Quantification of anthropogenic mercury releases by category in China in response to Minamata Convention on Mercury

Habuer [1*], Takeshi Fujiwara [1], Masaki Takaoka [2]

1: Okayama University, 3-1-1 Tsushima Naka Kita-Ku, Okayama 700-8530, Japan

2: Graduate School of Engineering, Kyoto University, C-1-3 Nishikyo-ku, Kyoto 615-8540, Japan

*corresponding author: habuer@okayama-u.ac.jp

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INTRODUCTION

The combination of anthropogenic activities and long-term atmospheric transport has resulted in a sustained increase in global mercury concentrations in air, in water and on land (Streets et al. 2018). The Minamata Convention on Mercury (MCM), is a global treaty with the goal of protecting human health and the environment from anthropogenic releases of mercury. This study aimed to investigate on the subsequent distribution of mercury among the natural environmental under consideration of the scenario/technology transformation required by the MCM. As the MCM moves into the implementation phase, further information from scientific data and studies is critically needed to support decision-making and management. The results of this study can provide such information, facilitating the creation of strategic management policies for mercury as the MCM is implemented in China.

MATERIALS AND METHODS

According to a previous study (Habuer 2021), the sources can be divided into five categories of anthropogenic mercury release: mineral production (C1), intentional uses (C2), secondary metal production (C3), extraction and combustion (C4), and waste treatment (C5). These categories can be further divided, leading to 36 subsources in the initial distribution step (step 1) and 32 subsources in the redistribution step (step 2). Each output scenario (OS) includes six levels of treatment technology for each subsource, running from 0 to 5, where 0 is the worst, 1 is bad, 2 is normal, 3 is good, 4 is very good, and 5 is the best from environmental friendly point of view. The potential mercury distribution into the environment is calculated using Eqs (1), (2), and (3):

$$TR_{Hg\to i} = iTR_{Hg\to i} + rTR_{Hg\to i} \tag{1}$$

$$iTR_{Hg\to i} = \sum_{i=(1)}^{(3)} \sum_{c=1}^{36} \sum_{j=0}^{5} [I_{Hg,c} * \partial_j * iDF_{c,j\to i}] \tag{2}$$

$$rTR_{Hg\to i} = \sum_{i=(1)}^{(3)} \sum_{c=37}^{68} [I_{Hg,c} * rDF_{c\to i}] \tag{3}$$

where $TR_{Hg\to i}$ is the total potential mercury release into different sinks i, with (1) air, (2) water, and (3) land. in the year 2019. $iTR_{Hg\to i}$ is the total potential mercury release into different sinks in step 1. $rTR_{Hg\to i}$ is the total potential mercury release into different sinks in step 2. The ∂_j values are the various OSs, which number j. I refers to input factor, and DF indicates distribution factor.

RESULTS AND DISCUSSION

Total mercury releases by category in China, 2019

In 2019, 1239 t of mercury were released into the environment, with 462 t, 532 t, and 29 t being released to air, water, and land in step 1, respectively. About 35 t, 15 t, and 166 t were then re-released to air, water, and land, respectively in step 2. The largest contributor is the category of waste treatment, accounting for 44% (545 t), followed by the extraction and combustion, accounting for 23.5% (292 t); the mineral production, accounting for 21.3% (264 t), and the intentional uses, accounting for 11% (137 t) of the total releases. The category of secondary metal production contributed the small amount to the total releases. Mercury emit to air, mostly attributed to the category of extraction and combustion (Figure 1). Mercury discharge to water, mostly attributed to the category of waste treatment. Mercury release to land, mostly attributed to the category of mineral production in 2019 (after MCM was implemented).

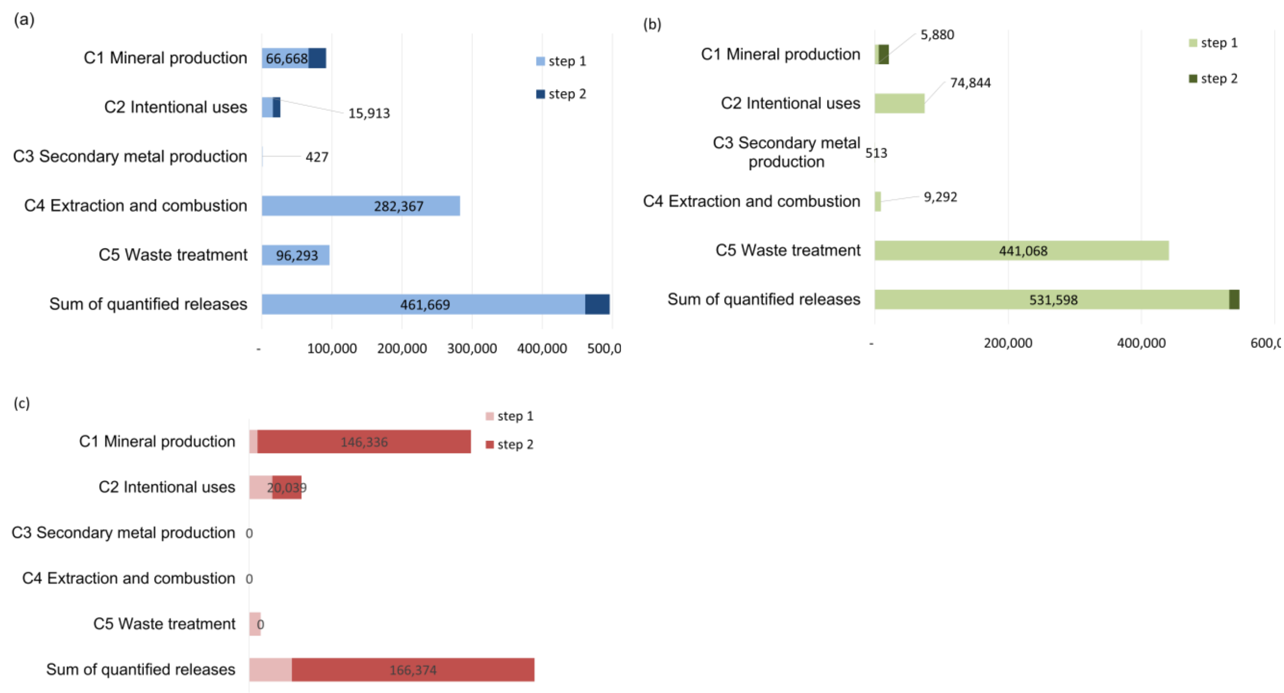

Figure 1 Illustration of (a) Mercury releases to air, (b) water, and (c) land (kg Hg/y) in 2019

CONCLUSION

This study investigated on the subsequent distribution of mercury among the natural environment. In 2019, 1239 t of mercury were released into the environment, with 462 t, 532 t, and 29 t being released to air, water, and land in step 1, respectively. About 35 t, 15 t, and 166 t were then re-released to air, water, and land, respectively in step 2. The results of this study can provide such information, facilitating the creation of strategic management policies for mercury as the MCM is implemented in China.

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