

Sedimentological and Mineralogical Investigations of Heavy Mineral Sand Deposits in Mahaweli River Alluvial Fan

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Introduction

Most of the economically important offshore heavy mineral sand deposits in Sri Lanka including Koddigar bay is not fully investigated and there are very limited studies available in literature. Koddigar Bay is the Mahaweli River discharging area. Detailed investigation on heavy mineral sand deposits is vital before extracting them. This paper presents the results of a sedimentological and mineralogical investigation of Koddigar Bay heavy mineral sands deposit with the view of identifying its economic potential.

More than ninety percent of Sri Lankan terrain is underlain by metamorphic rocks with meta - sedimentary or meta-igneous origin. Meta-sediments consists of quartzites, quartz schists, fine to medium grained acidic gneisses and granulites, calc gneisses, crystalline limestones, dolomites, sillimanite gneisses and silimanite-garnet-graphite rocks (Fernando, 1986). During the ice age, the present inner harbor area of Koddigar Bay might have had the normal ridge and valley topography as we find in present day inland. With the rise of the sea level the present inner harbor area has submerged gradually and it has opened up rapidly due to wave and current actions with time (Wijayananda, 1985).

Rock fragments are flown to Mahaweli River mainly during rainy season from catchment areas. Heavy mineral particles are derived from these detrital materials. Heavy mineral grains are subjected to abrasion during this transportation. Grains with higher hardness like ilmenite, rutile and garnet do not change their shape during the course of transportation. Moderately hard grains like magnetite are changed slightly their shape and they tend to form round grains. Low hardness grains like monazite and zircon are changed slightly their size and shape also tend to well roundness. Then this heavy and light mineral grains move with combination of sea waves and tidal forces. Then sedimentation occurs along coastal stretch in Koddigar bay. This processes are not continue throughout the year. During monsoon period deposition layer thickness is higher than dry season.

Methodology

Sand samples were collected randomly in alluvial fan of the Mahaweli River approximately up to one meter depth by manual auguring technique. Location (X, Y) and sample ID (MW 1, MW 2, MW 3...) were recorded.

All individual samples were mixed together using spatula. Size of the samples was reduced by cone and quarter method and suitable size fractions were selected. Selected samples were washed out to remove organic materials, clay and sea shells. There was no significant amount of clay, organic materials and sea shells in all samples. Samples were dried in an oven at about 110 °C for 15 minutes. Then a fraction of 250 g was weighed from each sample and grain size distribution analysis was carried out using mechanically sieved fractions. Another 500 g from each sample was weighed and separated into four size fractions for mineralogical analysis.

For mineralogical analysis, sample portions selected for mineralogical analysis were sieved using 0.063 mm, 0.15 mm, 0.25 mm, 0.5 mm and 1 mm sieves and weight of each size fraction was measured and recorded. Size fractions of +0.063 mm to -0.15 mm, +0.15 mm to -0.25 mm, +0.25 mm to -0.5 mm and +0.5 mm to -1 mm were used to separate magnetic minerals using a permanent hand magnet. Non-magnetic fractions from above separation were further processed to separate weakly-magnetic fractions by lifting up magnetic separator under 0.2 A, 0.4 A, 0.6 A, 0.8 A, 1 A, 2 A input currents.

Non-magnetic fractions were taken for heavy liquid separation to separate heavy minerals from lighter minerals. Five grams of samples were taken, quartz was separated using *tetrabromoethane* (S.G. 2.96) and sillimanite in the remaining was separated using *diiodomethane* (S.G. 3.1).

Mineral fractions were observed under the polarizing microscope and different minerals were identified, counted (generally 5000 to 20000 grains) and different mineral percentages were calculated.

Results and Discussion

Grain size distributions at every location are nearly similar (Figure 1). Amount of medium size sand fraction of this moderately sorted sand deposit is significantly higher than other fractions. This particle size range is also rich in dark coloured heavy minerals. Fine and very fine size particle fractions also consist of very high percentages of dark color heavy minerals (Figure 2, Table 1). There are no black colored mineral grains in coarse and very coarse grain fractions.

