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Mercury and Other Trace Elements in the Sediments and Representative Biota of an Anthropogenically Impacted Estuary

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Estuaries

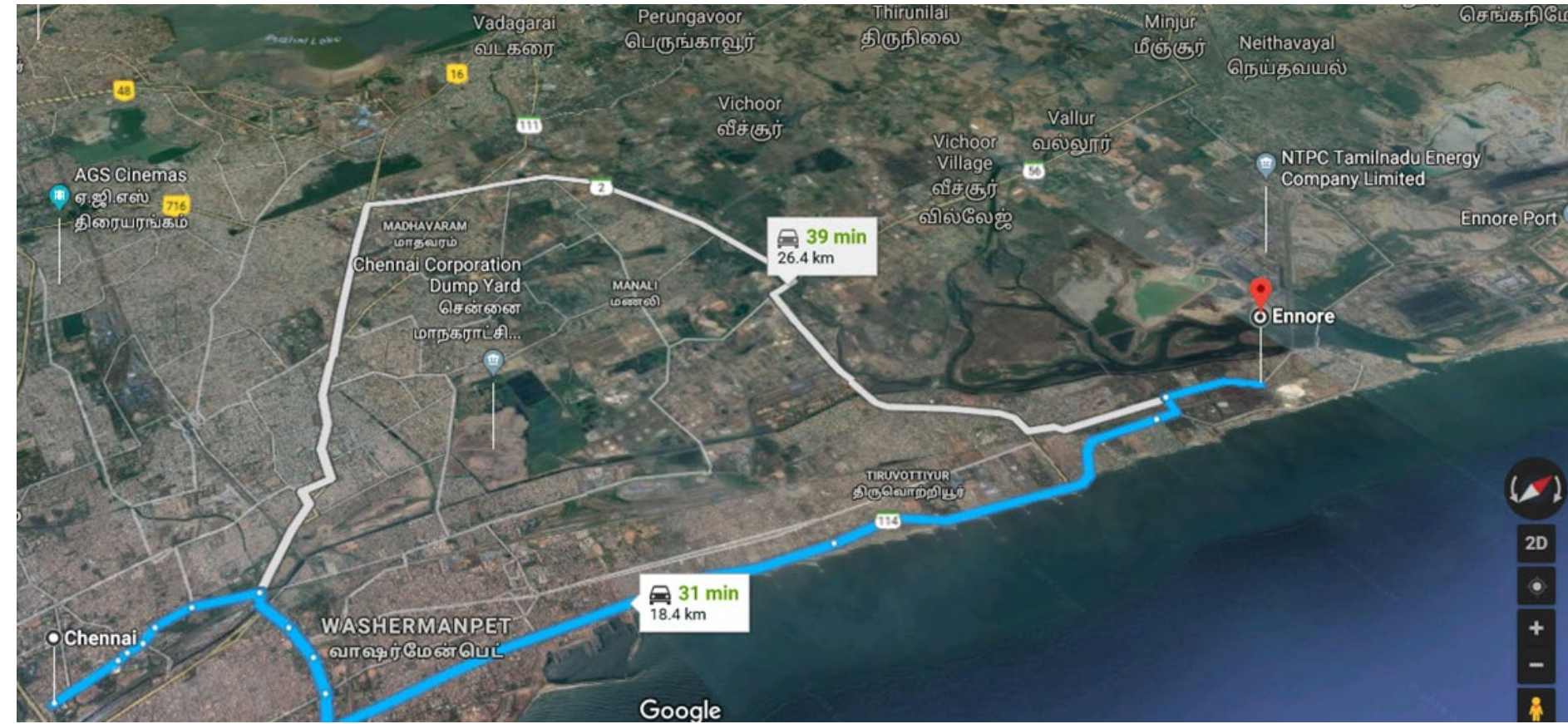
- Vulnerable and dynamic coastal ecosystems
 - Often rich in biodiversity and providing vital ecological services
- Many estuaries face pollution problems
 - Industrial and urban discharges
- Act as a repository for Hg, MeHg and other heavy metals

Some key considerations

- Anthropogenically impacted, and anthropogenically inhabited (in vicinity) estuaries
 - What is the ecological health, in terms of levels in species supported in the estuary
 - Can a level of contamination be related to the industries or industrial discharges?



Ennore Estuary, India



Ennore Estuary, India

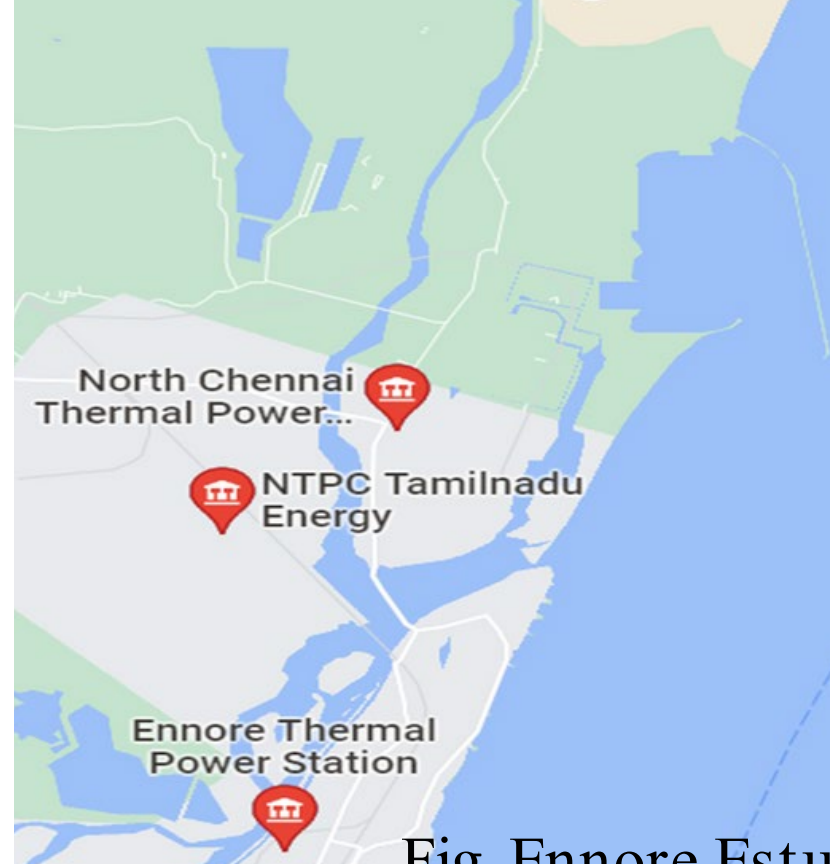
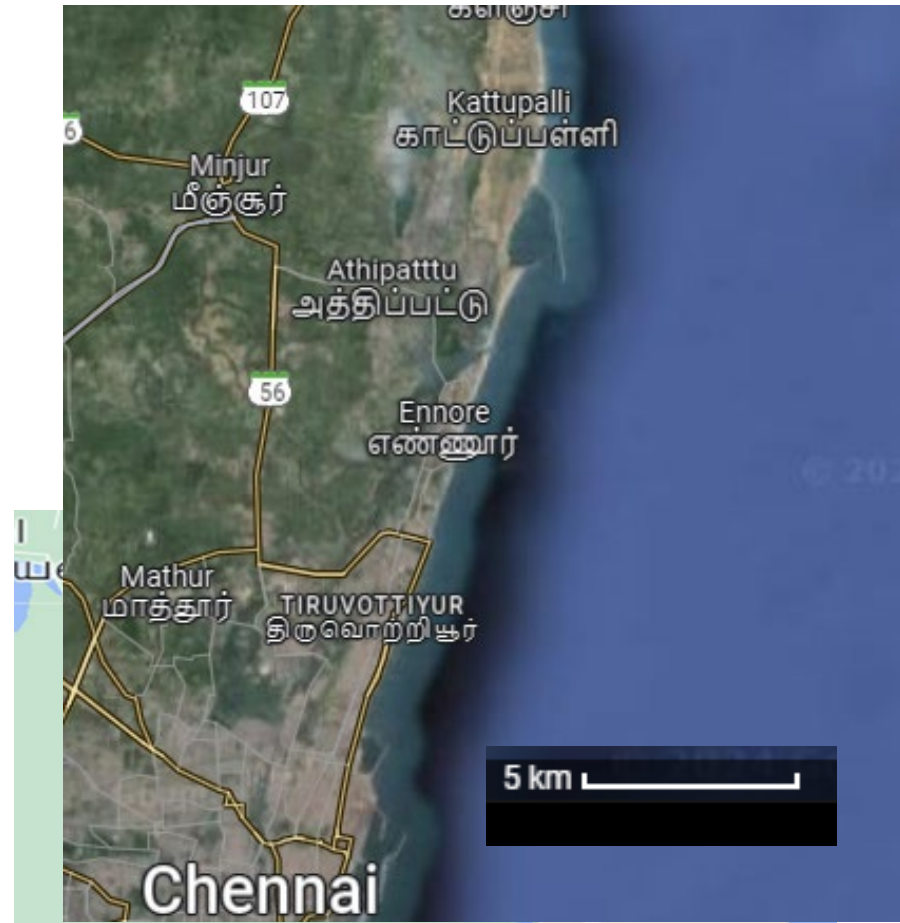


