

GS-012: Heavy Metal Concentration in River Sediments of Sungai Lebir, Sungai Galas, and Sungai Kelantan

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INTRODUCTION

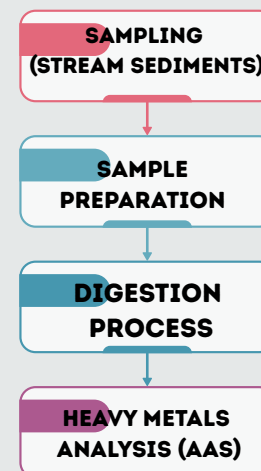
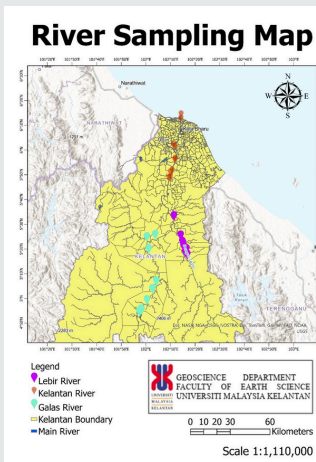
Heavy metal contamination in river sediments has become a major environmental concern due to its persistence in aquatic environments (Saravanan *et al.*, 2024). Rivers act as major transport pathways for land-based pollutants, with reduced flow in downstream areas leading to the accumulation of heavy metals and increased contamination (Wang *et al.*, 2025). Heavy metals enter river systems through runoff, rainfall, and industrial discharges. Elements such as iron (Fe), manganese (Mn), zinc (Zn), cadmium (Cd), and nickel (Ni) can originate from both natural processes like rock weathering and anthropogenic activities such as mining, industrial discharge, and agricultural runoff (Hashim, *et al.* 2014).

These metals can accumulate in aquatic organisms and transfer through the food chain, posing risks to human health (Zhang *et al.*, 2019; Sufiani, & Ishak., 2015) While several studies have addressed water quality in Kelantan's rivers (Abdullah *et al.*, 2020; Hashim *et al.* 2014). A comprehensive assessment focusing on sediment contamination across major river systems remain limited. This study aims to address this gap by systematically evaluating the concentrations of Fe, Mn, Zn, Cd, and Ni in the stream sediments of Sg Lebir, Sg Galas, and Sg Kelantan.

METHODOLOGY

Study Area and Sample Collection

A total of 29 sediment samples were collected at a depth of 50 cm using a hand auger from selected points along the three rivers. 10 : Sg Lebir (LS1-LS10), 9 :Sg Galas (GS1-GS9), 10 : Sg Kelantan (SK1-SK10).



Sample Preparation

The stream sediments were first air-dried and oven dried in a furnace at 80°C for 48 hours to ensure complete removal of moisture. The samples were then manually ground using a pestle. The powdered samples were then sieved through a 500 µm mesh and collected in sampling bags and properly labelled

Sample Preparation

The stream sediments were first air-dried and oven dried in a furnace at 80°C for 48 hours to ensure complete removal of moisture. The samples were then manually ground using a pestle and mortar until a fine powder was obtained. The powdered samples were then sieved through a 500 µm mesh and collected in sampling bags and properly labelled

Digestion

First, each 4.00 g sample was treated with concentrated nitric acid and hydrogen peroxide under controlled heating to achieve complete digestion. The digested solution was filtered and diluted to a final volume of 100 mL using distilled water.

Heavy Metal Analysis

The concentration of Iron (Fe), Manganese (Mn), Zinc (Zn), Cadmium (Cd), and Nickel (Ni) in each samples were quantified in ppm using PerkinElmer PinAAcle 900F Flame Atomic Absorption Spectrometer (AAS). The data quality was assured via reagent blanks and standard reference materials.

RESULTS

Sample	Fe (ppm)	Mn (ppm)	Zn (ppm)	Cd (ppm)	Ni (ppm)
GS1	973.60	6.60	1.26	0.02	0.56
GS2	664.80	6.17	1.16	0.01	0.19
GS3	472.20	4.67	0.58	0.01	0.19
GS4	938.00	5.57	0.66	0.02	0.10
GS5	476.70	13.42	0.92	0.02	0.19
GS6	394.80	16.44	2.11	0.03	0.28
GS7	489.50	17.97	1.21	0.02	0.17
GS8	402.00	8.82	0.65	0.01	0.13
GS9	514.00	18.19	1.14	0.02	0.15
Range	394.80 – 973.60	4.67 – 18.19	0.58 – 2.11	0.01 – 0.03	0.10 – 0.56

Table 1: Concentration of Heavy Metals (Fe, Mn, Zn, Cd, Ni) in sediment samples from Sg Galas (GS).

