EXPLORATION OF ILMENITE POTENTIAL IN AND AROUND KALU AND BENTHARA RIVER MOUTHS WITH SPECIAL REFERENCE TO THE VARIATION OF TiO_2 CONTENT ALONG A SELECTED STREACH OF KALU GANGA

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ABSTRACT

Although Ilmanite, Rutil, Zircon and Monazite occurs in beach sand of Sri Lanka, the sufficiently concentrated deposits for economic exploitation have been only identified yet in and around Pulmoddai, Baruwala and Kudremalai beaches. Of these, Pulmoddai is the largest beach sand deposit ever found in Sri Lanka, which is estimated to contain nearly, 4,000,000 tons of raw sand.

However it has been noticed that beach mineral sand occurrence in many other parts of the country and detail investigation has not been carried out yet in those areas. Exploitation has been carried out only in Pulmoddai which is located near the rebels control areas. Since 1998 with production coming to a stand still, the Pulmoddai plant which a government own company is confined to selling its existing stockpile with Zircon and Rutile being bagged and transported to Colombo and exported. Therefore finding an alternative source to supply the demand of the export market to earn foreign exchange is a prior necessity of the country. Therefore this study was carried out to identify ilmenite potential in and around Kalu and Benthara river mouths and investigation has been carried out to identify the variation of TiO2 content in ilmenite along the Kalu Ganga track by sand sediment analysis.

Gravity and the magnetic separation processes were employed for the processing of the sand samples. Results show that the particle size of Ilmenite in both river mouths deposits were reported in the range of+125μm to +250μm sizeand this may mainly depend on grain size, flow velocity of the river , distance travel as well as energy of the sea waves. Variation of the titanium content in ilmenite along the Kalu Ganga can be concluded may due to the replacement of Fe in Ilmenite with another foreign element available in the river.

KEY WORDS

Fusion, Ilmenite, Magnetic separation, Titanium

INTRODUCTION

Although historical records stated that the presence of metallic minerals in the island, no economically exploitable deposit yet to be identified.

However Ilmanite, Rutil, Zircon and Monazite are found in beach mineral sand of many parts of the country, the sufficiently concentrated deposits for economic exploitation have been identified yet in and around Pulmoddai, Baruwala and Kudremalai beaches. Of these, Pulmoddai is the largest beach sand deposit ever found in Sri Lanka, which is estimated to contain nearly, 4,000,000 tons of raw sand.

Heavy minerals, which are available in mineral sand deposits, originally occur as traces in the igneous rocks such as granite, pegmatite, and basalt. Highly metamorphosed rocks such as kondolite provide the best source for titanium and other heavy minerals. The more resistant components separate from the less resistant minerals as the rocks are subjected to weathering and erosion. The heavy minerals

are carried down to the oceans where they accumulate as placer deposits (e.g. alluvial gold) along the river channels or along coastal shorelines. Along The inter-tidal zone of the beach, the impacting waves drop washed away sand on the beach. As waves wash back, some of the lighter sand is carried back into the sea, leaving the heavy minerals behind the beach.

In order to form an economic concentration of minerals, volume of source sediments flowing into the sea should be above the rate of removal from the trap. Often these deposits are covered by lighter sand material blown over from dunes at the back of the beach forming heavy mineral sand deposits at the front of the dunes.

Ilmenite, Monazite and Zircon are found abundantly in beach sand deposits of Sri Lankan shores in a readily accessible form which are suitable for commercial exploitation. Even though there are several beach mineral sand deposits identified the only exploiting beach mineral sand deposit in Sri Lanka is the Polmuddai deposit. Production of Ilmenite, Rutile and Zircon from Pulmuddai is exported in bulk and in some instances in bags for small quantities from the Port of Colombo.

During past few years production of Pulmuddai plant has ceased operations due to the unfavorable security situation and the inability to ship the products from the mine site due to the non-availability of the loading Facilities. Due to this the Sri Lankan economy has lost a considerable amount of foreign exchange, which could otherwise have been gained by exporting the processed mineral sands.

Although investigations have been done in order to identify new mineral deposits, most of them were found to be concentrated on the rebels control areas, which experience the same unfavorable security conditions. E.g.: Mayur, north of Trinco, Kudremalai, north of Puttalam and Puttalam.

Therefore finding an alternative source to supply the demand of the export market to earn foreign exchange is a prior necessity of the country. Therefore this study was carried out to identify ilmenite potential in and around Kalu and Benthara river mouths and investigation has been carried out to identify the variation of TiO_2 content in ilmenite along the Kalu Ganga track by sand sediment analysis.

METHODOLOGY

Sand samples were collected at river mouth areas of Kalutara and Benthara by digging test pits of about 60cms deep at selected locations. GPS readings of all the locations were recorded. Samples for the determination of the titanium concentration of the Ilmenite along the Kalutara River were collected from every tributary of Kalutara River at the point it meets the main river when it was accessible. In addition samples were taken from every 3 Km intervals along the main river course.

Coning and quartering was done to reduce the samples by considering the weight and the particle size.