Fig. Ennore Estuary





Ennore Estuary, India

- Highly impacted by power plants fly ash
 - Municipal, petrochemical discharges as well
- East:
 - North Chennai Thermal Power Station (NCTPS) 3×210 MW; 2x 600 MW
 - Kamaraj Port Limited (KPL; formerly known as Ennore Port)
- West:
 - Chettinad International Coal Terminal
 - NTECL's Vallur Thermal Power Plant 3×500 MW
 - HPCL – Hindustan Petroleum Corporation Limited
- South: Ennore Thermal Power Plant
- New proposals for thermal power projects
 - 3600 MW total

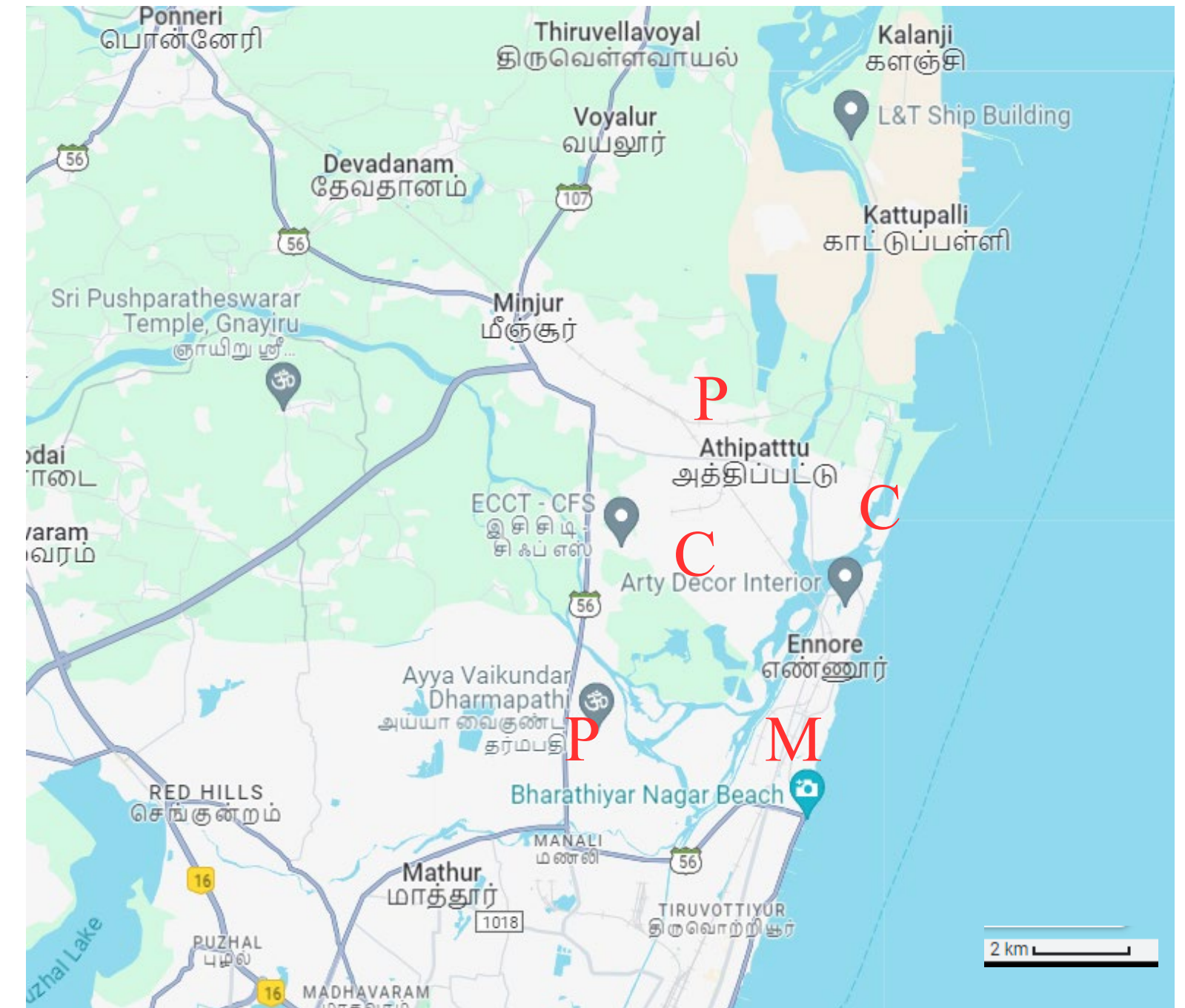


Fig. Ennore Estuary



GOALS

THg, MeHg, As, Cd, Cr, Pb, Se

- Conditional Assessment
 - Surface sediments
 - Aquatic organisms: shrimps, fiddler crabs and mussels
 - Geo-accumulation Index for assessing pollution enrichment
 - Compare aquatic THg values to USFDA 0.5 ppm THg limit, India 0.25 ppm MeHg limit in fish



