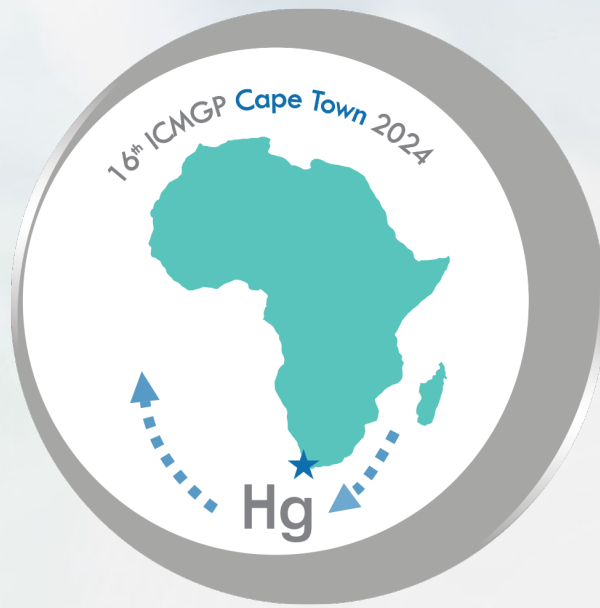




ICMGP 2024
CAPE TOWN • SOUTH AFRICA • 21 - 26 JULY

Mercury species, stable isotopes and distribution of total mercury in coastal sediments of Honda Bay, Palawan, Philippines

Jessie O. Samaniego, Cris Reven L. Gibaga, Alexandria M. Tanciongco, Rico Neil M. Quierrez, Rachelle
Clien G. Reyes, John Henry C. Gervasio, Anie Felicia P. Rasay

Department of Science and Technology - Philippine Nuclear Research Institute Commonwealth Avenue,
Diliman, Quezon City, Philippines



WWW.MERCURYCAPETOWN.COM

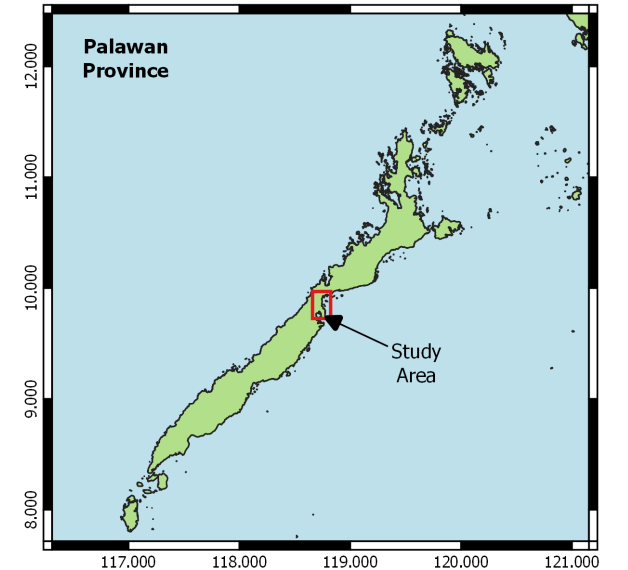
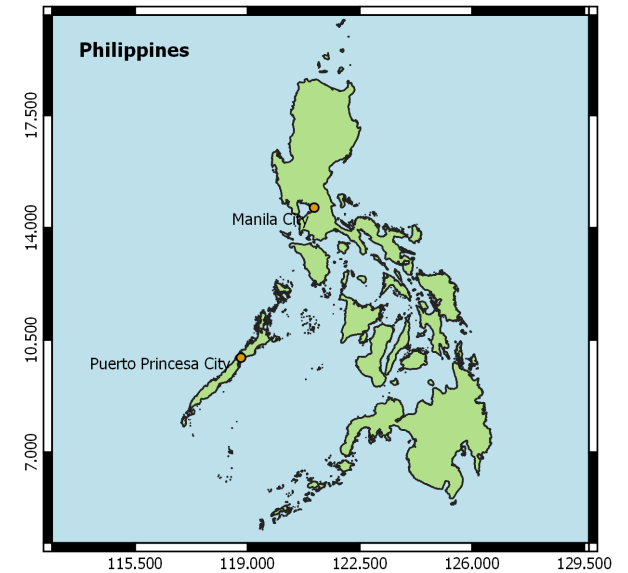
Introduction

