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Distribution of Cromium (Cr) in the Bottom Substrate around Kebintik and Batu Belubang Coastal Waters, Bangka Island

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Abstract. Within the next five years, the post-tin mining coastal waters of Kebintik and Batu Belubang in Central Bangka are expected to run out. Habitats for commercially significant and community-consumed benthos (bivalve class, such as *Anadara granosa* and *Meretrix meretrix*) can be found in both coastal seas. Consequently, there are worries regarding the effects of heavy metals (such Cr) from tin mining on marine resources since they build up in the biota, which is eventually ingested by humans. This work uses quantitative descriptive methods and Cr measurement with ICP-EOS to evaluate the concentration and distribution of Cr in sediments surrounding Kebintik and Batu Belubang coastal waters. According to the findings, the sediments in both coastal waterways had Cr concentrations ranging from 0.0210 to 0.044 ppm (the category is still within the quality threshold). The area of post-tin mining tailings pilings at station 6 had the largest dispersion of Cr. The distribution and concentration of heavy metals in the sediments of Kebintik and Batu Belubang's coastal waters are still below the quality standards, meaning that the waters are still suitable for benthic life—which is significant to the local economy and does not pose a health risk to humans—and are therefore generally in good condition.
Keywords : Batu Belubang, Kebintik, Cr, sediment

1 Introduction

On Bangka Island, heavy metal pollution in tin mining and post-mining areas has grown to be a significant problem. According to previous research, heavy metals found in tin mining waste [1, 2] have raised public concerns, particularly about the possible disruption of marine resources. Because it is poisonous to both humans and animals, chromium (Cr) is one of the heavy metals that has grown to be a significant problem in mining [3]. Cr buildup will disrupt the function of enzymes and result in death if exposed for an extended period of time [4]. The loss of marine larval organisms in the water, which lowers the marine biological resources in Kebintik and Batu Belubang, is the effect that the community is most worried about. According to [4], Cr metal will lower the quality of embryo hatching and larval growth, which will lower the organisms' survival rate. In the waters of Kebintik and Batu Belubang, non-fish resources like shellfish are still plentiful during the season and could be a possible catch for the local population.

Numerous studies have examined the heavy metal content of Bangka Island's waters, including those on Pb, Cd, Zn, and Cu pollution in Matras Waters, Bangka Induk [5], Pb metal in Kelabat Bay [6], Pb, Cd, Zn, Cu, Sn, and Al metals in the central Bangka waters [1, 7], and Cd, Pb, Co, and Ni metals in the central Bangka waters [2]. It is imperative to address public concerns because the extensive distribution of Cr metal has not been investigated in any of the studies carried out in the Bangka Island maritime area.

Therefore, this study aims to assess the concentration and distribution of Cr metal in sediments in Kebintik and Batu Belubang waters, which are post-tin mining areas. The area is also a habitat for benthic, bivalve classes such as blood clams (*Anadara granosa*) and crab clams (*Meretrix meretrix*) which are abundant in season. With this concentration and distribution data, it is very useful in habitat security for fish and non-fish biological resources on the Kebintik and Batu Belubang coasts.