<https://biology-assets.anu.edu.au/>

Relation to industrial pollution (with focus on fly ash)

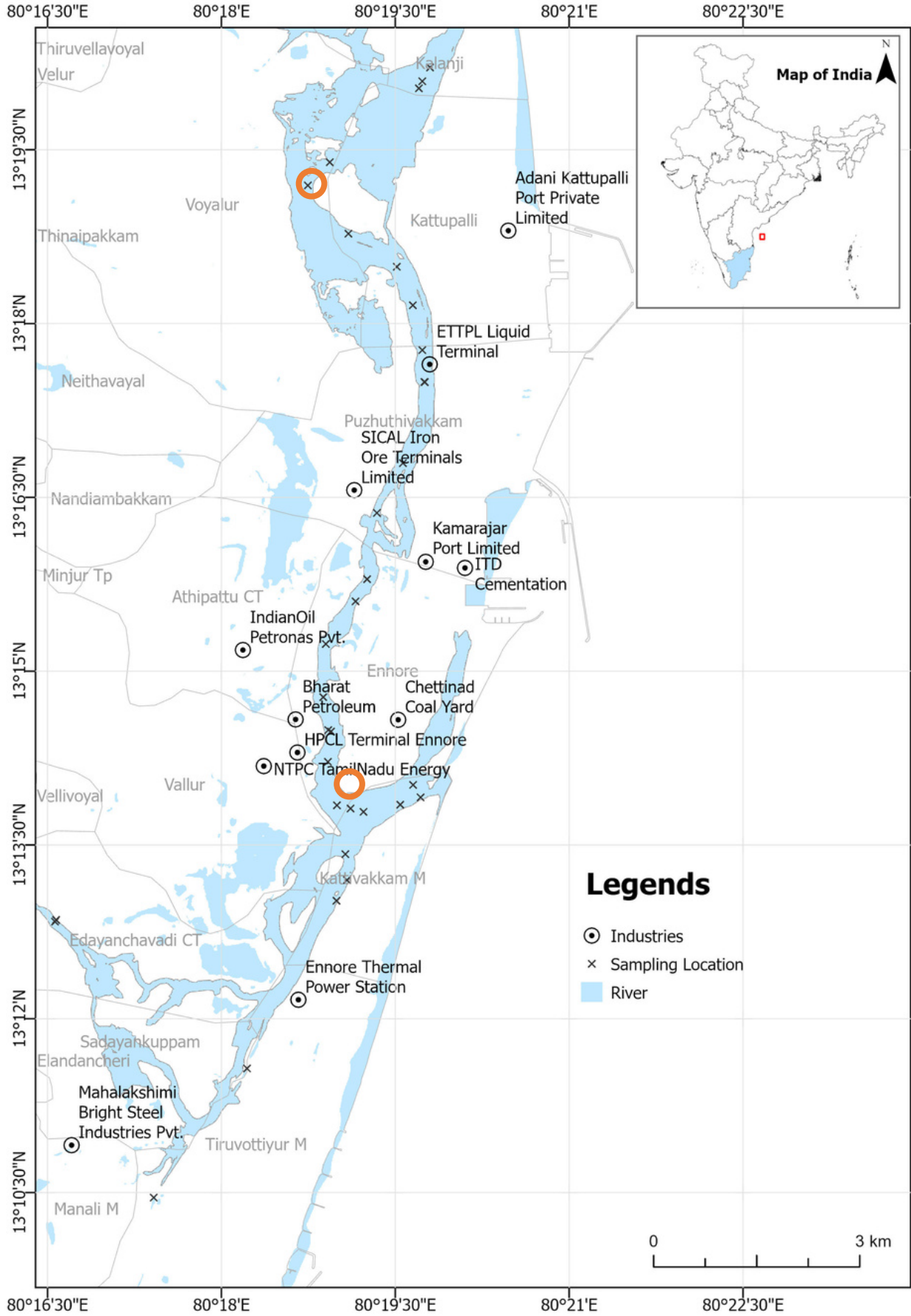
- Physico-chemical analysis of surface sediments and two cores
 - SEM, XRD, XRF: major chemical constituents, oxides, presence of fly ash (amorphous content as proxy)
 - Correlations with THg, MeHg and other elements
 - Date the core (to be done)

2 'control' coastal sediments were taken from about 35 km away, in an area with no industries (although there will be place with no human footprint)