Sample	Fe (ppm)	Mn (ppm)	Zn (ppm)	Cd (ppm)	Ni (ppm)
LS1	476.90	348.90	1.21	0.02	0.58
LS2	346.20	174.60	1.04	0.01	0.32
LS3	127.70	24.09	1.26	0.01	0.11
LS4	502.70	250.50	1.45	0.03	0.76
LS5	665.50	361.60	1.20	0.01	0.54
LS6	359.10	229.50	1.44	0.02	0.48
LS7	755.40	509.10	2.04	0.04	1.07
LS8	332.30	133.30	1.23	0.02	0.30
LS9	563.60	207.50	1.70	0.04	0.46
LS10	183.40	84.22	0.81	0.02	0.16
Range	127.70 – 755.40	24.09 – 509.10	0.81 – 2.04	0.01 – 0.04	0.11 – 1.07

Table 2: Concentration of Heavy Metals (Fe, Mn, Zn, Cd, Ni) in sediment samples from Sg Galas (Sg Lebir).

Sample	Fe (ppm)	Mn (ppm)	Zn (ppm)	Cd (ppm)	Ni (ppm)
KA1	91.09	10.52	0.47	0.01	0.13
KA2	902.80	25.29	2.10	0.02	0.30
KA3	149.70	16.36	1.56	0.01	0.15
KA4	145.10	15.19	0.63	0.01	0.16
KA5	146.60	9.14	0.64	0.01	0.50
KA6	997.70	69.14	1.76	0.03	0.20
KA7	523.10	16.47	1.50	0.02	0.20
KA8	136.00	11.50	0.40	0.01	0.10
KA9	511.60	15.71	2.59	0.02	0.17
KA10	115.30	8.37	0.33	0.01	0.08
Range	91.09 – 997.7	8.373 – 69.14	0.328 – 2.587	0.009 – 0.026	0.084 – 0.501

Table 3: Concentration of Heavy Metals (Fe, Mn, Zn, Cd, Ni) in sediment samples from Sg Kelantan (KA).

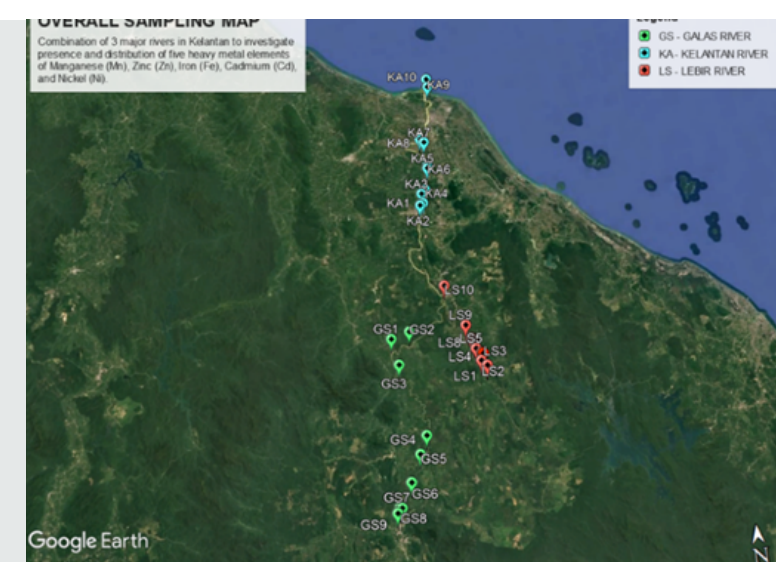


Figure: Distribution of heavy metal concentration for (a) Fe, (b) Mn, (c) Zn, (d) Cd and (e) Ni at Sg Lebir (LS), Sg Galas (GS) and Sg Kelantan (KA)

- Along the Sg Lebir, from upstream (LS1) to downstream (LS10), the concentrations of Mn, Zn, and Ni are higher in the midstream section, particularly at LS7, suggesting localised mineral sources or possible anthropogenic inputs (Wang *et al.*, 2025).
- In Sg Galas, from upstream at GS9 to downstream at GS1, Fe concentrations gradually increase along the river, with the highest levels found at GS1 and GS4.
- Sg Kelantan, where sediment samples taken from upstream (KA1) to downstream (KA10) show that Fe and Mn concentrations are highest at KA6 and KA2.

CONCLUSION

- Sampling point LS7 in Sg Lebir stands out with high concentrations of almost all measured metals, indicating a possible mineralised zone or localised pollution source.
- In contrast, Sg Galas generally records lower levels of Mn, Zn, and Ni, but exhibits high Fe concentrations at GS1 and GS4, which may reflect natural iron enrichment with minimal association with other metals.
- On the other hand, Sg Kelantan displays greater variability, with KA6 and KA9 showing notably elevated metal concentrations of Fe and Mn, suggesting the influence of complex geochemical processes or anthropogenic activities.

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