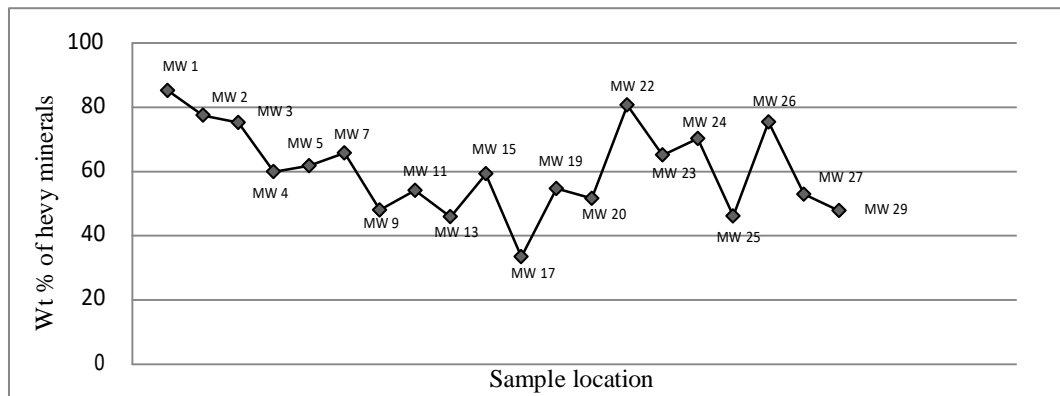


Figure 1. Heavy mineral percentages according to sampling location

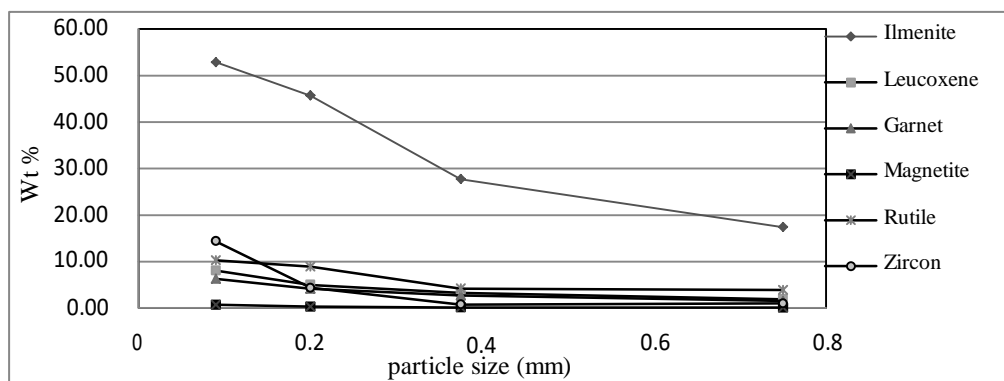


Figure 2. Wt. % of heavy minerals according to particle size fraction

Table 1. Weight and percentages of each mineral in composite sample in research area

Mineral	Wt. % of -1 mm fraction	Wt. % of -2 mm fraction	Wt. % of overall sample
Ilmenite	35.88	35.59	35.14
Leucoxene	4.53	4.49	4.43
Garnet	3.65	3.62	3.57
Magnetite	0.29	0.28	0.28
Rutile	6.69	6.64	6.56
Zircon	4.65	4.61	4.55
Silimenite	0.38	0.37	0.37
Quartz	42.85	43.32	43.37
Others	1.08	1.07	1.06

Conclusions

Ilmenite, rutile, zircon, garnet and leucoxene minerals were identified as major heavy minerals in the deposit. Quartz was observed as major lighter mineral. Hornblende, sillimanite, mica, feldspar and monazite were identified as minor minerals of Koddigar Bay sand deposit. Total economically important heavy mineral (Ilmenite, Leucoxene, Rutile, Zircon) percentage of Koddigar Bay deposit is nearly 50.68 %.

References

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Wijayananda, N.P., 1985. Geological setting around the heads of the Trincomalee canyon, Sri Lanka, Journal of the Geological Society of Sri Lanka, 13(2), 213-226