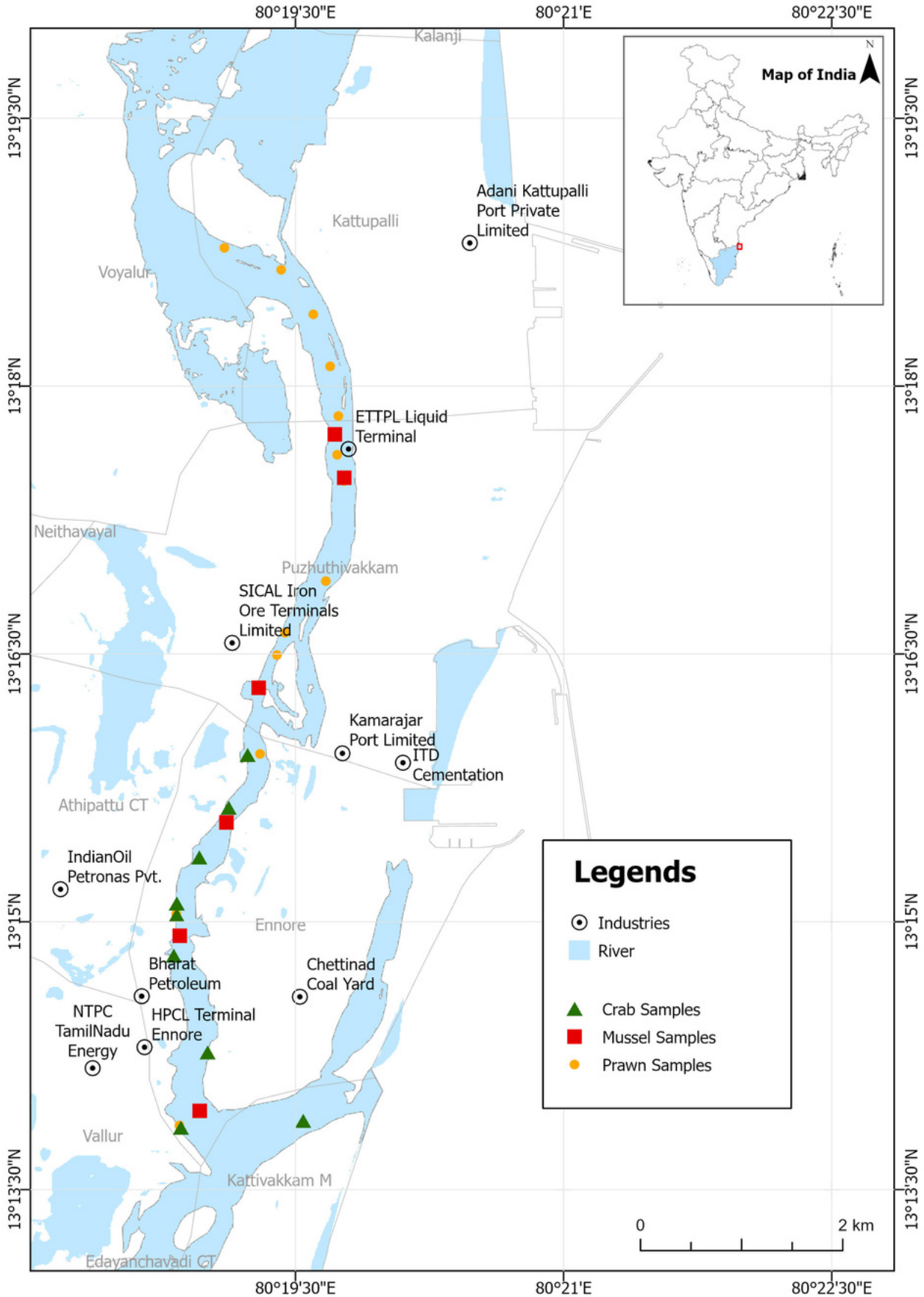


Sa mpling

Sediments (incl. core)



Biota



Results

THg and MeHg

Total Mercury and Methylmercury in sediment (mg/kg) and biota (µg/kg) [min- max; mean ± SD]

Concentration µg/kg	THg	MeHg	MeHg/ THg, %	TOC, %
Sediment (n = 38)	2.4- 106 74 ± 19	1.7- 8 4 ± 2	0.4- 99 34 ± 32	1.8- 16.1 4.3 ± 3.2
Control Site (n=2)	1.5- 3	0.3- 0.6	16- 38	0.49- 1
Shrimp (n = 13 x 5)	3.9- 32 9.4 ± 4.3	3.7- 14 7.9 ± 2.6	40- 107 88 ± 16	-
Fiddler crab (n = 10 composites)	1.2- 23 8.6 ± 7.7	0.6- 15 6.3 ± 5.6	32- 96 68 ± 18	-
Mussel	29- 55 41 ± 7	19- 32 26 ± 4.3	34- 85 64 ± 15	-



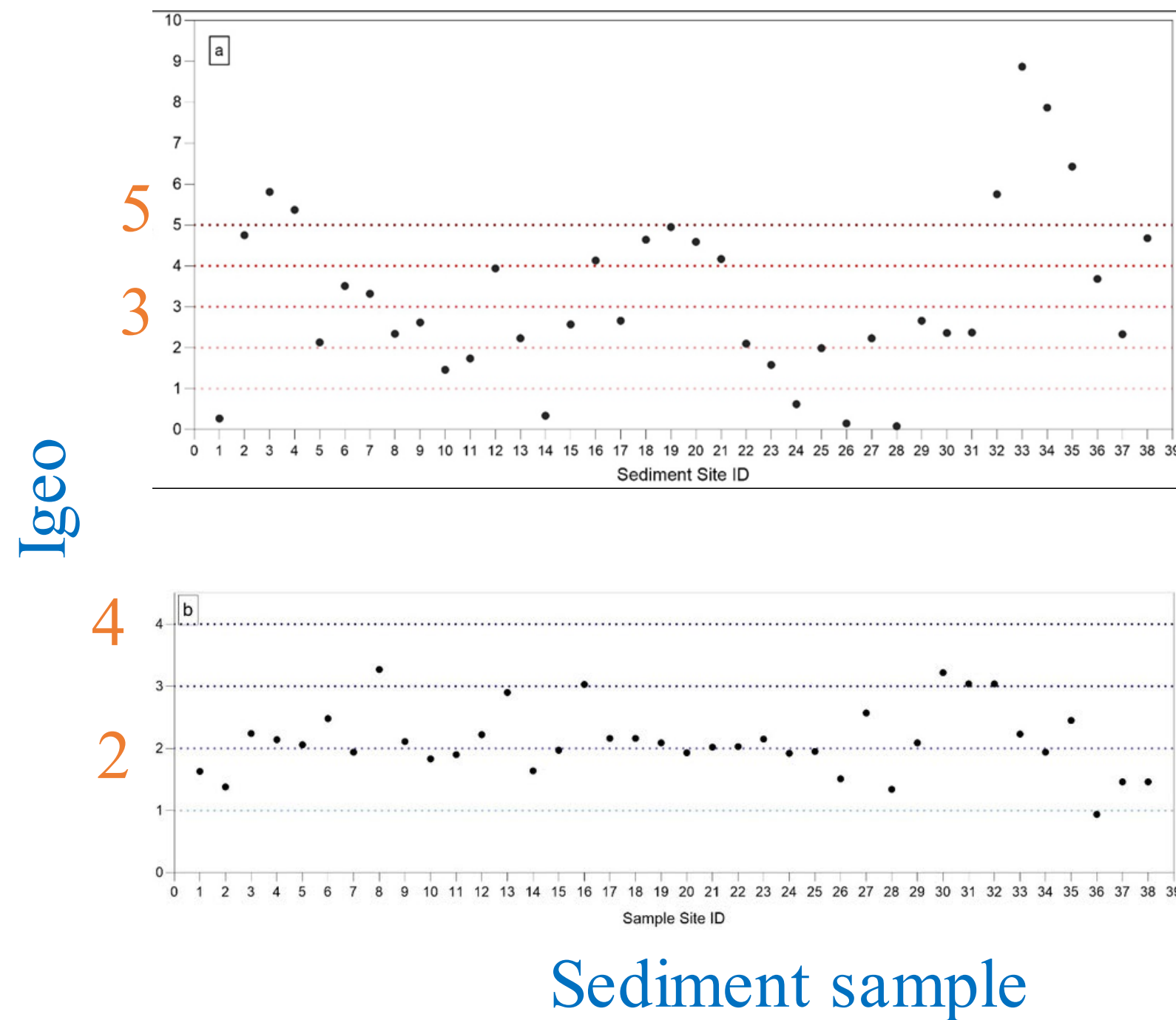
Comparison of THg and MeHg concentrations in Ennore estuary with other estuarine and coastal environments throughout the world

Place	THg (mg/ kg)	MeHg (mg/ kg)	References
Present study	0.0024- 1.061	0.0017- 0.008	
Vembanad Estuarine system, Kerala, India	0.03- 2.9	0.014- 0.257	(Sruthi et al., 2018), (M.B. et al., 2023)
Port of Kaohsiung, Taiwan	0.198- 9.13	0.0003- 0.0426	(Chen et al., 2020)
Nalon estuary, Asturias, Spain	0.2- 1.33	0.0003- 0.00086	(Garcia-Ordiales et al., 2018)
Jiulong River Estuary (JRE), China	0.013- 0.19	-	(Zhang et al., 2022)
Zuari Estuary, Goa, India	0.04- 0.08	0.0017- 0.0044	(Chennuri et al., 2020)
Yellow River Estuary, China	0.0068- 0.087	0.00006- 0.00015	(X Liu et al., 2023)