Abandoned Palawan Quicksilver Mines

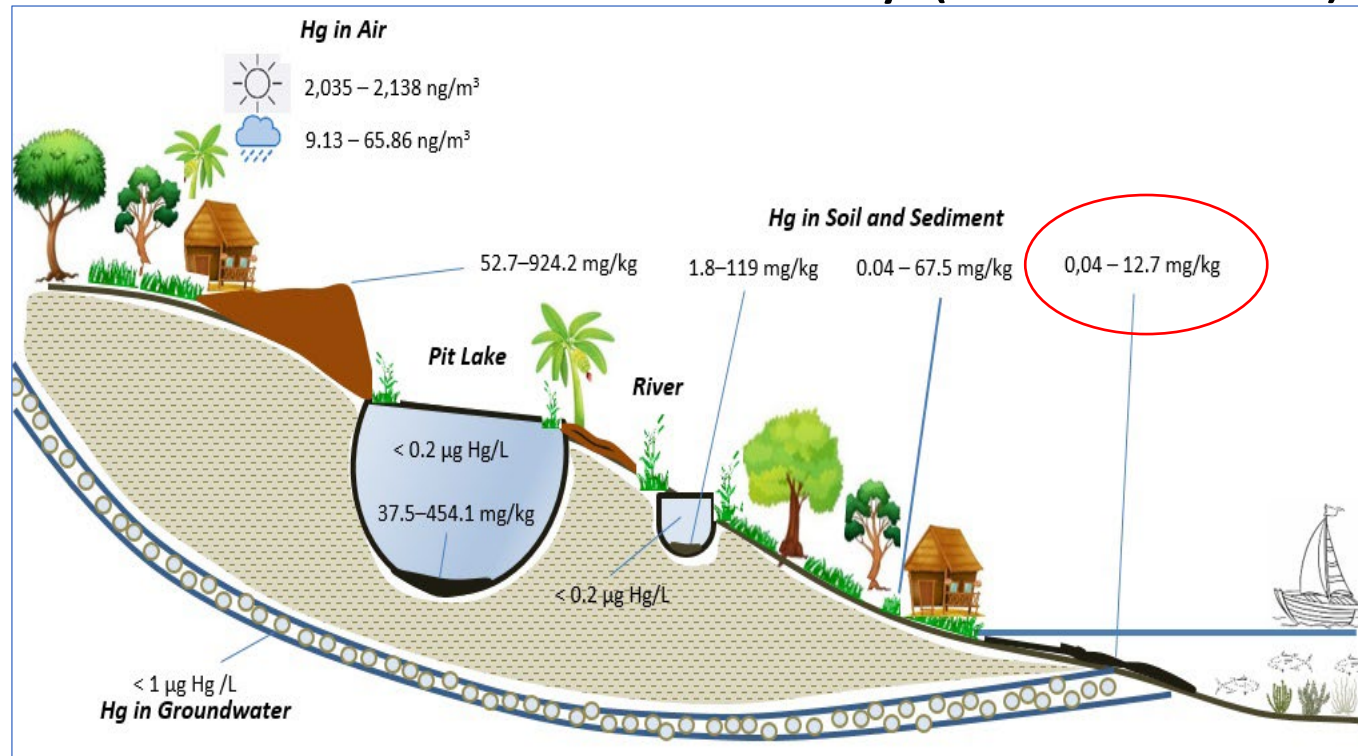
- Naturally-occurring form of Hg (cinnabar) hosted by the Tagbueros Opalite formation in Central Palawan Island.
- Operated by Palawan Quicksilver Mines Inc. (PQMI) from 1953 to 1976
- Produced about 2,900 metric tons of Hg during mining of cinnabar ores
- Soil in the vicinity is reddish because of presence of cinnabar and lateritic soil
- Lake formed from abandoned mercury open pit mine



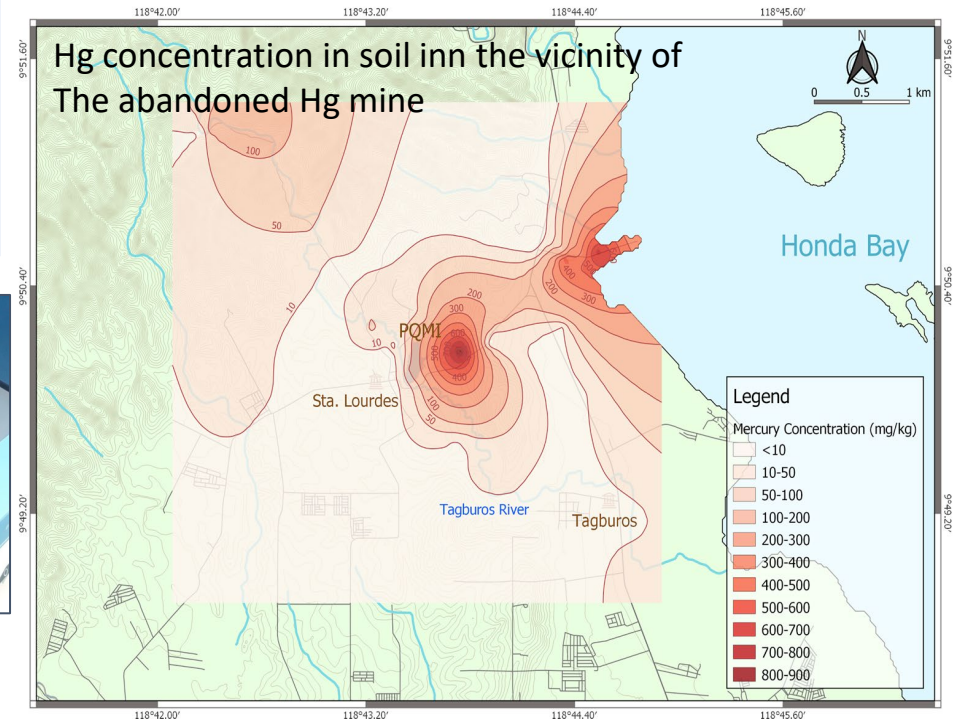
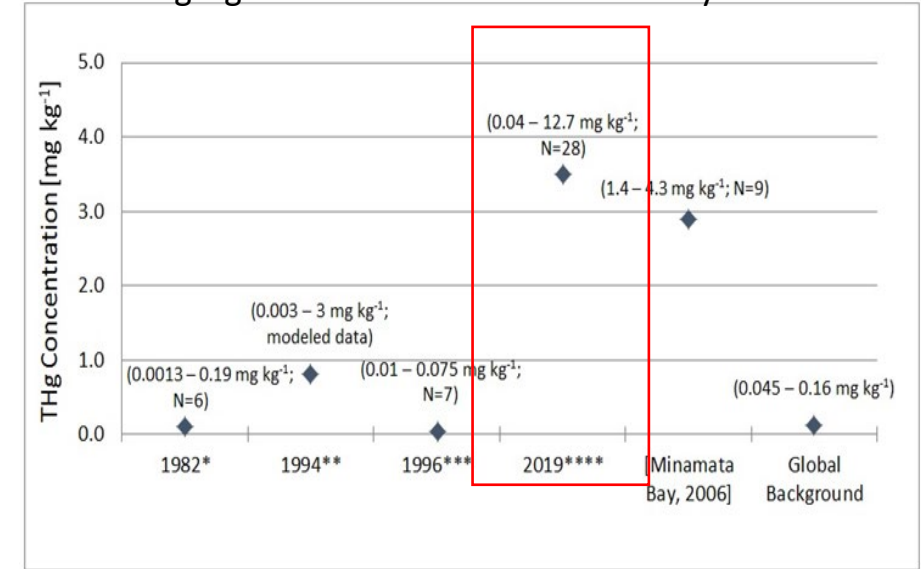
Project Area



