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Mercury levels in tar mat contaminated beaches and its marine organisms living along the Qatari coasts

Ahmed Abou Elezz , Azenith Castillo, Hassan Mustafa Hassan, Hamood Abdulla Alsaadi, Ponnumony Vethamony
Environmental Science Center, Qatar University

Abstract

One of the pollutants that impacts the coastal environment of Qatar is the vast expanse of oil residue, 'tarmats' deposited on its beaches. The current study aimed to gauge the concentration levels of total mercury(THg) in tarmat contaminated sediments and test their presence in select coastal species. Three biota classes(Gastropoda, Bivalvia, and Crustacea) have been found on the tarmat of Ras Rakan and Umm-Tais islands. Layers of hard asphalt-like tarmats and sediments samples were collected from 34 sites, along the coast of Qatar. Moreover, the Biota Sediment Accumulation Factor(BSAF) was calculated for THg through sentinel species. The mean concentrations of THg is 0.089 ± 0.02 $\mu g.g^{-1}$. Compared to earlier studies, a relatively higher concentration of THg ($0.463 \mu g.g^{-1}$) had been observed.

Keywords

Qatar coast, tarmat, total mercury, accumulation, BSAF.

1. Introduction

After an oil spill, the oil stranded on the beach go through normal erosional, depositional and degradation processes affected by the beach hydrodynamic cycle, weather conditions e.g. temperature and seasonal wind patterns, therefore the oil would become buried, hardened, exposed, and mobilized several times. Tarmats found on the coasts of Qatar are mostly exposed, except at select locations, where they are submerged during high tides. These weathered remnants are petroleum products derived from both natural and anthropogenic sources. The latter includes releases from oil exploration, consumption, and transportation, while naturally occurring seeps on the seafloor is a constant source of oil pollution. After the Gulf War oil spill of 1991, the northern to northwestern coast of Qatar was severely affected by tarmat contamination. Mercury(Hg) analysis in crude oil and petroleum oil residues i.e. tar can be associated with many distinct problems as these samples are very complex and the Hg is found at very low concentrations that require the use of highly sensitive techniques. As a pollutant, Hg has been reported to affect the aquatic environment in a number of ways, from biodiversity to environmental health.

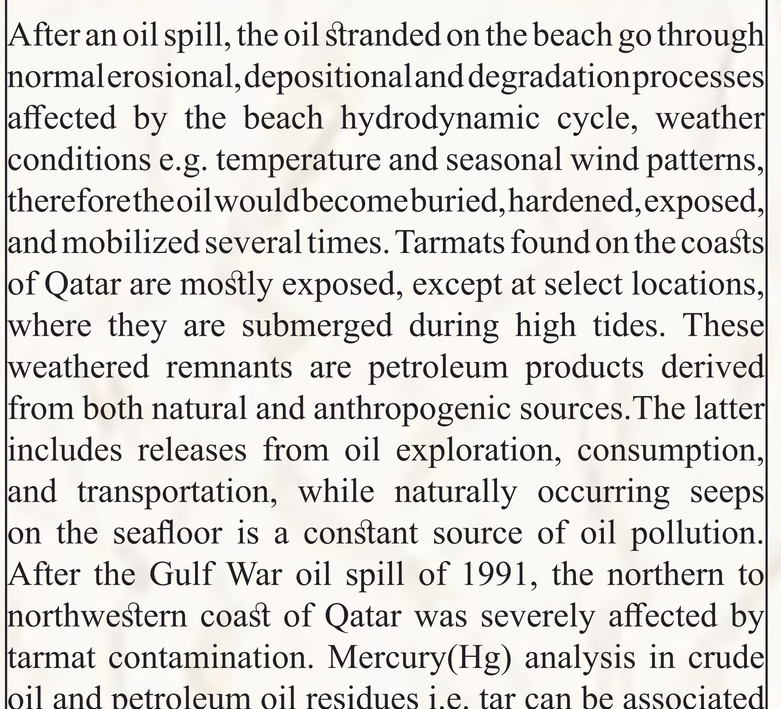
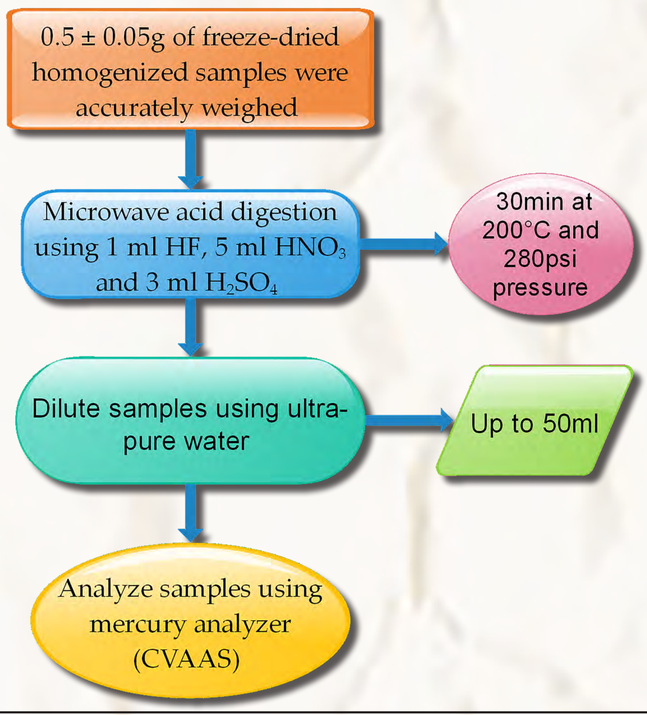