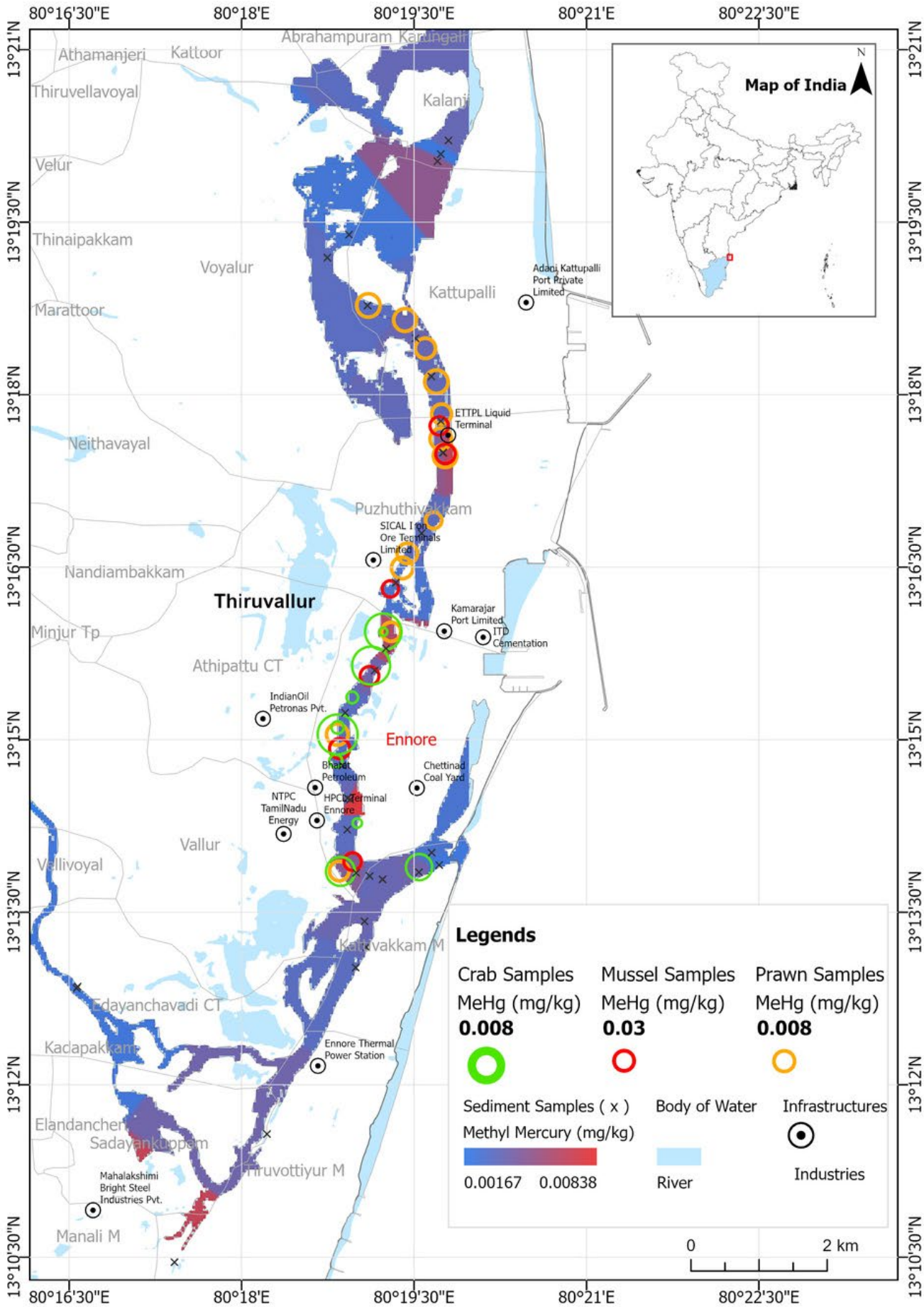
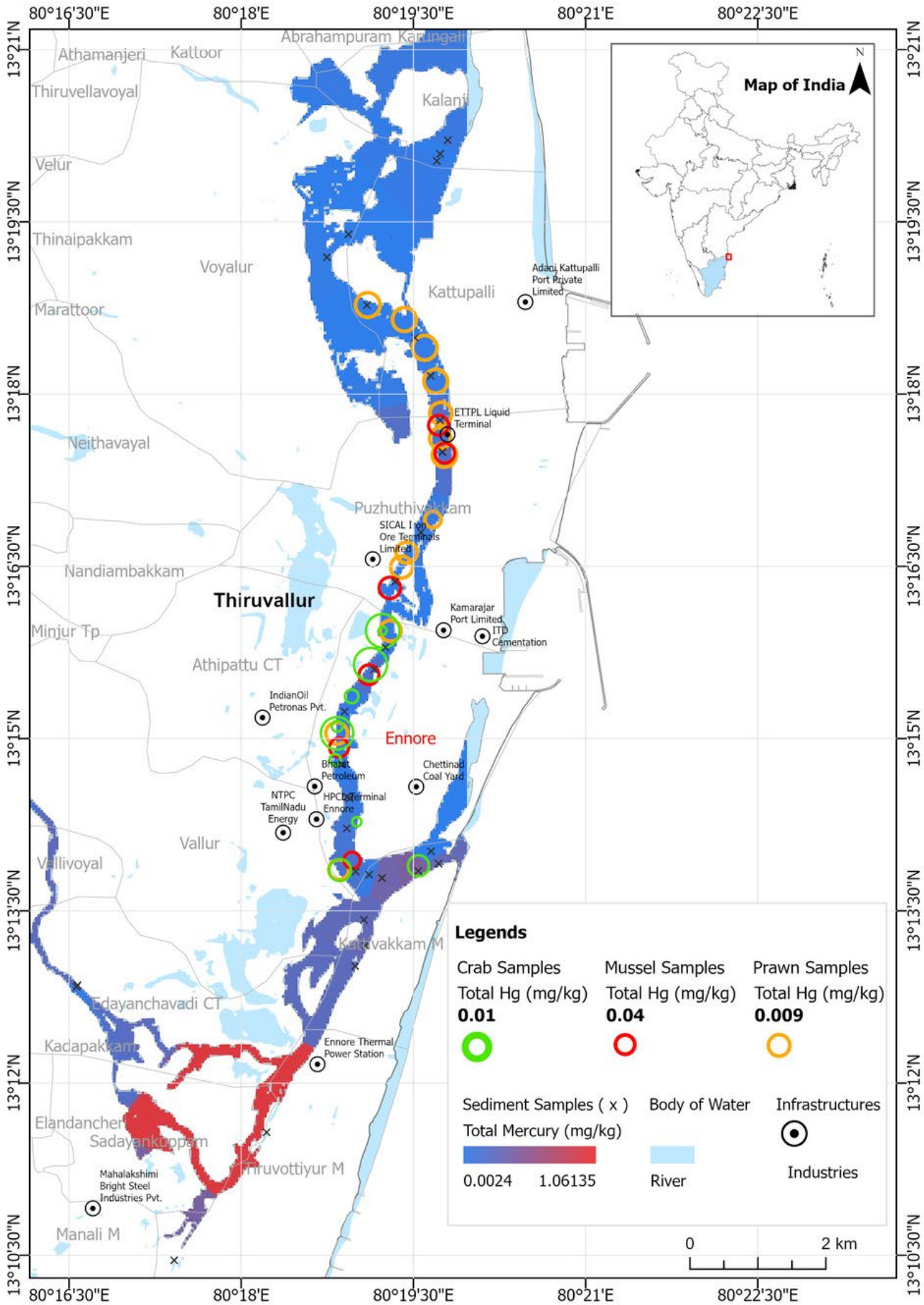
Geoaccumulation index (Igeo): THg & MeHg