Recent Study (2019 – 2020)



Increasing Hg conc in sediment in Honda Bay



Objectives

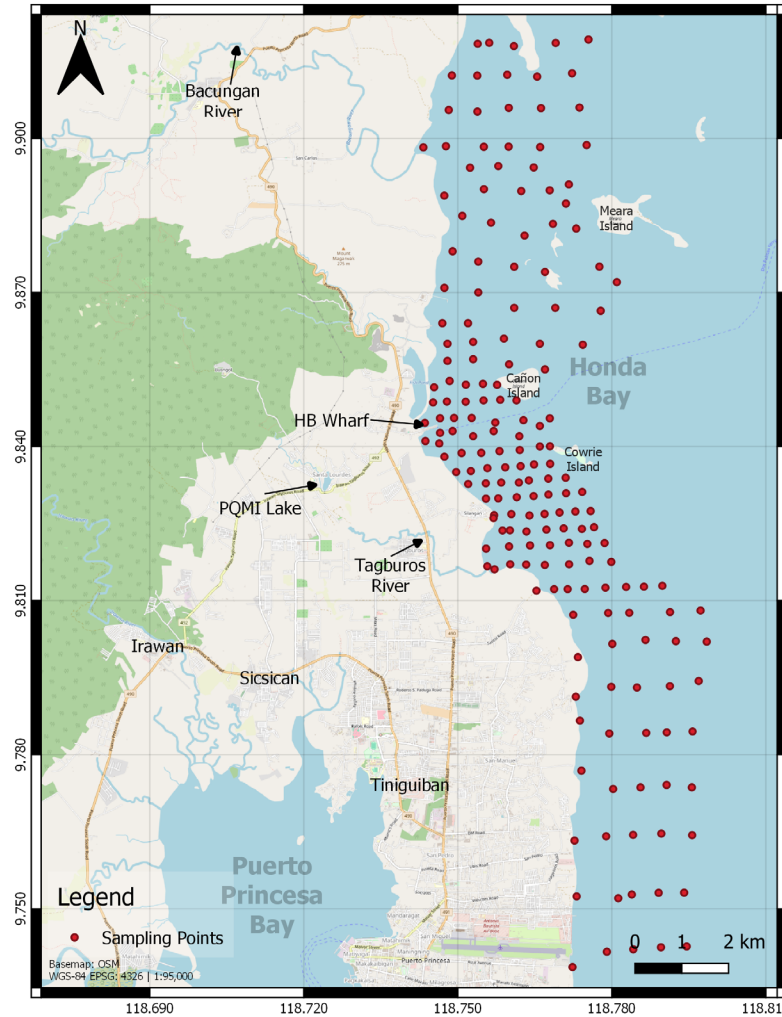
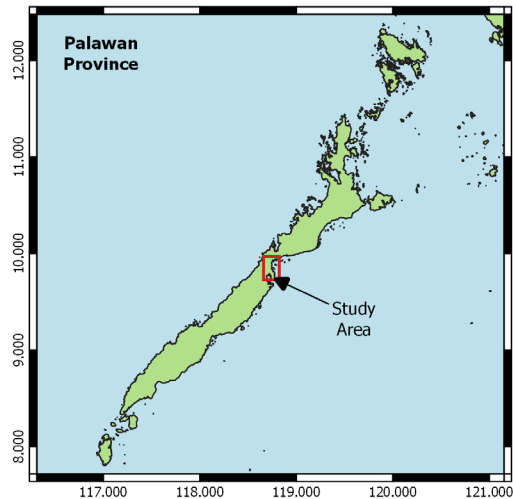
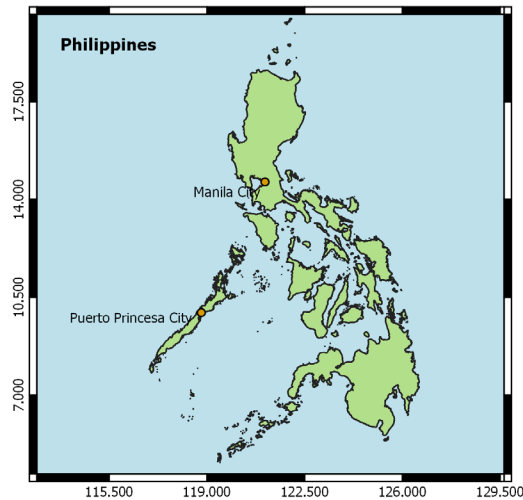
- Determine the present distribution of Hg concentration in Honda Bay sediments and assess the sedimental contamination brought by the release of Hg-laden soil particles eroding the mine.
- Identify the species of mercury present in the sediment samples
- Measure the isotopic compositions of Hg within ore, soil, sediment and biota and determine its variability.



Methods

Sampling points

Marine sediment samples: $n = 166$



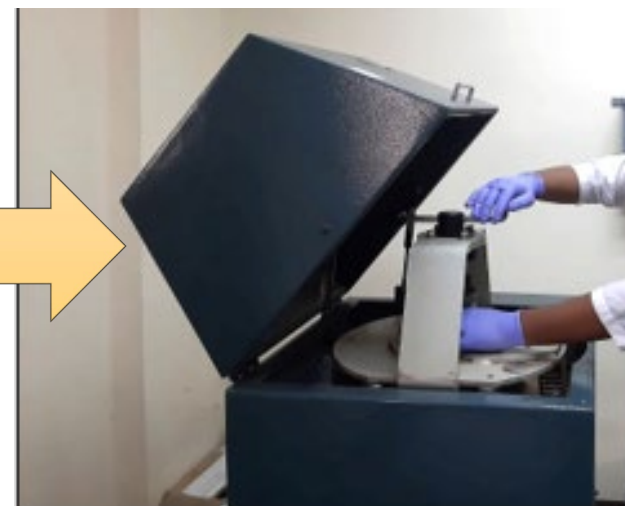
Sediment samples preparation and Hg analysis



