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Distribution of water turbidity concentrations and phosphate content in tanah merah beach and semujur island waters, central bangka regency

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Abstract. A large number of tin (Sn) mining activities carried out in the coastal area of Bangka Belitung has a direct impact on water quality, especially water turbidity. Turbid waters can produce large amounts of phosphate in local waters, and its distribution is influenced by the direction and speed of ocean currents. This study aims to determine the value of water turbidity concerning the amount of phosphate content in two different locations with tin (Sn) mining activities as a source of pollution. This research was conducted in July 2018, in the coastal waters of Tanah Merah Island and Semujur Island. The results of the water turbidity value in the Tanah Merah coastal waters were 12.50-22.50 NTU greater than that of Semujur Island waters, namely 4.14-7.22 NTU. The phosphate value in Tanah Merah coastal waters is 0.02-0.05 mg / L, greater than the Semujur Island waters, which is 0.01-0.02 mg / L. This indicates that Tanah Merah coastal waters are more turbid with a value higher phosphate. The existence of tin (Sn) mining activities in Tanah Merah waters has an impact on the amount of water turbidity that can bind phosphate elements compared to Semujur waters.

1. Introduction

The Province of Bangka Belitung Islands is located at 105° - 108° East Longitude and 03°30 "South Latitude". Has an area of 81,582 km² of land area consists of 16,281 km² (19.96% of Total Land), which includes two large islands of Bangka Island with an area of 11,481 km² (70.62% Land) and Belitung islands with an area of 4,800 km² (29.48% mainland) and 950 small islands. The length of the coast is 2,189,553 km and the total area of sea waters is 65,301 km² (80.04% of the total sea) [1]. The division of the area is: Bangka Island Marine Waters 16,619 Km² (25.45% Sea Area) and Belitung Island Marine Waters covering an area of 29,606 Km² (45.34% Sea Area).

Tin ore (Sn) mining carried out by PT.Timah, Tbk and the private sector in the Bangka Belitung Islands Province has been carried out for a long time. Mining activities carried out on the territory of the plains to coastal and marine areas. The result is ecological damage from land to sea. In normal conditions, nutrient-rich marine waters are able to support the availability and sustainability of existing marine resources. On the other hand, the water function will decrease if the waste disposal from tin (Sn) mining exploitation continues and is discharged into coastal and marine areas. The exploitation of



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tin ore (Sn) produces waste in the form of sludge, oil, and several heavy metal elements such as Cd, Cu [2].

Marine pollution and nutrient pollution are two types of surface water contamination [3]. Waste flows will result in decreased water quality in coastal areas and marine areas, especially the high value of turbidity and suspended solids, and also a number of heavy metal elements such as Cd, Cu increase in concentration, and cause damage to nitrate and phosphate nutrients which are limiting parameters such as water fertility, and environmental carrying capacity. Nutrients from nitrates and phosphates element is one element limiting water quality. According to [4], phosphorus is an essential element for higher plants and algae, so this element becomes a limiting factor for plants and aquatic algae and affects the level of aquatic productivity. The same statement was reinforced by [5], phosphorus and nitrogen is the element has a vital role for the growth of phytoplankton or algae which is used as an indicator of water quality and fertility of a water.

Based on this explanation, research on the distribution of water turbidity and phosphate content in Tanah Merah Beach and Semujur Island waters, Central Bangka Regency is deemed very important and needs to be carried out in order to analyze the water quality near tin mining activities. The research objective was to determine the turbidity of the water and the phosphate and direction of distribution in Tanah Merah coastal waters and Semujur Island waters, Central Bangka Regency.

2. Materials and methods

The research was conducted in October 2018 in the coastal area of Central Bangka Regency, Bangka Belitung Islands Province, Indonesia. Sampling was carried out at 2 locations, with 6 sample points at each location and repetition of sampling per point. The two research locations are in the coastal area of Tanah Merah Village, Namang Regency and Semujur Island, Pangkalan Baru Regency. Both locations are facing each other. The first location is the site of tin mining activities, while the second location is a mine-free zone. Each sampling coordinate point is presented in table 1 and Figure 1.