- Hg: 32% of the sampling sites were classified as moderately to heavily polluted for THg
- MeHg: 45%

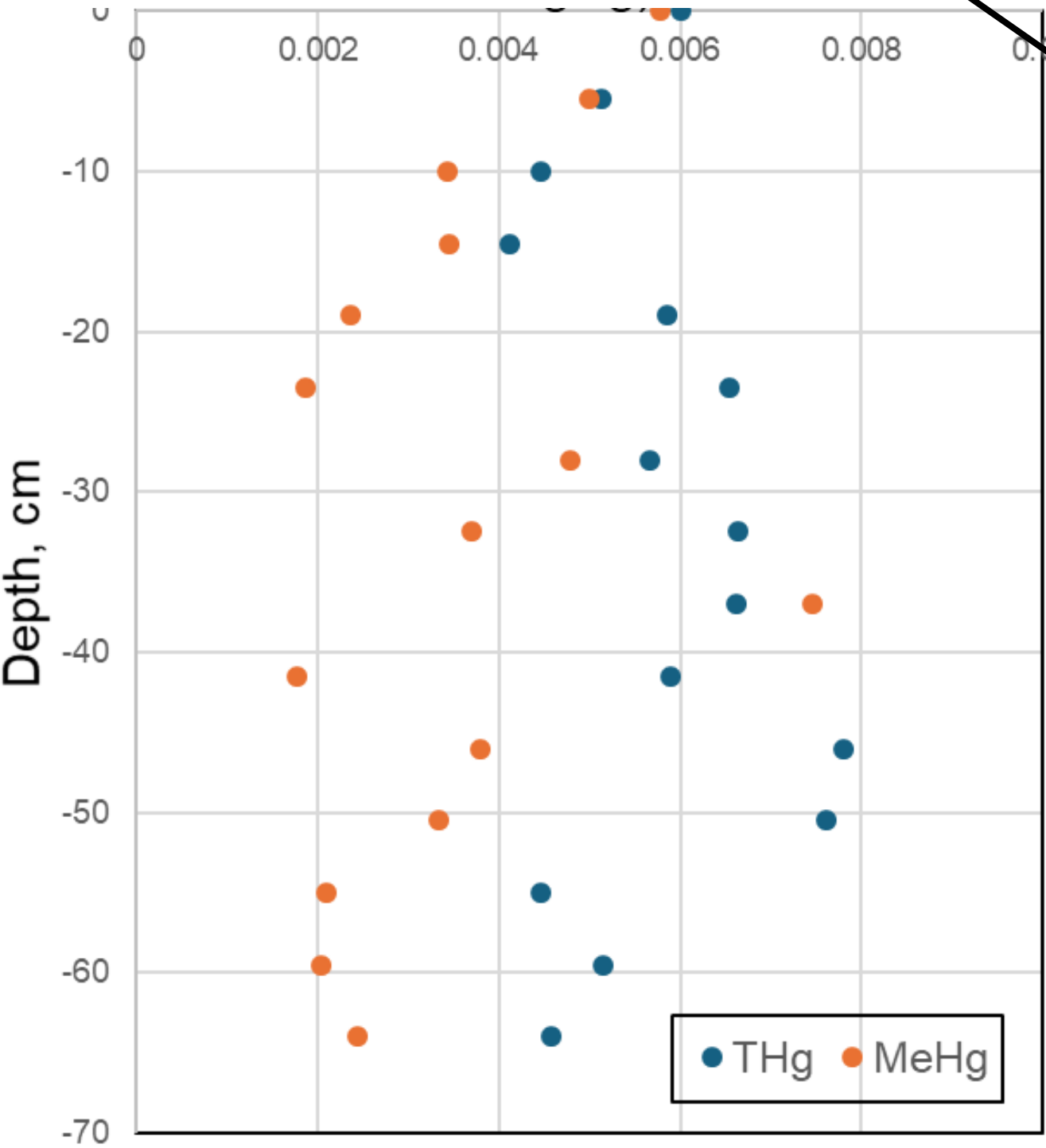


THg

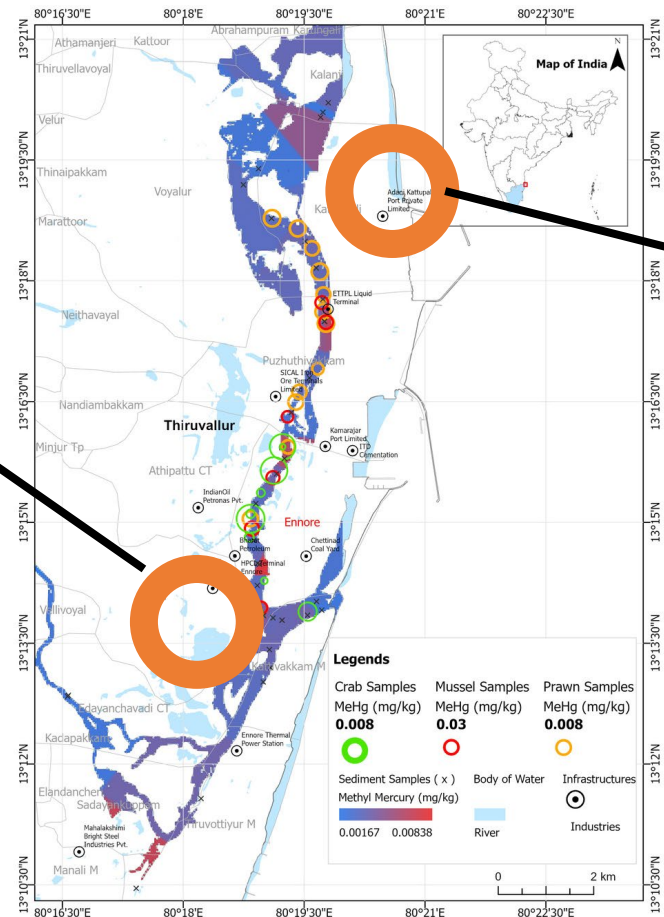