Upgrading of Process

Microscopic analysis has been carried out to examine the heavy mineral content of the beach mineral sand. Gravity and magnetic separators have been used to separate Ilmenite from other heavy minerals constituents available in the collected sand samples.

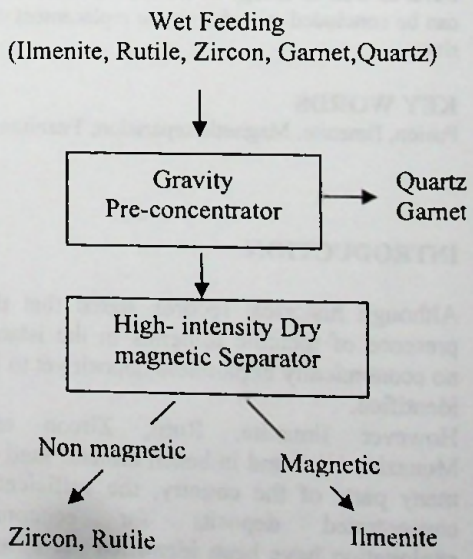

Figure 1: Flow Sheet

Shaking table was selected as the best method to utilize for gravity separation by considering the weight and the particle size of the samples. To achieve a higher rate of effective separation, all the samples were first sieved and each size fraction was introduced to the shaking table separately.

When employing the magnetic separator, side slope of it was adjusted to 20^0 and the current was adjusted to 0.4A as per user instructions manual. After introducing the sample in to the feeder the magnetic portion was collected separately as Ilmenite.

Fusion method

Five hundred milligrams of oven dried Ilmenite sample was weighed into a tare Pt crucible. 0.800g of sodium carbonate and 0.400g of Sodium tetra borate were introduced in to the same crucible, well mixed and fused in the rock furnace for 45 minutes at 1030^0C.

Fused sample was completely extracted from the crucible using 60ml of dil HCl (3:7) in to a 150ml beaker at 100^0C. The mixture was agitated sufficiently until the solution appeared to turn in to clear transparent yellow. 5mls of HF was introduced and stirred further for some time until the solution became persistently clear yellow. After cooling for some time, the solution was transferred to a 100ml volumetric flask and 5mls of prepared ammonium chloride solution was added. Finally the volume was made to 100ml by adding distilled water.

Sample Analysis

Determination of concentration of Titanium content in Ilmenite along the Kalutara River has been carried out by UV Visible Spectroscopy.

RESULTS

Average content of heavy minerals and the Ilmenite in and around benthara river mouth was 30.14% and 0.72% respectively where as average content of heavy minerals and the f Ilmenite in and around Kaluthara river mouth was 62.77% and 17.22% respectively