Table 1. Coordinate Points of Research Sampling

No	Coordinate Positions	
	Tanah Merah (TM)	Semujur Island (PS)
1	106° 13' 21,529" E	106° 17' 39,242" E
	2° 14' 39,667" S	2° 9' 57,546" S
2	106° 13' 34,421" E	106° 18' 10,886" E
	2° 14' 59,334" S	2° 10' 8,854" S
3	106° 14' 10,889" E	106° 18' 49,871" E
	2° 15' 15,293" S	2° 9' 49,313" S
4	106° 13' 50,099" E	106° 17' 11,695" E
	2° 15' 15,761" S	2° 10' 29,482" S
5	106° 13' 53,857" E	106° 17' 59,341" E
	2° 14' 57,696" S	2° 10' 39,608" S
6	106° 13' 43,000" E	106° 18' 46,894" E
	2° 14' 37,381" S	2° 10' 44,864" S

Water samples were taken using nansen water sampler and put into bottles of High Density Poly Ethylene (HDPE), then preserved with nitric acid (HNO₃) until the pH reached 2 and stored in an ice box. Sea water samples were analyzed levels of lead using Atomic Absorption Spectrophotometry (AAS) [6,7]. Chemical analysis carried out in the Laboratory of Research and Standardization Industry Palembang. Water quality data measured in the field will be compared with the Decree of the Minister of Environment of the Republic of Indonesia Number 51 of 2004 on the Marine Water Quality Standards. The data obtained are presented in tabular form and discussed descriptively.

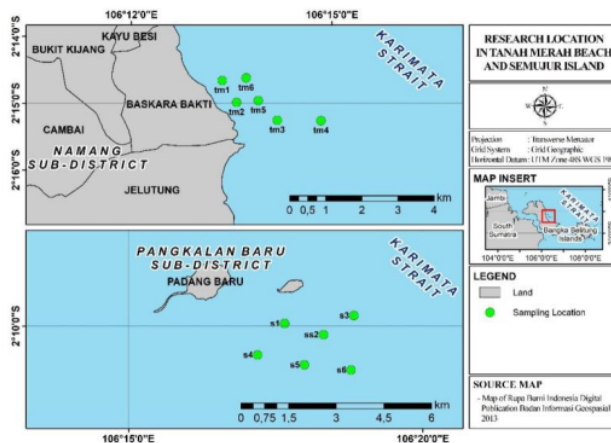


Figure 1. Location Research In Tanah Merah Coastal waters and Semujur Island.

Water quality measurements are carried out directly. Flow velocity is calculated by real time flow measurement system using acoustic Doppler current profiler (ADCP) [8] and current direction is determined by Surface Hydrology Software [9]. The salinity and density content were measured using a salinometer. The degree of water acidity (pH) was measured using a digital pH measuring instrument called the Hanna HI 98107 brand. Oxygen levels were measured using a digital DO meter Lutron DO 5510 with an accuracy level of 0.001 mg / L. Brightness was measured by a disk and depth was measured on a scale.

3. Result and discussion

The results of the research in two locations, Tanah Merah coastal waters and Pulau Semujur are presented in table 2. The overall temperature is relatively the same and stable, ranging from 30-31 ° C. The values of temperature and salinity are still considered natural from the properties of sea water. The pH value is still within the range of marine water quality standards set by the government. Meanwhile, the water transparency and turbidity values exceed the seawater quality standards. The value of water transparency in Tanah Merah coastal waters is lower than that of Semujur Island waters. The value of water turbidity in the Tanah Merah coastal waters has exceeded the quality standard for seawater and the value is much higher than that of Semujur Island waters. The value of water turbidity in Tanah Merah coastal waters is 12.50-22.50 NTU, greater than that of Semujur Island waters, which are 4.14-7.22 NTU (Figure 2).