MeHg



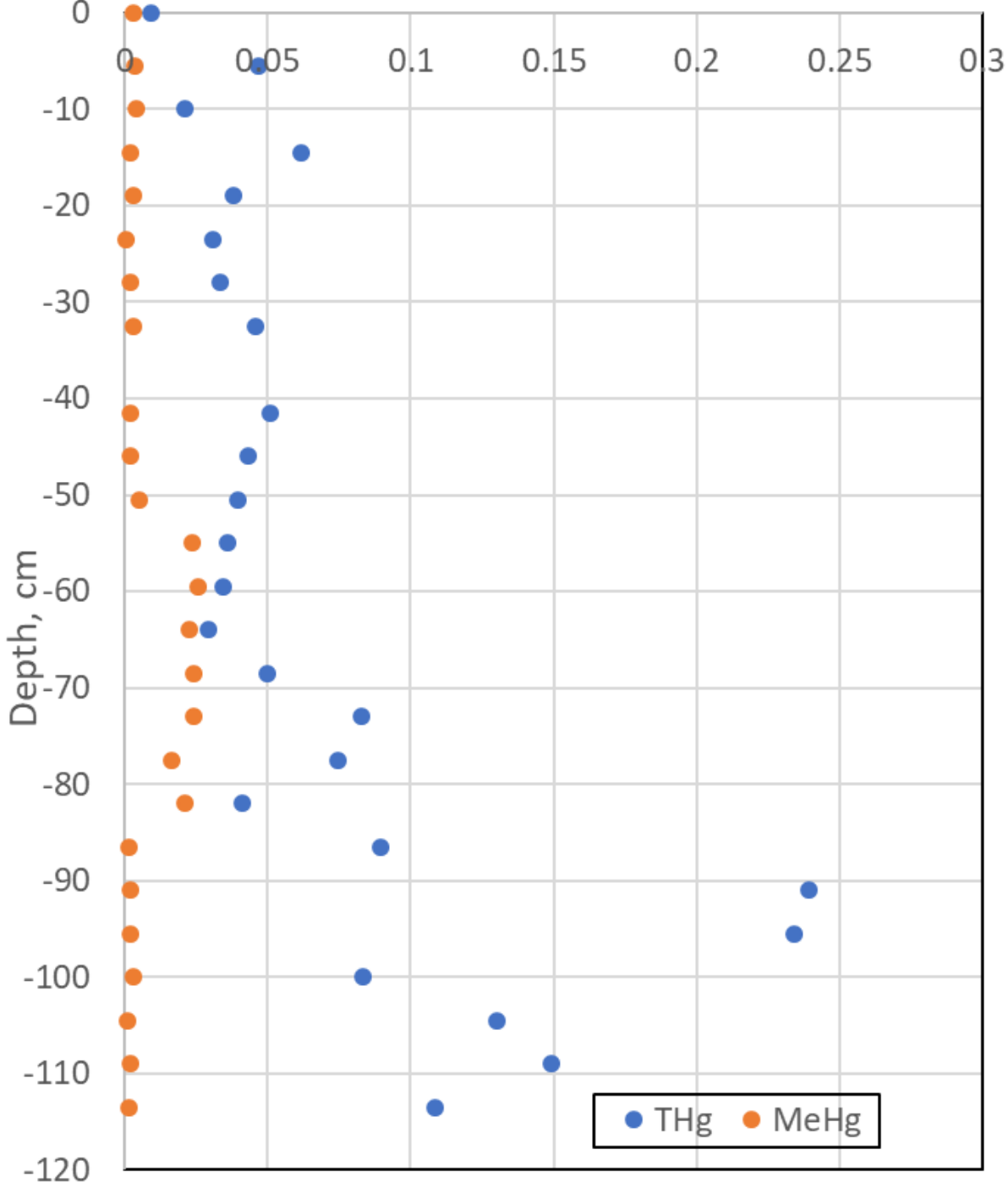
Core 1



THg and MeHg (mg/kg)



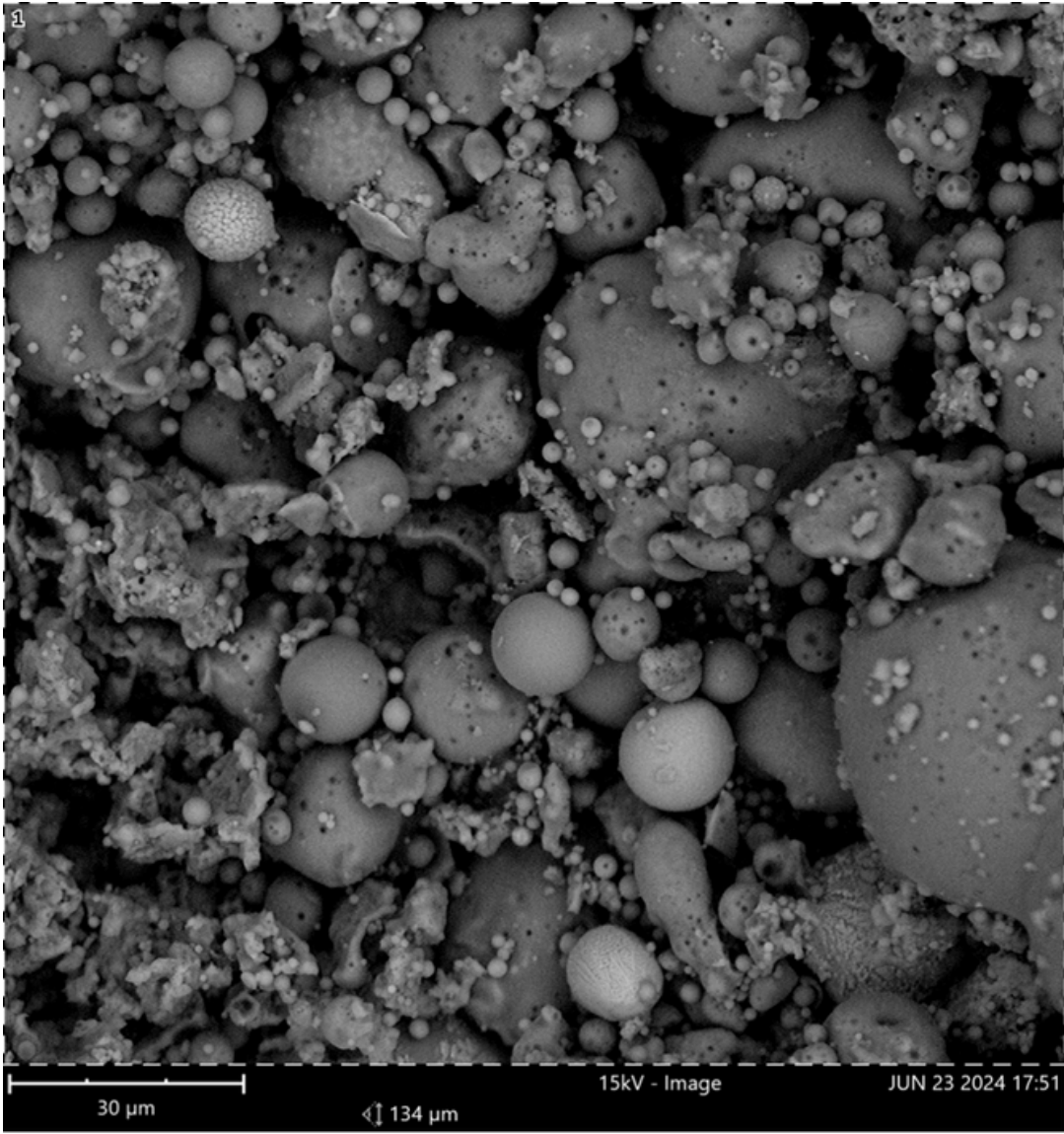
Core 2



THg and MeHg (mg/kg)