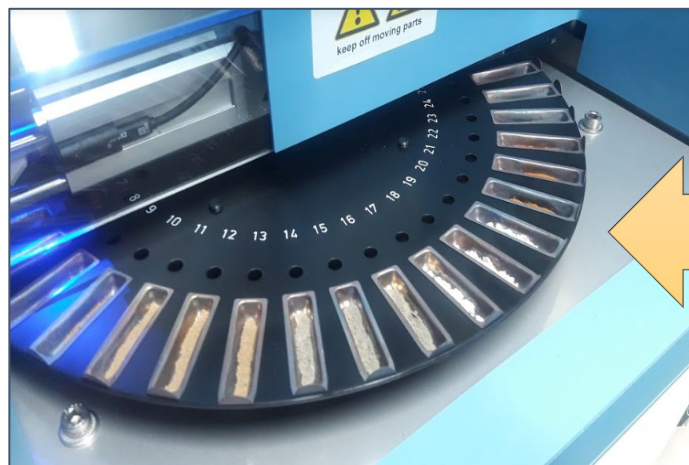
Coning and Quartering



Air Drying



Pulverization



Mercury Analysis



Sieving

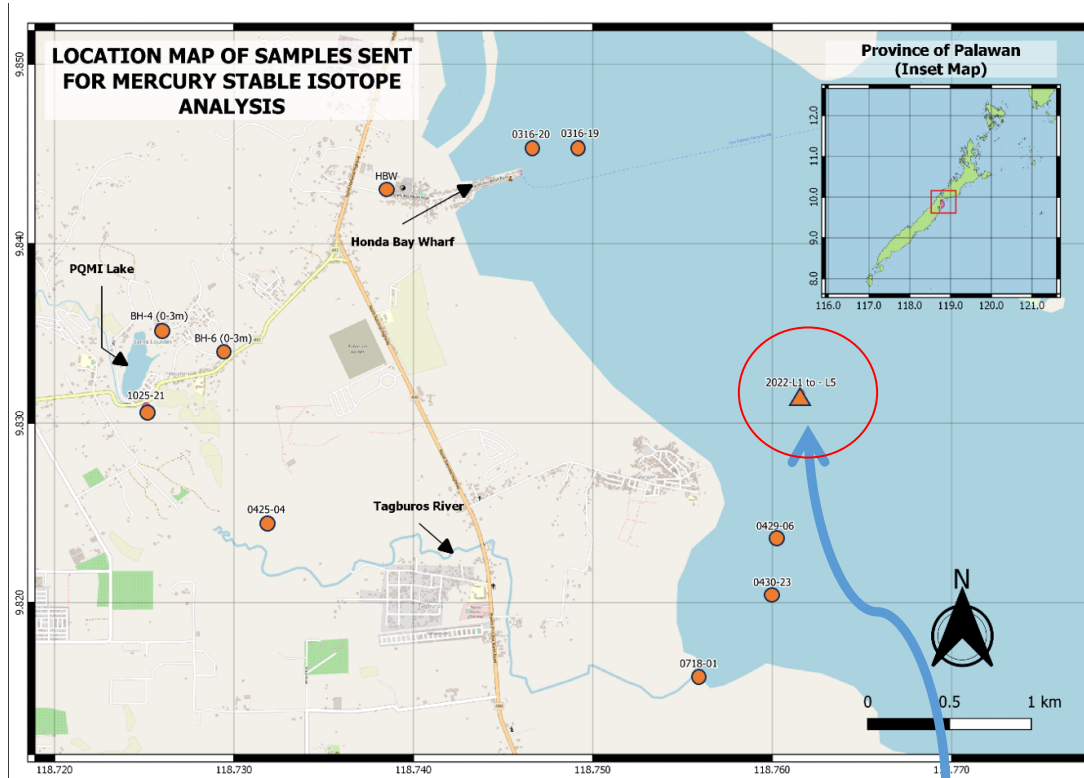


Mercury stable isotopes

Analyses of Mercury stable isotopes (^{199}Hg , ^{200}Hg , ^{201}Hg , ^{202}Hg , ^{204}Hg)

Using multiple collector inductively coupled plasma mass spectrometer (**MC-ICP-MS**) (*Nu Plasma at AIA, France*)

Total mercury concentration – analyzed using **DMA 80 evo** (*Milestone*)



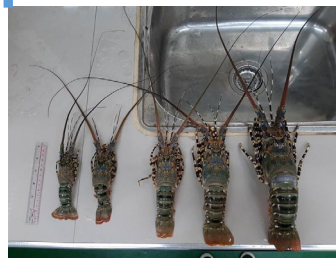
Surrounding soils



Marine sediment sampling

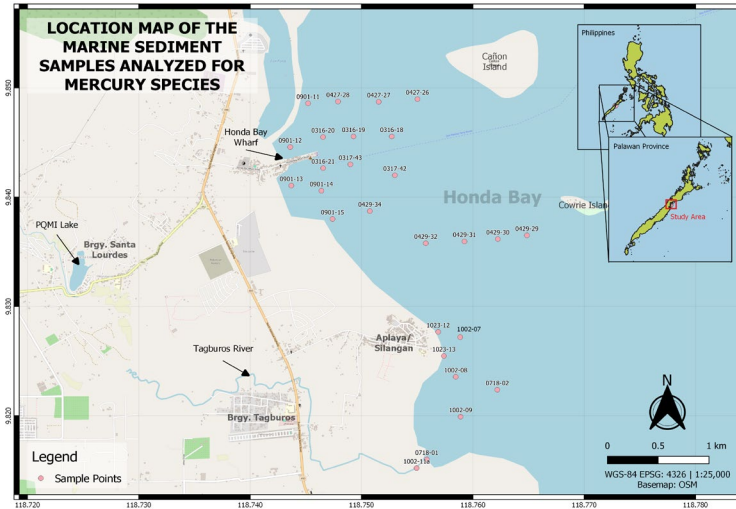


Lobster (*Panulirus ornatus*)