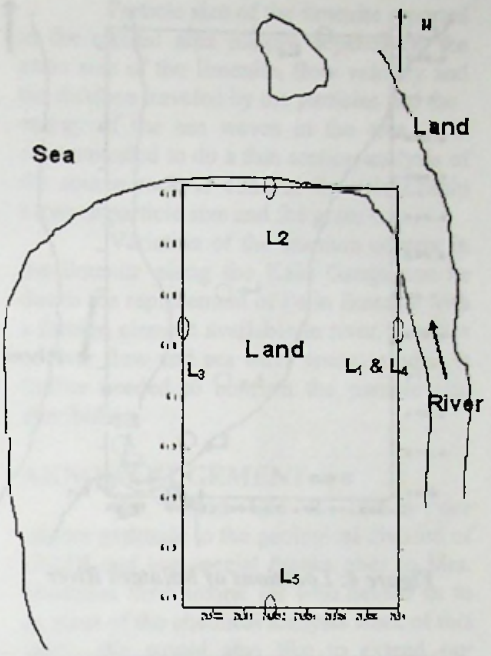

Figure 2: Locations of Bethara River

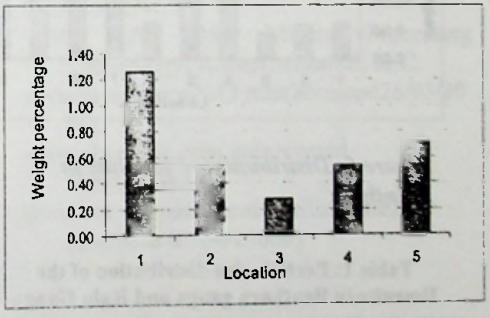

Figure 3: Distribution of Ilmenite in Benthara

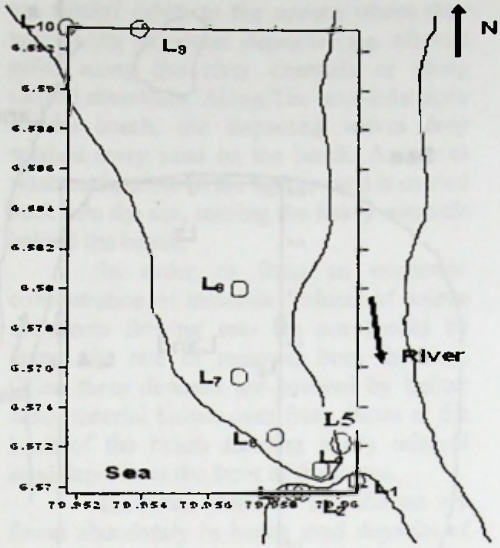

Figure 4: Locations of Kalutara River

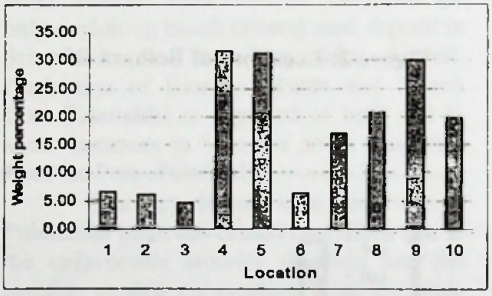

Figure 5: Distribution of Ilmenite in Kaluthara

Table 1: Particle size distribution of the Ilmenite in Benthara ganga and Kalu Ganga

Appature Size/ µm	Benthara		Kalutara	
	Weight/g	wt%	weight/g	wt %
+500	0.00	0.00	93.07	2.02
+425	0.00	0.00	82.29	1.78
+355	0.53	0.88	222.57	4.82
+250	24.00	39.91	1128.27	24.43
+212	3.29	5.47	606.45	13.13
+180	25.56	42.50	770.44	16.68
+125	6.55	10.89	1587.07	34.36
+106	0.21	0.35	69.27	1.50
+75	0.00	0.00	59.15	1.28
	60.14		4618.58	

Table 2: Variation of TiO_2 percentage along the Kalu Ganga

Sample No	Sample Weight	TiO2 Concentration	TiO2 Percentage
1	0.4963	5.6173	28.30
2	0.5040	10.9690	54.41
3	0.5009	10.1850	50.83
4	0.5063	15.9760	78.89
5	0.5042	10.5540	52.33
6	0.5009	10.8540	54.17
7	0.5029	12.1690	60.49
8	0.4995	9.9774	49.94
9	0.5015	10.6230	52.96
10	0.5059	11.6040	57.34
11	0.5008	13.2300	66.04
12	0.5060	11.0730	54.71
13	0.5053	13.3690	66.14

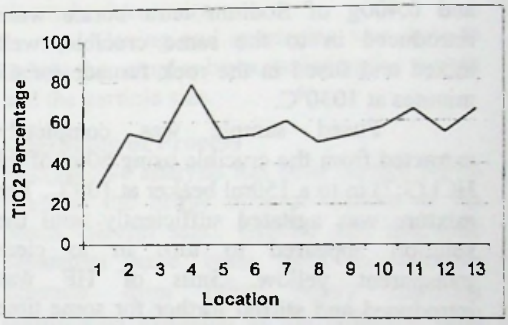

Figure 6: Distribution of TiO_2 content along the Kalu Ganga.

DISCUSSION

Overall results of the two river mouths show that Ilmenite percentage of Kalu Ganga happens to be very much higher than that of the Benthara Ganga. Further results indicated that the source rock is located very much near to the path of Kalu Ganga than to that of Benthara Ganga

It appears that the most of the illmenite particle size can be found in the size range of +125µm to +250µm. This may be due to one or more of the following reasons.

1. In the crystallization process of the kondolite, which is the prominent source rock of the Ilmenite bearing minerals, crystal grains might have been formed in a size which is reduced to the above range as a

result of the weathering process while traveling along the river to the coastal area.

2. Due to the difference in the morphology of the river mouth, energy of the waves are drastically reduced or increased. This is also one of the reasons for above particle size distributiont.

3. In the formation process of Ilmenite deposits, source rock gets weathered and eroded, and the grains of the Ilmenite are carried down to the coastal area by heavy rain falls and fast flowing streams. Depending on the traveling distance and the velocity, the size of the particles may get reduced the above range.

The dominant particle sizes of the Ilmenites reported at the two locations were varied mainly due to the energy difference of waves.

Titanium concentration in the samples along the Kalu Ganga significantly increases except in the two cases at location one and four. This may be due to the replacement of an element of higher molecular weight with Fe in the Ilmenite grains in the while being transported down stream. The first sample was collected from the first tributary to the south and the results indicate that the source rock is away from the path of that tributary.

CONCLUSION

This study confirmed that the location of the source rock of Ilmenite is very much near to the track of Kalu Ganga than to that of the Benthara Ganga.

Particle size of the ilmenite reported in the coastal area mainly depends on the grain size of the Ilmenite, flow velocity and the distance traveled by the particles and the energy of the sea waves in the area. It is recommended to do a thin section analysis of the source rock to confirm the relationship between particle size and the grain size.

Variation of the titanium content in the ilmenite along the Kalu Ganga can be due to the replacement of Fe in Ilmenite with a foreign element available in river. Kinetics of river flow and sea wave energy studies is further needed to confirm the particle size distribution.

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REFERENCES

Wills, B.A.; 1980; Mineral Processing Technology; Robert Maxwell, M.C.

www.mindat.org2013.htm(accessed26/03/2006)

www.chemlink.com.au(accessed 02/04/2006)

www.encyclopidia.com/doc/ilmenite.htm (accessed 02/04/25006)