Figure 1. Tar mat and marine biota sampling locations along the Qatar coast.

2. Materials and Methods

Tarmat samples deposited on beach sediments and biota were randomly collected from 34 sites from April 2018 to May 2019 (Figure 1). The tarmats were littered on the shoreline. Moreover, some residual oils were observed on rock surfaces (refer to Figure 2a, and b). Total mercury concentrations in samples were analyzed by Cold Vapour Atomic Absorption Spectrometry (CVAAS) as described in the following flowchart:



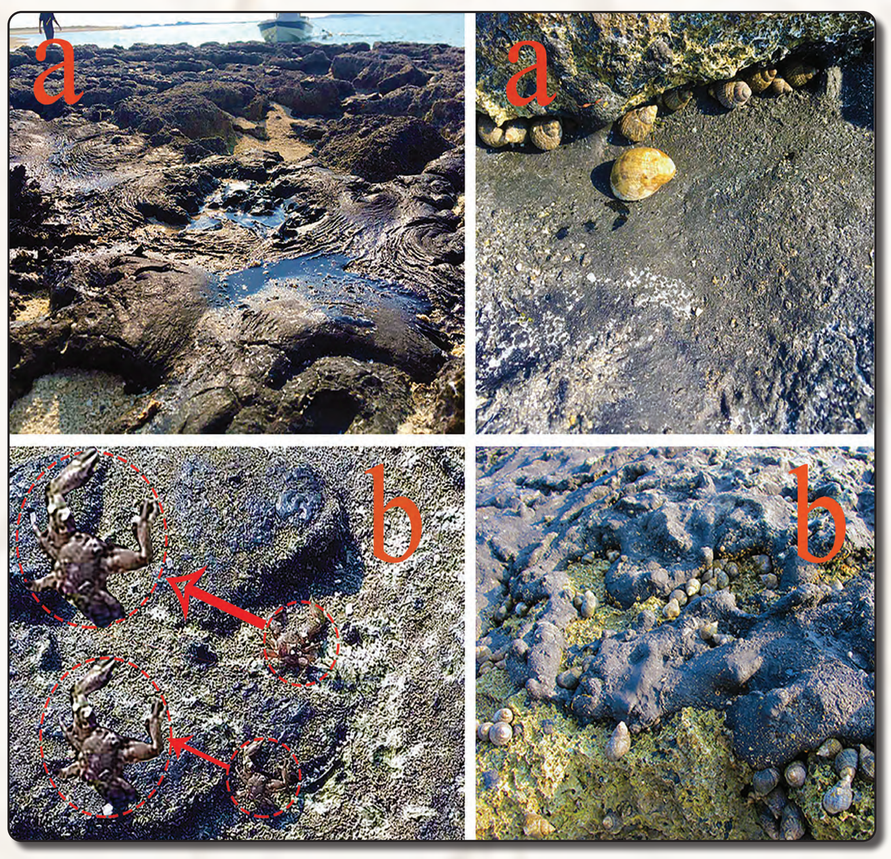


Figure 2. Crab, gastropod, and bivalve species found on the tar-mats in (a) Umm Tais and (b) Ras Rakan Islands.

3. Results

The results indicated that THg concentration was relatively higher only in three sites located in the north-northeast shoreline: Al Ghariya "weathered", 0.463 ± 0.021 $\mu g.g^{-1}$; Umm Al Far South, 0.445 ± 0.002 $\mu g.g^{-1}$; and Fuwairit "deep sample", 0.305 ± 0.028 $\mu g.g^{-1}$) dew to petrochemical and industrial activities that mercury levels could result from accumulation of the pollutant from these sources, while in other locations, the concentrations were less than 0.07 $\mu g.g^{-1}$ (Figure 3). In the present study THg concentrations in tarmat-sediment mixture is higher compared to the asphalt sample in the study of Bloom (2000) with a mean concentration of 0.27 ± 0.32 $ng.g^{-1}$. A significant variation ($p<0.5$) in THg levels ($\mu g.g^{-1}$) was observed between the North and East from one side and the West of Qatar from the other side (Figure 4). BSAF results of THg that is > 2 in all species. The organism can be classified as macroconcentrators.