Table 2. Water quality measurements in two research locations

Parameter	Location of Sampling Points												QS
	TM-1	TM-30	TM-3	TM-4	TM-5	TM-6	PS-1	PS-2	PS-3	PS-4	PS-5	PS-6	
Temperature (°C)	31	35	31	31	31	31	30	31	30	30	31	30	Natural
Salinity (ppt)	31	8.36	35	34	32	32	33	35	37	35	33	35	Natural
pH	8.27	3.9	8.23	8.21	8.23	8.23	8.32	8.36	8.39	8.31	8.36	8.36	7-8.5
Tranparency (m)	0.76	4.88	1.20	0.09	1.10	1.20	5.0	4.0	4.6	5.9	4.9	3.9	> 6.0
Turbidity (NTU)	19.50	22.50	15.00	14.90	12.20	12.50	4.82	7.80	4.14	7.22	3.60	4.88	5.0
Fosfat (mg/l)	0.03	0.05 0.05	0.03	0.04	0.03	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.015

*Description: TM = Tanah Merah; PS = Semujur Island; QS = Quality Standards are based on the decision of the Minister of Environment of the Republic of Indonesia Number 51 of 2004.

The high value of turbidity of water in Tanah Merah beach because at this location there are a lot of mining activity tin (Sn) is the source of the pollutants. During the tin (Sn) mining process it produces mud and fine sand which comes from the screening and separation of tin metal (Sn) from the fine particles that bind it. Turbidity is caused by the presence of suspended and dissolved organic and inorganic materials (mud, fine sand) [10,11].

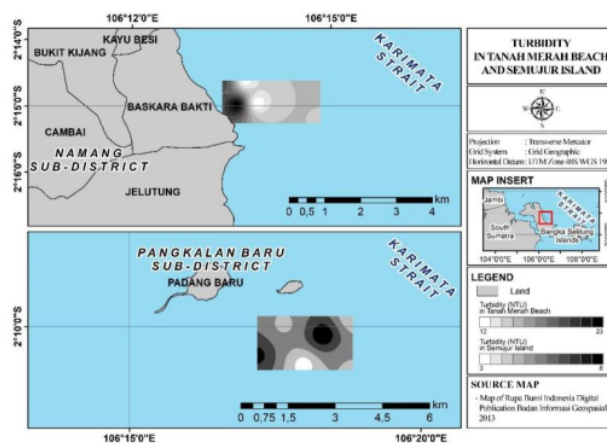


Figure 2. Turbidity in Tanah Merah Coastal Waters and Semujur Island

The phosphate content in Tanah Merah coastal waters is 0.02-0.05 mg / L, greater than that of Semujur Island waters, which is 0.01-0.02 mg / L (Figure 3). This indicates that the Tanah Merah coastal waters are more cloudy, but the phosphate content is higher than the location in the waters of Pulau Semujur. The presence of tin (Sn) mining activities in Tanah Merah coastal waters has an effect on the amount of water turbidity, and turbid water can bind more phosphate elements, compared to locations in the waters of Semujur Island waters with lower turbidity values and relatively clear water, because it is far from a source of pollution is tin mining [12]. Phosphorus content generally decreases farther out to sea (off shore) [13]. In the coastal waters and the continental shelf, mining activities and the flow of the land will bring drift-drift garbage, tailings, as well as other land phosphate resources and result in greater concentration than the surroundings.

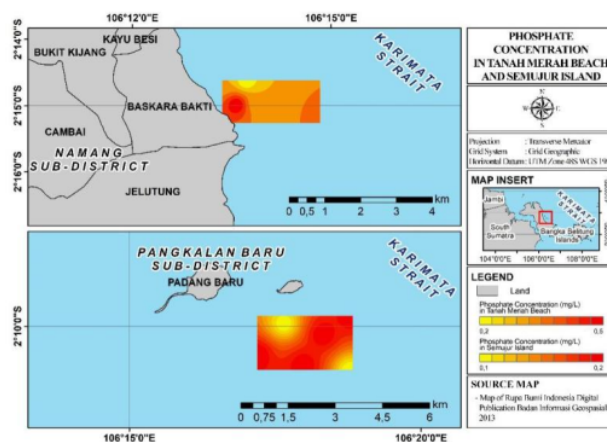


Figure 3. The phosphate concentration in Tanah Merah coastal waters and Semujur Island.