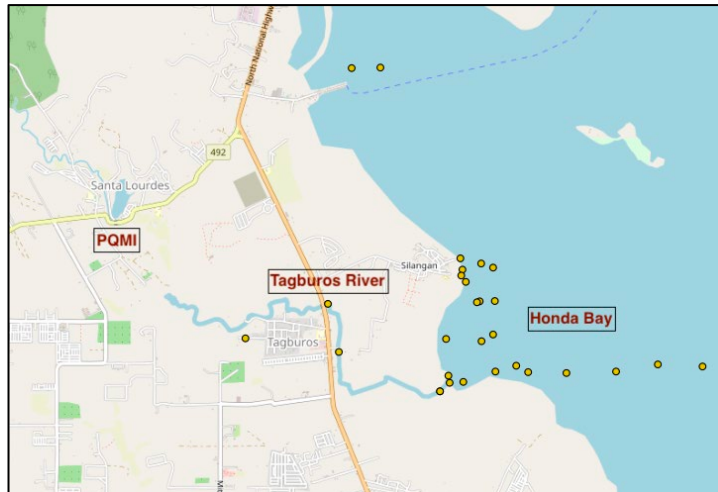


Mercury speciation

Sampling points



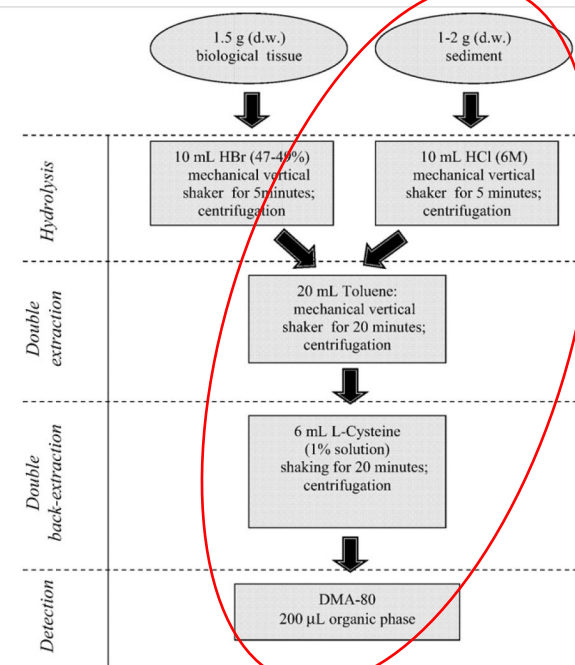
Coastal samples



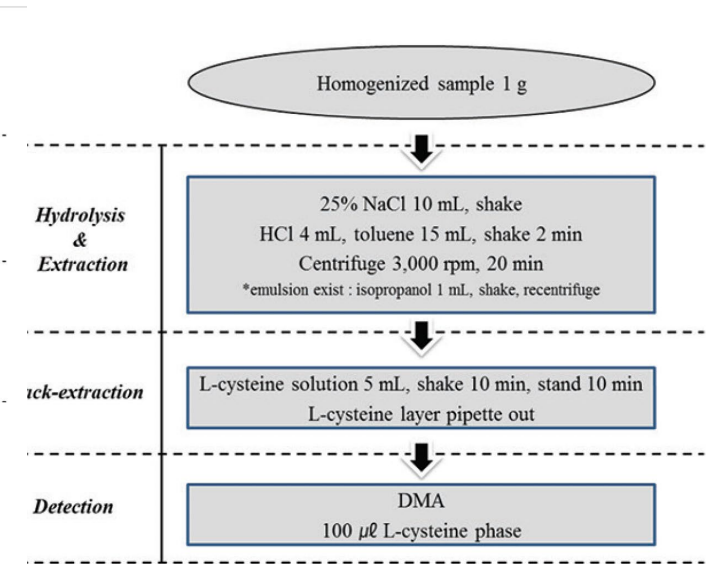
River and coastal samples

MeHg

MeHg in sediment (Maggi et al, 2009)



MeHg in biota (Kim et al, 2020)



Hg Species

Stepwise heating program using DMA 80 evo (Milestone), following methods by Windmoller et al (2017). Temp.: 50 °C, 100 °C, 150 °C, 200 °C, 250 °C, 300 °C, 400 °C, 500 °C, 600 °C, 700 °C, and 850 °C