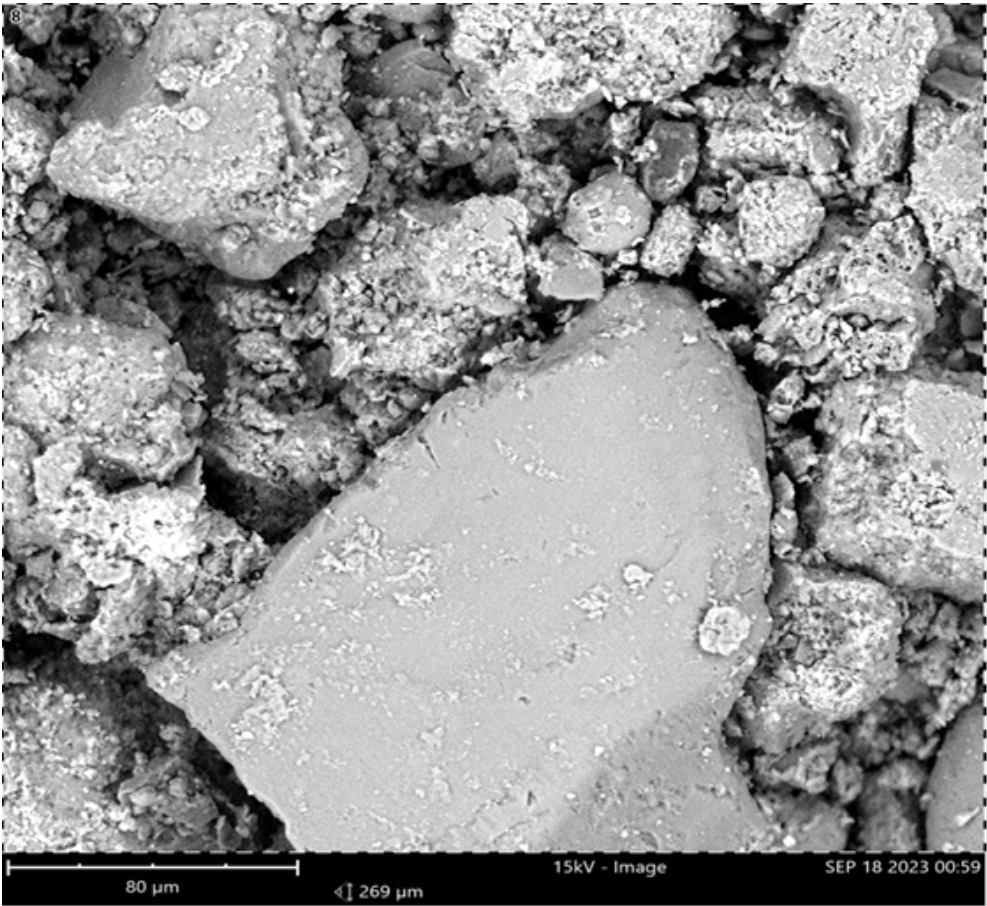
SEM

Fly a sh

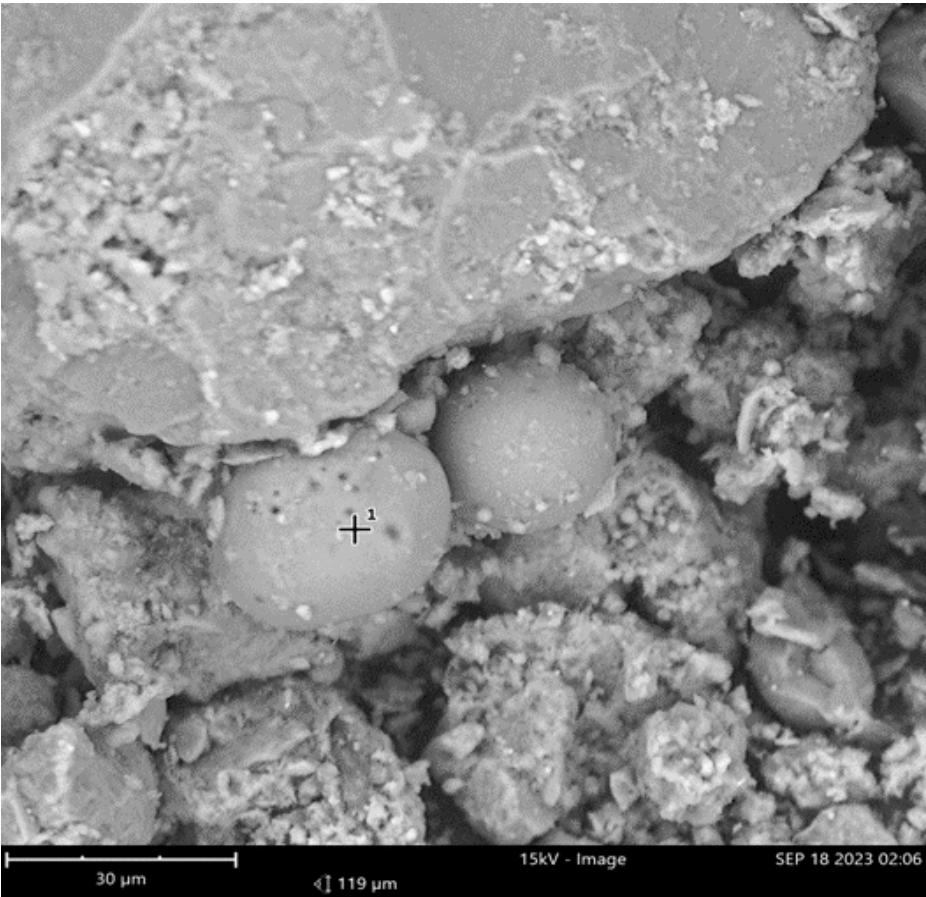


Sediment sample

Region analysis



Point analysis



Fly ash percent

Amorphous content as proxy

Sample	Amorphous content %	Fly ash %
Fly ash	49.7	100.0
Sample 1	19.3	38.8
Sample 2	9.1	18.4
Sample 3	13.5	27.1

Fly ash % with Elements

Element	r	p- value
THg	-0.09	0.67
As	0.19	0.40
Cd	-0.03	0.90
Cr	0.39	0.08
Pb	0.46	0.03
Se	-0.39	0.07
MeHg	-0.11	0.65

THg with Elements

Element	r	p- value
As	0.17	0.3
Cd	0.69	< 0.01
Cr	0.07	0.65
Pb	0.05	0.74
Se	0.43	< 0.01

SUMMARY

- In terms of metrics, yes, the estuary appears impacted
- Looks like, contribution from fly ash, but also other sources, depending on location
- More work on understanding sources is ongoing

Thank you

Talk 26th: Room 1.6 9:45 - 10 AM

If You Don't See It Doesn't Mean It Is Not Working:
Sample Size And The Effectiveness Evaluation Of The Minamata
Convention

Instruction : Don't worry about the session name