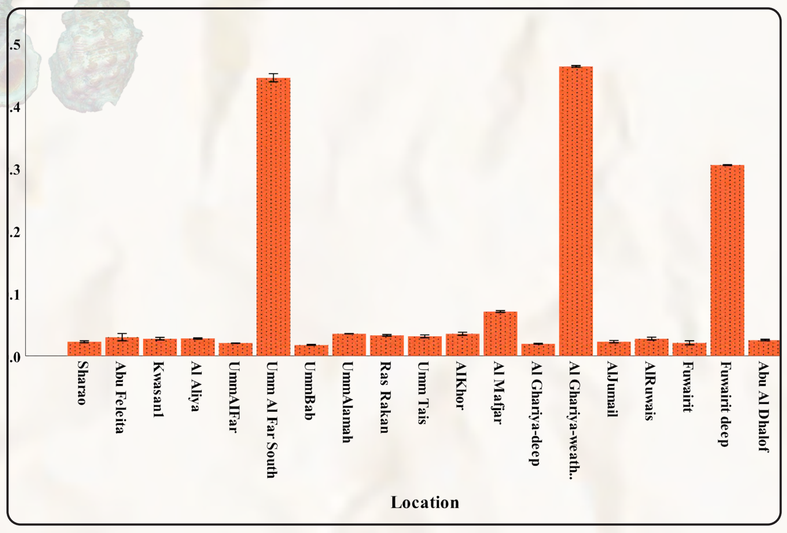


Figure 3. The concentration of total mercury ($\mu g.g^{-1}$) in the tarmat-sediments mixture obtained along the coast of Qatar.

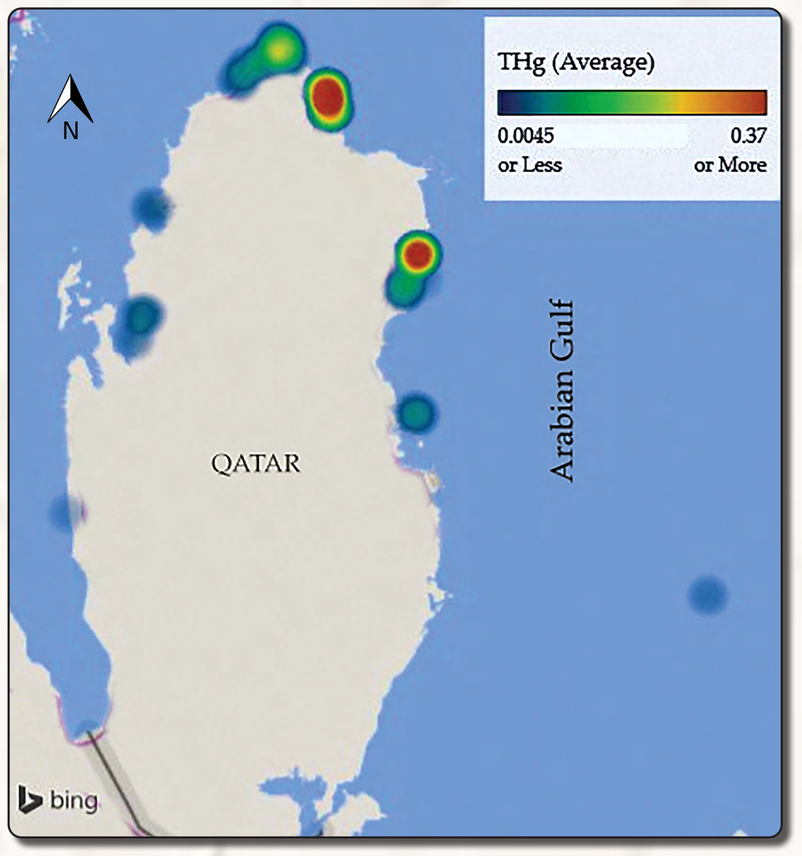


Figure 4. Distribution of Total mercury (T-Hg) measured along the Qatar coast.

4. Conclusion

Tarmat is an environmental issue along the Qatar coast, particularly in the eco-sensitive regions. It is rather difficult to remove the residue they left behind; in fact, tarmat is far more threatening than the original spill. It is the accumulation of years of small spill residues. The present study has shown that a remarkable amount of total mercury pollutant is found in the tarmats, especially in Qatar's north and northeast shorelines due to the mode of transport of oil spills. Compared to previous studies, the present study reports higher concentration levels of mercury. As Qatar's exclusive economic zone is experiencing rapid industrial and urban development, it is prudent to monitor all contaminants having the potential of bioaccumulation, including Hg, and investigate their sources further.

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