Results

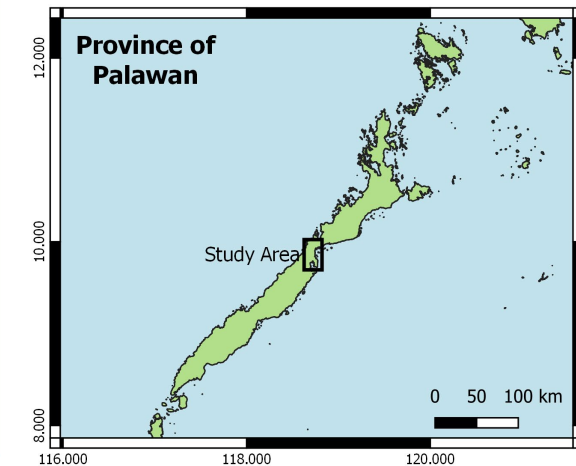
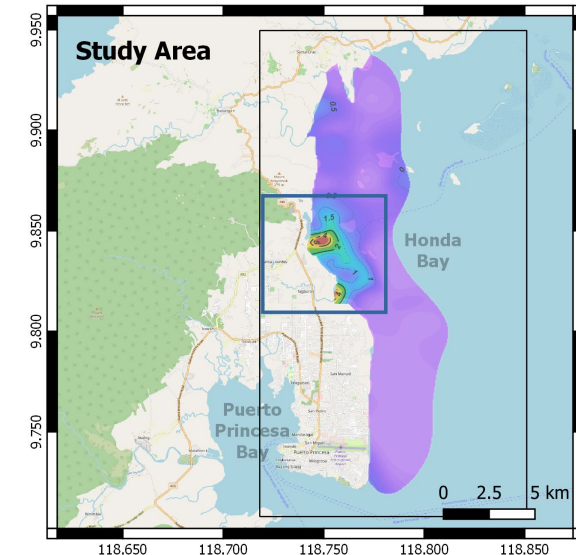
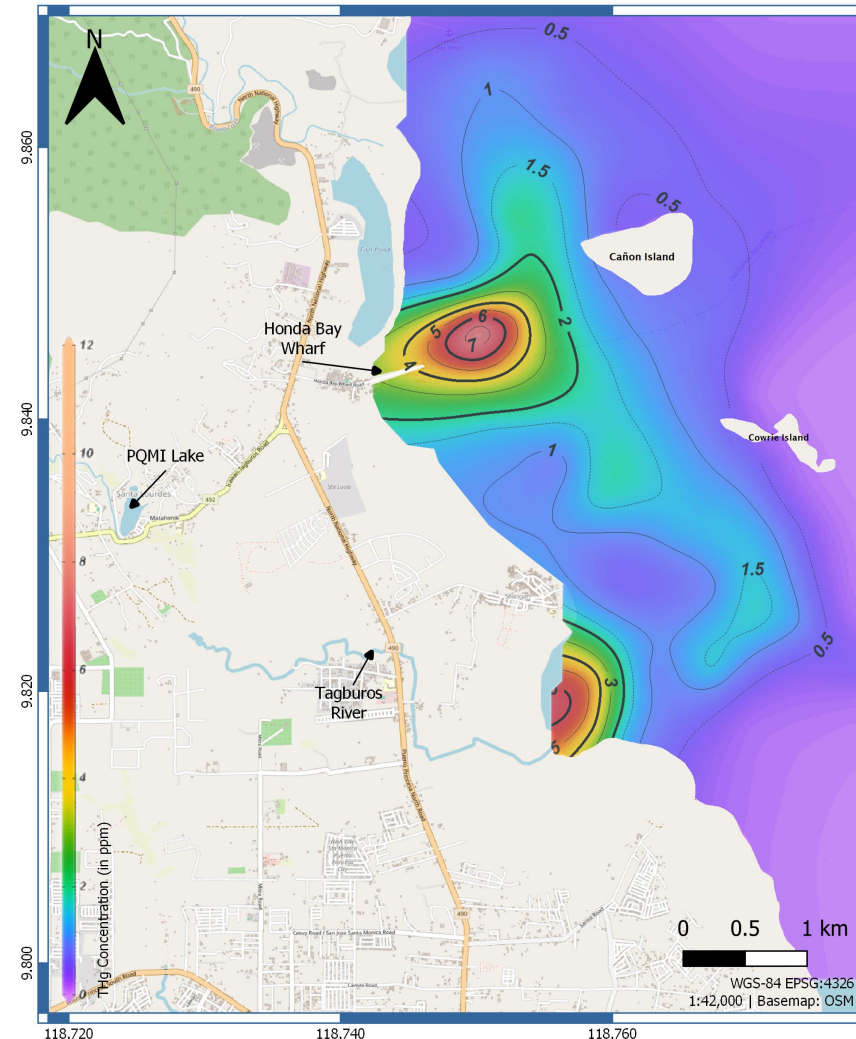
Distribution of total mercury concentration in surface sediments.

➤ Mercury hot spots:

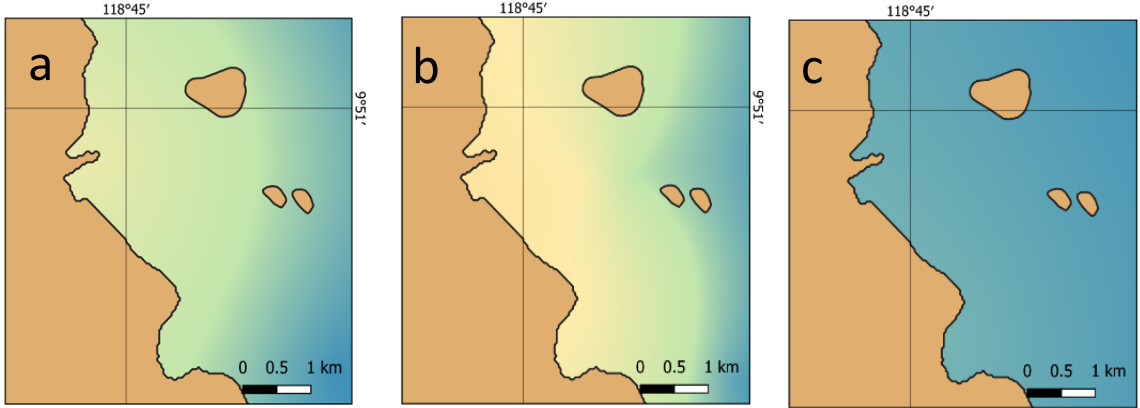
Honda Bay wharf
(1.50 – 11.70 mg/kg)

Tagbueros River mouth
(1.09 – 5.84 mg/kg)

➤ Mercury in the sediments of Honda Bay is the highest among coastal regions of the Philippines



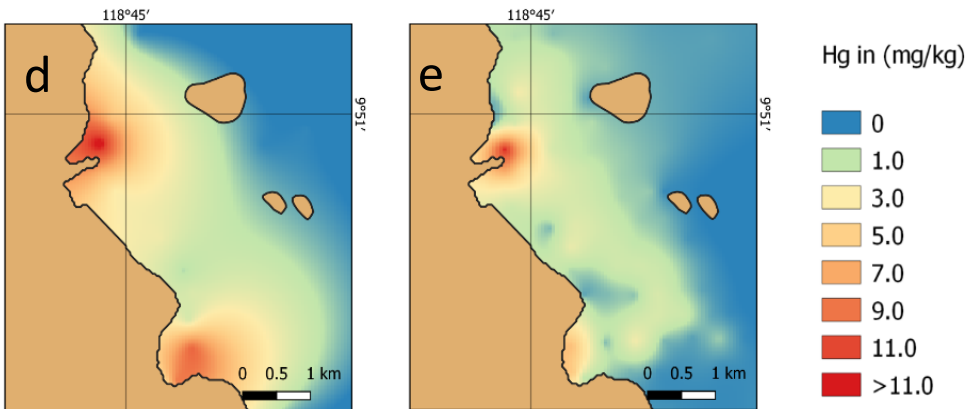
Total mercury concentration in Honda Bay coast measured in different sampling years by different authors. **(a)** 1979. **(b)** 1994. **(c)** 1999. **(d)** 2019. **(e)** 2022.