2 Methodology

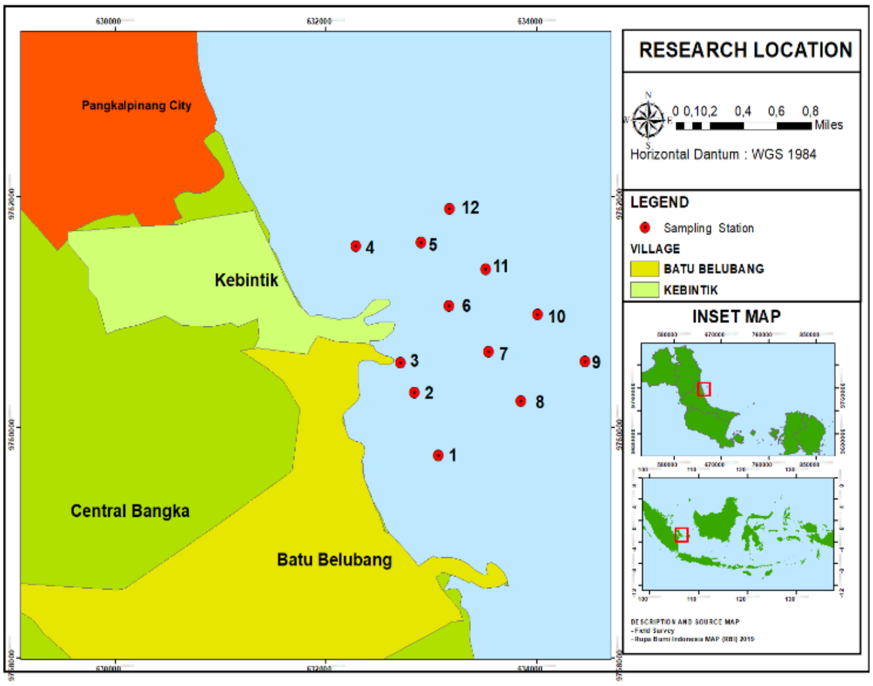

Fig. 1. Sampling stations for Cr metal in water and sediment at Kebintik and Batu Belubang Coast

Sampling locations for sediment, water, and aquatic physico-chemical parameters were conducted at 12 points (**Figure 1**). Sampling was conducted in the waters of Kebintik and Batu Belubang in March 2023. The research method is descriptive quantitative, consisting of field surveys (determining the location and time of research), sediment sampling and physical parameters - water chemistry, sample analysis in the laboratory and data analysis.

Preparation of Cr metal in sediments based on [1, 2, 7], and measurement of heavy metal concentrations using Inductively Coupled Plasma - Optical Emission Spectroscopy (ICP-EOS).

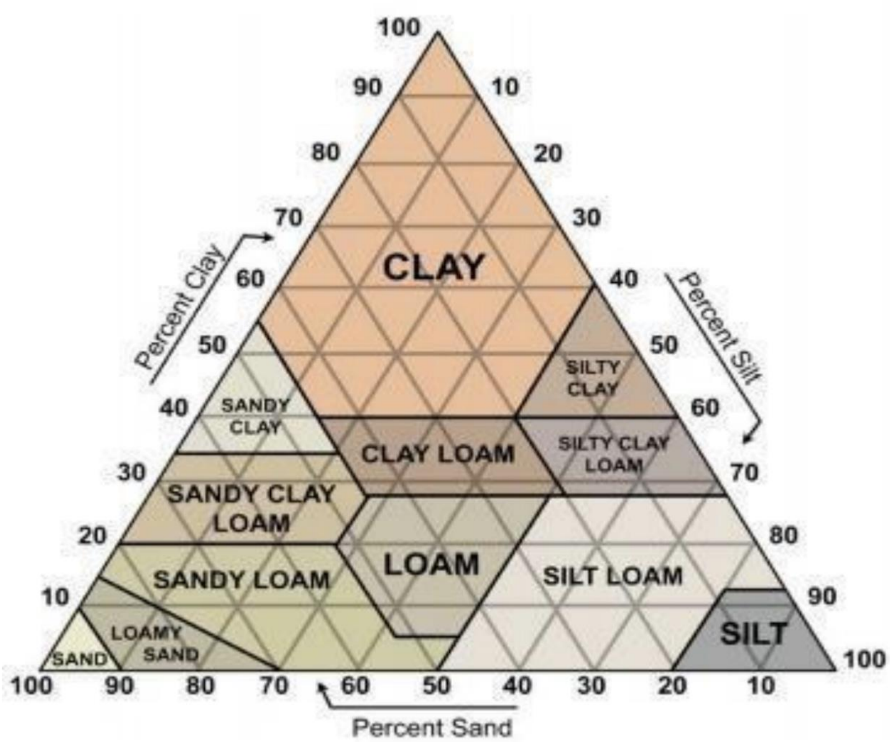

Fig. 2. The Triangle of Shepard [10]

Sediment Texture Analysis

100 grams of sediment samples were collected, and they were dried at 1000C for 24 hours. 25 grams of the dried sediment samples, with diameters of 4 mm, 1.00 mm, 0.150 mm, and 0.038 mm, were put in a sieve shaker and sieved for 20 minutes after being ground up with a mortar. Following each sieve level, the products were weighed. Additionally, Shepard's triangle was used to examine sediment samples [8]. Following that, each fraction's percentage value was determined, displayed, and given a name based on the Wentworth categorization [9].

