Science of the Total Environment 509–510 (2015) 67–90

Contents lists available at ScienceDirect

Science of the Total Environment

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

Review

Mercury in the marine environment of the Canadian Arctic: Review of recent findings

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HIGHLIGHTS

- The water column in Arctic marine waters is important for mercury methylation.
- Mercury deposited on marine snow pack is rapidly re-emitted to the atmosphere.
- Rates of mercury biomagnification were similar across Arctic marine food webs.
- Mercury is higher in Beaufort Sea biota than in other Canadian Arctic areas.
- Mercury in some marine biota has increased in recent decades.

ARTICLE INFO

Article history:
Received 13 December 2013
Received in revised form 9 May 2014
Accepted 27 May 2014
Available online 19 June 2014

Keywords:
Canadian Arctic
Mercury
Marine environment
Biogeochemical processes
Food webs
Temporal trends

ABSTRACT

This review summarizes data and information which have been generated on mercury (Hg) in the marine environment of the Canadian Arctic since the previous Canadian Arctic Contaminants Assessment Report (CACAR) was released in 2003. Much new information has been collected on Hg concentrations in marine water, snow and ice in the Canadian Arctic. The first measurements of methylation rates in Arctic seawater indicate that the water column is an important site for Hg methylation. Arctic marine waters were also found to be a substantial source of gaseous Hg to the atmosphere during the ice-free season. High Hg concentrations have been found in marine snow as a result of deposition following atmospheric mercury depletion events, although much of this Hg is photoreduced and re-emitted back to the atmosphere. The most extensive sampling of marine sediments in the Canadian Arctic was carried out in Hudson Bay where sediment total Hg (THg) concentrations were low compared with other marine regions in the circumpolar Arctic. Mass balance models have been developed to provide quantitative estimates of THg fluxes into and out of the Arctic Ocean and Hudson Bay.
Several recent studies on Hg biomagnification have improved our understanding of trophic transfer of Hg through marine food webs. Over the past several decades, Hg concentrations have increased in some marine biota, while other populations showed no temporal change. Marine biota also exhibited considerable geographic

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http://dx.doi.org/10.1016/j.scitotenv.2014.05.133

variation in Hg concentrations with ringed seals, beluga and polar bears from the Beaufort Sea region having higher Hg concentrations compared with other parts of the Canadian Arctic. The drivers of these variable patterns of Hg bioaccumulation, both regionally and temporally, within the Canadian Arctic remain unclear. Further research is needed to identify the underlying processes including the interplay between biogeochemical and food web processes and climate change.

Contents

1. Introduction

The marine environment in the Canadian Arctic is truly vast and diverse. It includes deep basins and large shelves of the Arctic Ocean, many fjords, channels and straits in the Arctic Archipelago, Hudson Bay (the largest northern inland sea) and large, productive polynyas such as the North Water Polynya in Baffin Bay and the Bathurst Polynya in the Beaufort Sea. Over the last two decades, investigations of mercury (Hg) in these marine ecosystems have largely focussed on marine mammals and birds because of their dietary and cultural importance for northern Aboriginal peoples and the presence of elevated Hg concentrations in some animals. Marine mammals such as seals, beluga (*Delphinapterus leucas*), and polar bears (*Ursus maritimus*) generally have higher concentrations of Hg than terrestrial mammals and