1979 Hg Concentrations
(Kapuan et al, 1982)

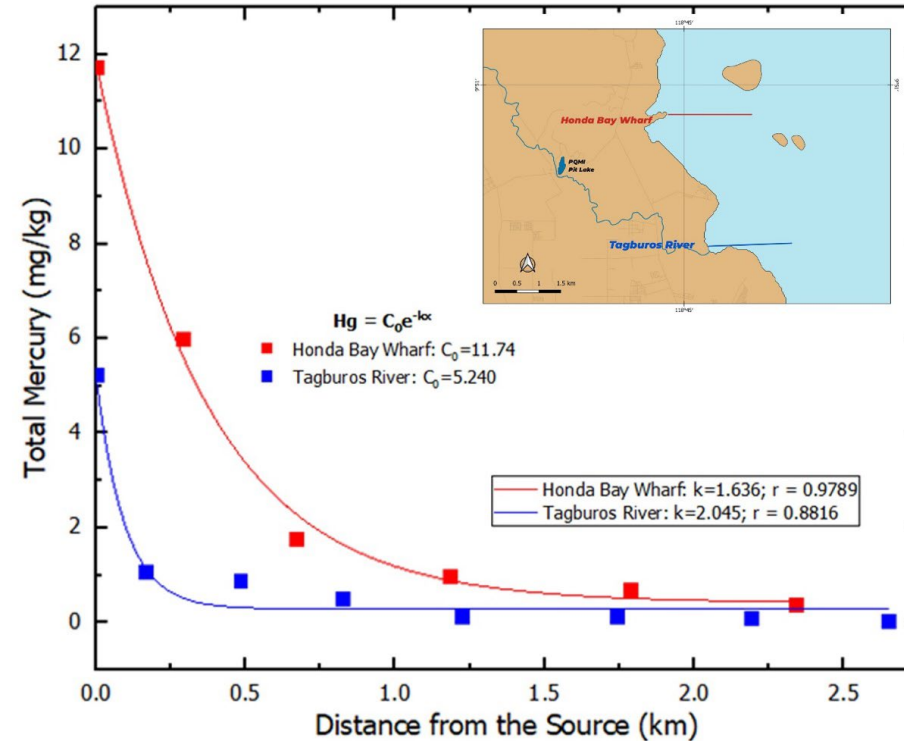
1994 Hg Concentrations
(Benoit et al, 1994)

1999 Hg Concentrations
(Williams et al, 1999)



2019 Hg Concentrations
(Samaniego et al, 2019)

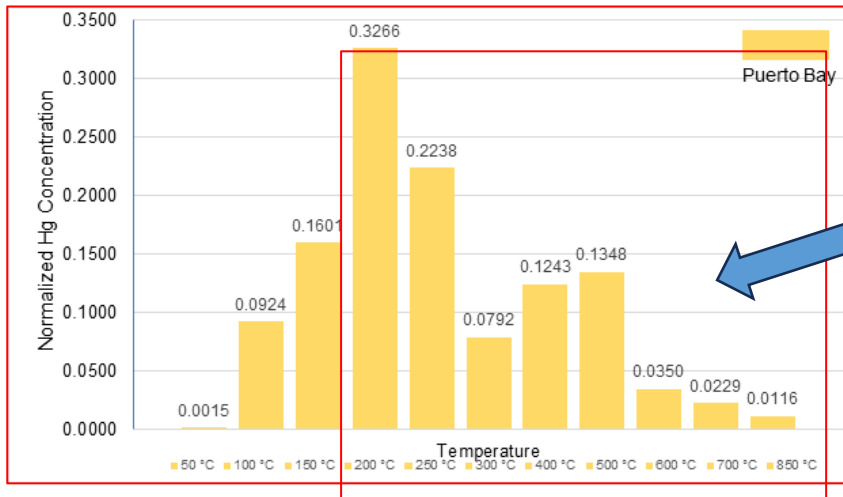
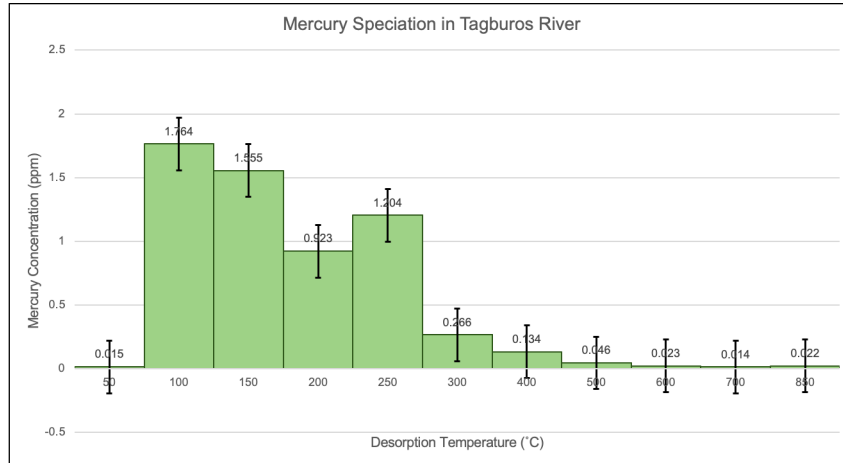
2022 Hg Concentrations
(This Study)



Mercury concentration decrease in surface sediments as a function of distance from Honda Bay wharf and Tagburos River mouth



Mercury species



50 °C = elemental mercury Hg(0);
100 to 150 °C = Hg(I)
200 °C = organic and inorganic Hg(II)

