacts (<effect range low), (2) sediments with occasionally or frequently adverse biological impacts (>effect range low and <effect range median) (Long et al., 1995).

Table 1
Sampling geographical locations in the Chabahar Bay.

No	Stations	Depth (m)	Geographical locations
1	Tiss	3.8	25°21'46" N 60°35'40" E
2	Tiss	9.0	25°22'50" N 60°33'59" E
3	Konarak	5.0	25°19'58" N 60°15'44" E
4	Konarak	10.5	25°22'23" N 60°28'30" E
5	Desalination plant	5.8	25°26'3" N 60°30'14" E
6	Entrance of the Chabahar Bay	13.6	25°17'44" N 60°32'12" E
7	Posm	12.10	25°19'58" N 60°15'44" E
8	Posm	6.0	25°22'54" N 60°15'21" E
9	Ramin	4.5	25°15'42" N 60°46'18" E

Enrichment factor (EF) technique for determining sedimentary metal sources (Selvaraj et al., 2004; Vald'es et al., 2005; Bastami et al., 2014a, 2014b) was calculated as follow (lee et al., 1998; Woitke et al., 2003):

$$\text{Enrichment factor (EF)} = (Cs/C_{Fe})_{\text{sample}} / (Cs/C_{Fe})_{\text{Background}} \quad (2)$$

While $(Cs/C_{Fe})_{\text{sample}}$ are the average element level and Fe concentrations in our study, respectively, $(Cs/C_{Fe})_{\text{Background}}$ are the average element level and Fe concentrations in background sample, respectively. Iron or aluminum is used as a normalization element to reduce the variations produced by heterogeneous sediments; the reference element must have minimum variability of occurrence or large concentrations in the studied environment. In the present study, Iron (CV: 3.73%) had a homogeneous concentration in the selected stations.

Also, we used background concentrations of metals in sediment from Iranian waters of the Oman Sea which are 7.4, 63.7, 92.4, 42.17, 99, 78, 15.2, 372, 0.21 ppm, 2.80 and 6.05% for As, Ni, Pb, Cu, Zn, V, Co, Cr, Cd, Fe and Al, respectively (Hamzeh et al., 2013).

Potential ecological risk index (PER) was also introduced to assess the contamination degree of heavy metals in the present sediments. The equations for calculating the PER were proposed by Hakanson (1980) as the following:

$$E = TC \quad (3)$$

$$C = C_a/C_b \quad (4)$$

$$\text{PER} = \sum E = \sum TC \quad (5)$$

Table 2
Detection limits of the elements (mg kg⁻¹).

Element	Detection limit	Element	Detection limit
As	5	V	5
*Fe	0.01	Pb	5
Co	0.5	Zn	5
Cu	5	*Al	0.1
Cr	10		
Ni	5		

Elements marked as "*" are reported according to their %.

Download English Version:

<https://daneshyari.com/en/article/6356269>

Download Persian Version:

<https://daneshyari.com/article/6356269>

[Daneshyari.com](https://daneshyari.com)