Analysis of Cr Concentration Distribution Map in Sediment

Maps of Cr heavy metal distribution in sediments from Kebintik and Batu Belubang waters were processed using Arcgis 10.4.1 and interpreted using different color scales in the form of displays with the Inverse Distance Weighted (IDW) method, then analyzed descriptively [7].

3 Result and Discussion

Table 1. Classification of Sediment Grain Size using Wenworth Scales [11]

Large Grain Size (mm)	Name
>256	Boulder
64-256	Couble
4-64	Pebble
2-4	Granule
1-2	Very course sand
½-1	Coarse sand
¼-½	Medium sand
1/8 -1/4	Fine sand
Large Grain Size	
1/16-1/8	Very find sand
1/256 – 1/16	Silt
<1/256	Clay

Table 2. Concentration of Cr in the sediment and water (ppm) at Pantai Kebintik and Batu Belubang, Bangka Tengah

Stations	S	E	$Cr_{sediment}$	Cr_{air}
1	02°10'23,1	106°11'47,8	0,0260	<0.001
2	02°10'05,4	106°11'40,5	0,0340	<0.001
3	02°09'56,9	106°11'36,1	0,0210	<0.001
4	02°09'24,0	106°11'22,4	0,0330	<0.001
5	02°9'22,77	106°11'41,8	0,0360	<0.001
6	02°09'40,9	106°11'51,0	0,0440	<0.001
7	02°09'53,8	106°12'03,2	0,0320	<0.001
8	02°10'07,7	106°12'13,1	0,0340	<0.001
9	02°09'56,5	106°12'32,8	0,0220	<0.001
10	02°09'43,2	106°12'18,3	0,0220	<0.00
11	02°09'30,5	106°12'02,3	0,0340	<0.001
12	02°09'13,4	106°11'51,2	0,0230	<0.001
[11] Guidelines		Low	80	
		High	370	

The range of 0.0210 - 0.044 ppm (**Table 2**) for the concentration of Cr metal in the sediments of the Kebintik and Balu Belubang waters indicates that the category is still below the [12] quality level. After more than five years of tin mining, both streams are post-tin. The concentration of Cr metal in water was likewise very low, at less than 0.001. This is because the metal is soluble, changing from carbonate to hydrocarbonate and hydroside, before joining other particles to form a bond and sinking to the bottom of the water's perticles.

Table 3. Physical – Chemical Parameters at the Pantai Kebintik dan Batu Belubang

Stations	Water						Sediment Texture (%)		
	Temperature (ºC)	pH	Salinity (º/ₒₒ)	DO (mg/L)	Depth (m)	TSS (mg/L)	Sand	Silt	Clay
1	28,3	5,33	28	7,3	2,40	0,13	73,15	20,95	5,91

Stations	Water						Sediment Texture (%)		
	Temperature (^oC)	pH	Salinity ($^o/_{oo}$)	DO (mg/L)	Depth (m)	TSS (mg/L)	Sand	Silt	Clay
2	28,8	5,32	28	7,1	2,20	0,18	91,39	7,73	0,95
3	29,6	5,33	28	6,8	1,63	0,14	89,40	8,49	2,19
4	28,8	5,34	31	6,8	2,00	0,10	78,99	20,02	0,98
5	29,6	5,32	29	7,0	2,40	0,13	99,41	0,47	0,15
6	29,8	5,28	29	7,0	2,67	0,24	88,76	11,05	0,19
7	29,9	5,31	31	6,9	2,92	0,12	97,39	2,10	0,53
8	30,0	5,32	29	6,9	2,00	0,25	98,54	1,35	0,16
9	30,5	5,26	29	6,8	4,63	0,11	87,19	12,17	0,74
10	30,4	5,25	31	6,9	4,18	0,14	98,43	1,51	0,08
11	30,2	5,32	30	7,0	2,62	0,16	98,89	1,07	0,07
12	30,9	5,28	30	6,7	2,82	0,19	94,83	4,93	0,26
Quality standard	28-30*	-	33-34*	>5*	-	<20*			

*Quality standard based on [18]