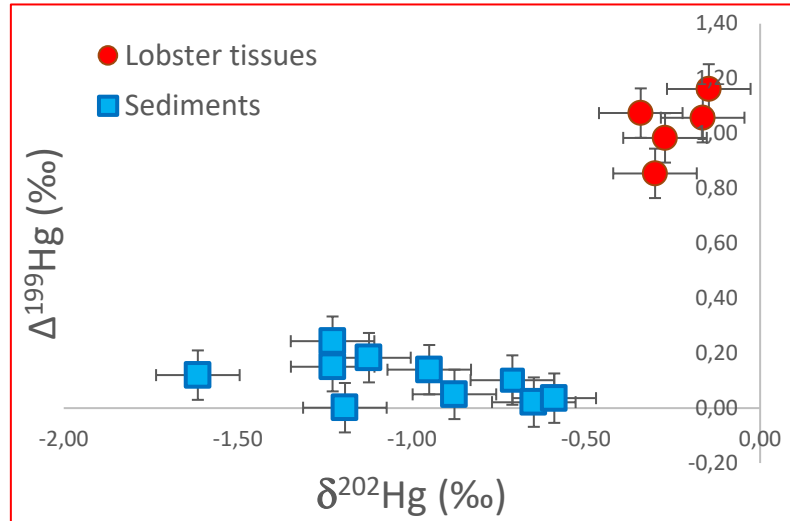
Methylmercury

- Sediment: 0.01 – 0.52 ppm
(1.2 – 2.4% MeHg/THg)
- Biota: 0.005 – 0.007 ppm
(0.24 – 0.64% MeHg/THg)

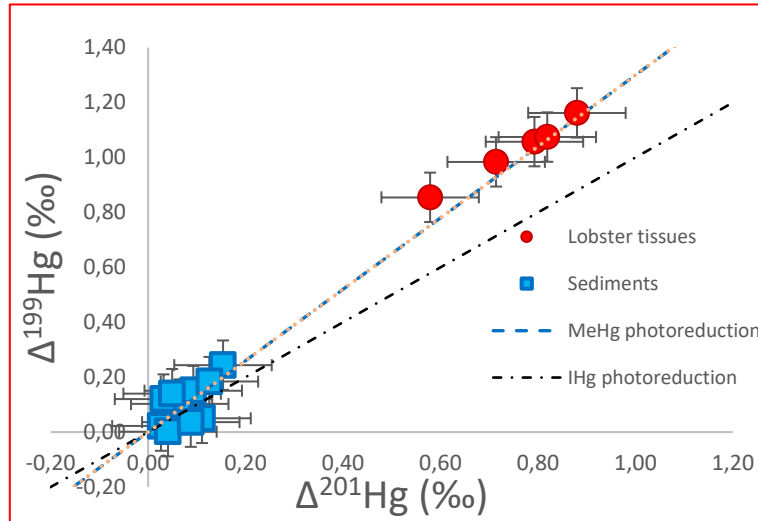
Oxidized Hg
(Hg II)



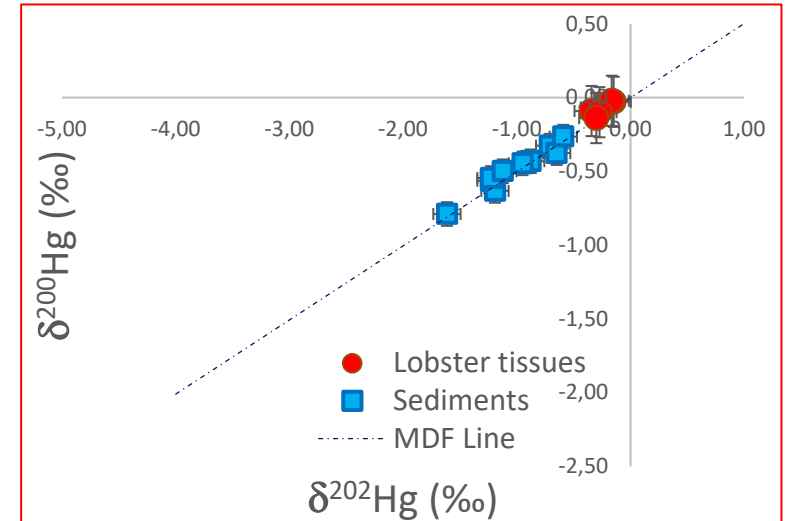
Mercury isotopic compositions



High ^{199}Hg in lobster due to feeding in shallow water part of the bay, where light penetration and MeHg degradation is higher.



MIF ^{199}Hg and ^{201}Hg in lobster lies in MeHg photoreduction line, suggest that the mercury from soil and sediments undergo photochemical reduction before entering the food chain.



Both lobster and soil and sediment samples are plotted well against the MDF line, indicates Hg in lobster are coming from the sediment in the area.



Conclusions

- This study indicates a rising trend in Hg concentrations within Honda Bay's coastal sediments, attributed to the erosion of heavy metal-laden soils from nearby abandoned mercury mine.
- Mercury species in marine sediment are in oxidized form. Methylmercury in sediment is within the typical range of MeHg in global data of MeHg in soil and sediments (1.5%).
- Hg isotope composition revealed that mercury found in biota are came from the sediment which is traced from the eroded mine soil.
- Rehabilitation of the mined-out area is needed by the city government to address the increasing contamination Hg in the coast.





ICMGP 2024

CAPE TOWN • SOUTH AFRICA • 21 - 26 JULY

Thank you very much.

Acknowledgement:



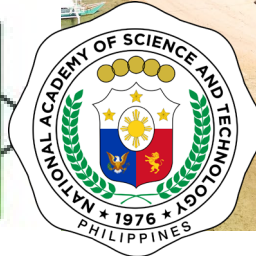
DOST - PNRI



DOST - PCIEERD



SCIENTIFIC CAREER SYSTEM



CITY OF
PUERTO PRINCESA



WESTERN PHILIPPINE
UNIVERSITY