There is a relationship between the distribution of water turbidity, phosphate and the currents that occur. The turbidity value is directly proportional to the phosphate in the water, Tanah Merah coastal waters located near the mining sites have high turbidity values (12.5-22.5 NTU) than Semujur Island waters (3.60-7.80 NTU). The phosphate content (PO₄) in Tanah Merah coastal waters is 0.02-0.05 mg / l, which is much greater than Semujur Island waters, namely 0.015-0.02 mg / l. The movement and velocity of the currents affect the distribution of heavy metals and turbidity of the water in the two waters. The current direction at low tide moves eastward with the speed of the current getting faster toward the sea. The distribution of nutrients from land and mining tailings in the sea is heavily influenced by the presence of ocean currents, namely the movement of water masses that flow nutrient sources, thus forming a certain distribution at a certain time. The higher the speed of ocean currents, the faster the distribution of nutrients will decrease (Figure 4).

Transparency values in both measured research locations differ significantly. At the first location the brightness value is measured between 0.09 - 1.1 m, while at the second location this value is better, which is 3.9 - 5.9 m. This difference is caused by the first location being the location of the active tin ore mine, so that particle scattering is still relatively high. The first location, Tanah Merah, was classified as contaminated with suspended material or high turbidity values. The turbidity value in Tanah Merah waters higher than Semujur Island waters. The distribution of fine sand and mud is the reason for the low transparency. In addition, the distribution of suspended material (turbidity value) in the form of fine sand and mud, due to tin mining at the first research location, reached 5.21 km from the mining location. The distribution of this suspended solution decreases in value, along with increasing distance, so that at the second research location, Semujur Island, transparency is more high. (figure 2). However, it is necessary to provide policies to protect the sea that have not been polluted, because the coastal management approach platform is the water transparency itself [14].

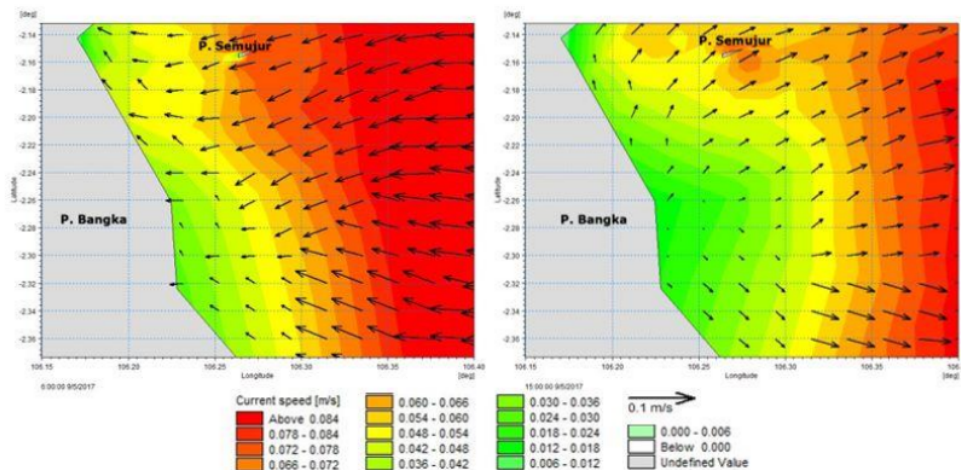


Figure 4. Map of current direction at high tide (left side) and low tide (right side) at Tanah Merah Coastal Waters and Semujur Island.

4. Conclusion

1. The value of water turbidity and phosphate content in Tanah Merah coastal waters is higher than that of Semujur Island waters, which are further away from pollutant sources (tin mining). The higher the opacity then the higher phosphate content.

2. Distribution of water turbidity and phosphate values, the more distant from the sources of pollution (mining tin) has declined to low. This value also occurs by the direction and current of the current.

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