Compared to Benoa Bay sediments [13]; Trimulyo Waters, Semarang [14]; and Muara Sungai Mati [15], the Cr metal content in the sediment and water column in Kebintik and Batu Belubang waters is lower. Sand dominates the sediment texture characteristics from stations 1 through 12, with 73.15% being the lowest and 99.41% being the highest (**Table 3**). This may result in a low concentration of Cr metal in the sediment. According to [2], sand has a restricted surface area and a decreased ability to bond with metals. In the sediments of stations 1 through 12, there was a link between textural type and Cr metal ranging from -0.610 to 0.600, according to a Pearson statistical analysis. Low Cr metal and sand texture had a positive correlation (r = 0.600), but silt and clay had negative correlations (r = -0.512 and -0.292, respectively). According to studies [13], there is a positive association (r=0.434) between sand texture and Cr metal in Benoa sediments in Bali. These findings are consistent with that finding. In addition to being caused by the sediment texture factor, the concentration of Cr metal in the sediment is relatively low. It is also known that the primary source of activity that flows waste containing Cr metal is still uncommon. Many sources of waste containing Cr metal are generated from waste from the textile and screen-printing industries [16 17]. The results of research by [17] in the sediments of the Muara Sungai Mati show that Cr metal has exceeded the quality standard limit, due to input from the waste stream of the screen-printing industry.

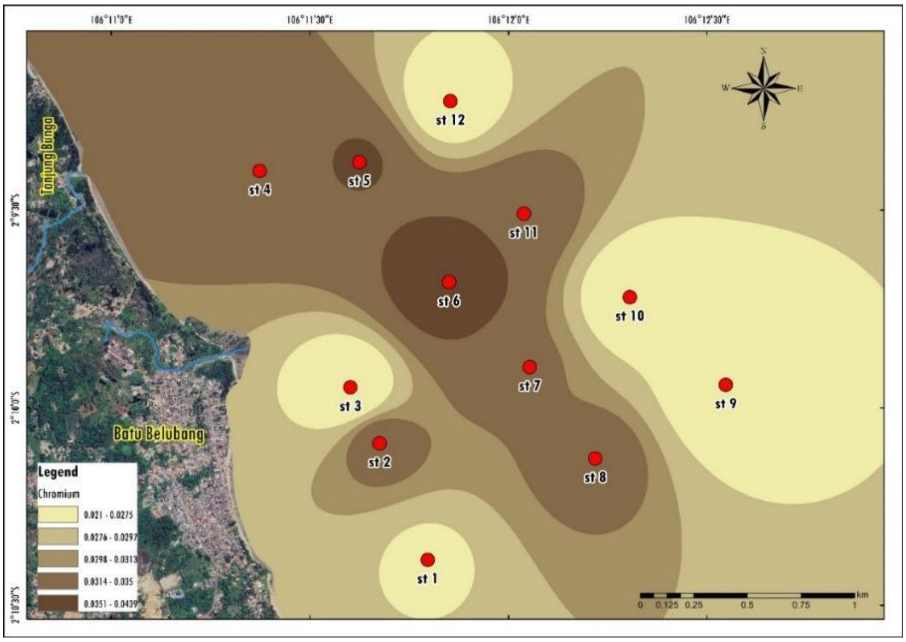

Fig. 3. Map of Cr distribution at Kebintik and Batu Belubang waters, Central Bangka

The area of post-tin mining tailings accumulation, station 6, exhibits a tendency towards the largest distribution of Cr metal (**Figure 3**). Furthermore, because there has already been sedimentation, the current conditions force particles that have bonded with metals to stop and gather in the vicinity of station 6. Since sediment sampling was done in the transitional season with moderate currents (0.098–0.183 m/s), there was also little variation in the distribution of Cr metal. The findings of the investigation of the distribution and concentration of heavy metals in the sediments of Kebintik and Batu Belubang demonstrate that the environmental conditions are still favorable and conducive to the existence of benthos, which have significant economic value and are consumed by the local population.

4 Conclusion

The concentration of Cr metal in the sediments of Kebintik and Batu Belubang Waters ranged from 0.0210 - 0.044 ppm, and was classified as still below the [12]. The distribution of Cr metal in the Kebintik and Batu Belubang water areas shows no significant difference due to moderate current conditions.

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